The Integrated Management Plan for the Coastal Zone of Brunei Darussalam

Department of Fisheries
Ministry of Industry and Primary Resources
Brunei Darussalam

THE INTEGRATED MANAGEMENT PLAN FOR THE COASTAL ZONE OF BRUNEI DARUSSALAM

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Department of Fisheries
Ministry of Industry and Primary Resources
Bandar Seri Begawan, Brunei Darussalam

Brunei, Dept. of Fisheries.

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The Integrated Management Plan for the Coastal Zone of Brunei Darussalam

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LIST OF ACRONYMS AND ABBREVIATIONS

AD	Agriculture Department
ASEAN	Association of Southeast Asian Nations
BM	Brunei Museum
BOD	biological oxygen demand
BSP	Brunei Shell Petroleum Co.
CE	Council on Environment
COD	chemical oxygen demand
CRM	coastal resources management
CRMP	Coastal Resources Management Project
CZM	coastal zone management
CZMA	Coastal Zone Management Act
DBI	Department of Broadcasting and Information
DMHS	Department of Medical and Health Services
DO	District Office
DOF	Department of Fisheries
DOTCP	Department of Town and Country Planning
EIA	environmental impact assessment
FAD	fish aggregating device
FD	Forestry Department
FSD	Fire Services Department
GDP	gross domestic product
hp	horsepower
IAC	Interagency Committee
ICLARM	International Center for Living Aquatic Resources Management
ICZM	integrated coastal zone management
Kg.	Kampong, i.e., village
LD	Land Department
LFA	logical framework analysis
LFR	Labu Forest Reserve
logframe	logical framework
MB	Municipal Board
MCYS	Ministry of Culture, Youth and Sports
MD	Marine Department
M & E	monitoring and evaluation
MEY	maximum estimated yield
MHWST	mean high water spring tide
MIPR	Ministry of Industry and Primary Resources
MOC	Ministry of Communications
MOD	Ministry of Development
MOE	Ministry of Environment
MOH	Ministry of Health
MOL	Ministry of Law
MSY	maximum sustainable yield
MuD	Museums Department
NDP	National Development Plan
NGO	nongovernmental organization
NOSCP	National Oil Spill Contingency Plan
NOSCS	National Oil Spill Contingency System

NRTCP	National Red Tide Contingency Plan
NRTCS	National Red Tide Contingency System
P.	Pulau, i.e., island
PD	Ports Department
PFP	paralytic fish poisoning
PSP	paralytic shellfish poisoning
PWD	Public Works Department
RBAF	Royal Brunei Armed Forces
RBPF	Royal Brunei Police Force
SFR	Selirong Forest Reserve
Sg.	Sungai, i.e., river
SS	suspended solids
SSL	Scientific Services Laboratory
STP	sewage treatment plant
STW	sewage treatment works
UBD	Universiti Brunei Darussalam
US	United States
USAID	United States Agency for International Development

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PREFACE

Almost all economic activities in Brunei Darussalam occur in the coastal zone and more than 85% of the population lives there. As such, it is subjected to major development pressures and the resultant environmental concerns. The need for judicious management of the environment is now well recognized at both the conceptual and policy levels. The vital interdependence between environment and development is now widely accepted by policymakers. The government of Brunei Darussalam is consulted in the sustainable development of its coastal zone.

In this regard, the successful completion of the national component of the Association of Southeast Asian Nations/United States Coastal Resources Management Project (ASEAN/US CRMP) is very much welcome. The formulation of *The integrated management plan for the coastal zone of Brunei Darussalam* and the publication of supporting documents, namely, *The coastal environmental profile of Brunei Darussalam: resource assessment and management issues* (1987) and *The coastal resources of Brunei Darussalam: status, utilization and management* (1992), will supplement our long-term development efforts.

This plan is topical and timely and will guide us towards an integrated and sustainable coastal zone management. Such a management plan is important in resolving the conflicting interests among development projects.

We are indeed honored to have been part of a unified effort to promote sustainable development of the coastal zone in the region through ASEAN/US CRMP. We have gained substantially from the experience of working with other ASEAN scientists on similar coast-related environmental problems and through the exchange of scientific knowledge.

Congratulations to all the team members who directly or indirectly participated in the preparation of this publication for a job well done. We particularly thank the United States Agency for International Development (USAID) for support and funding; the International Center for Living Aquatic Resources Management (ICLARM) for technical assistance; the National Steering Committee for locally executing CRMP; and the Department of Fisheries (DOF) for successfully coordinating the project.

Dato Paduka Malai Ali b. Malai Hj. Othman
Permanent Secretary
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The editorial board

FOREWORD

The coastal waters of Southeast Asian countries have some of the world's richest ecosystems characterized by extensive coral reefs and dense mangrove forests. Endowed with warm tropical climate and high rainfall, these waters are further enriched with nutrients from the land which enable them to support a wide diversity of marine life. Because economic benefits could be derived from them, the coastal zones in these countries teem with human settlements. Over 70% of the population in the region lives in coastal areas where resources have been heavily exploited. This situation became apparent between the 1960s and 1970s when socioeconomic pressures increased. Large-scale destruction of the region's valuable resources has caused serious degradation of the environment, thus affecting the economic life of the coastal inhabitants. This lamentable situation is mainly the result of ineffective or poor management of the coastal resources.

Coastal resources are valuable assets that should be utilized on a sustainable basis. Unisectoral overuse of some resources has caused grave problems. Indiscriminate logging and mining in upland areas might have brought large economic benefits to companies undertaking these activities and, to a certain extent, increased government revenues, but could prove detrimental to lowland activities such as fisheries, aquaculture and coastal tourism-dependent industries. Similarly, unregulated fishing effort and the use of destructive fishing methods, such as mechanized push-nets and dynamiting, have seriously destroyed fish habitats and reduced fish stocks. Indiscriminate cutting of mangroves for aquaculture, fuel wood, timber and the like has brought temporary gains in fish production, fuel wood and timber supply but losses in nursery areas of commercially important fish and shrimp, and coastal erosion.

The coastal zones of most countries in ASEAN are subjected to increasing population and economic pressures manifested by a variety of coastal activities, notably fishing, coastal aquaculture, waste disposal, salt-making, tin mining, oil drilling, shipping, construction and industrialization. This situation is aggravated by the expanding economic activities attempting to uplift the standard of living of coastal people, the majority of whom live below the official poverty line.

Some ASEAN nations have formulated regulatory measures for their coastal resources management (CRM) such as the issuance of permits for fishing, logging, mangrove harvesting, etc. However, most of these measures have not proven effective due partly to enforcement failure and largely to lack of support for the communities concerned.

Experiences in CRM in developed nations suggest the need for an integrated, interdisciplinary and multisectoral approach in developing management plans that will provide a course of action usable for the daily management of the coastal areas.

The ASEAN/US CRMP arose from the existing CRM problems. Its goal is to increase existing capabilities within ASEAN nations for developing and implementing CRM strategies. The project, which is funded by USAID and executed by ICLARM in cooperation with ASEAN institutions, attempts to attain its goals through these activities:

- analyzing, documenting and disseminating information on trends in coastal resources development;
- increasing awareness of the importance of CRM policies and identifying, and where possible, strengthening existing management capabilities;
- providing technical solutions to coastal resource-use conflicts; and
- promoting institutional arrangements that bring multisectoral planning to coastal resources development.

In addition to implementing training and information dissemination programs, CRMP has also attempted to develop site-specific coastal zone management (CZM) plans to formulate integrated strategies that could be implemented under the prevailing conditions in each nation. The pilot site in this case encompasses the entire coastal zone of Brunei Darussalam and areas impacting it. The country's participation in ASEAN/US CRMP began in earnest in early 1987. A National Steering Committee coordinated project activities, with technical assistance from ICLARM. The government institutions represented in the committee were the Department of Fisheries (DOF) as the lead coordinating agency, Forestry Department (FD), Ministry of Industry and Primary Resources (MIPR); Department of Town and Country Planning (DOTCP) and Public Works Department (PWD), Ministry of Development (MOD); Marine Department (MD) and Ports Department (PD), Ministry of Communications (MOC); and Museums Department (MuD), Ministry of Culture, Youth and Sports (MCYS). Major funding support for in-country activities was provided by the government of Brunei Darussalam.

The coastal environmental profile of Brunei Darussalam: resource assessment and management issues (1987) was the result of initial research work. This led to more extensive studies on biogeographical/technical, socioeconomic and legal/institutional aspects from 1988 to 1990 to provide information necessary in the planning process. A national conference on coastal resources management and planning was held in 1991 to present and evaluate the results of the various studies and submit the first draft of the plan for discussion and recommendations. The conference proceedings were published in *The coastal resources of Brunei Darussalam: status, utilization and management* (1992). Collaborative efforts of a dedicated team of professionals from diverse disciplines paid off and culminated in the publication of *The integrated management plan for the coastal zone of Brunei Darussalam.*

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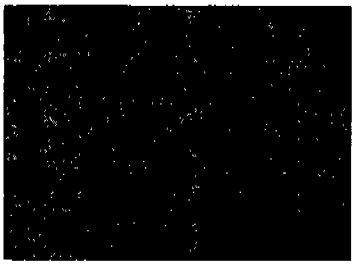
EXECUTIVE SUMMARY

INTRODUCTION



Brunei Darussalam considers the sustainable development of its coastal zone a priority. This is in view of its high significance to the country's economy and general well-being, and evident lessons from regional coastal degradation trends. The country is in a favorable position to promote such an endeavor. The dominance of the oil and gas sector has resulted in very little pressure on its coastal resources in general. However, some problems do exist, albeit in a relatively small and localized scale, and potential issues are many, given the country's accelerated economic development drive. An integrated, multisectoral approach and plan of action are essential to correct or preempt the existing and potential issues. The integrated coastal zone management (ICZM) plan for Brunei Darussalam sets the foundation and presents the essential elements in this direction.

The goal of this plan is sustainable development of the coastal zone and resources of Brunei Darussalam for the benefit of its present and future generations. In pursuit of this goal, and consistent with the principles of such sustainable development, the plan adopts the following objectives:

1. ensure an optimally sustainable flow of economic, social and environmental benefits from the coastal zone and resources;
2. limit exploitation of renewable coastal resources within their natural regenerative capacity;
3. promote equitable distribution of benefits from utilization of the coastal zone and resources in a manner that prevents or minimizes incompatibilities and conflicts;
4. undertake conservation and protection measures to maintain or enhance the functional integrity, aesthetic quality and biodiversity of the coastal zone;
5. develop viable and responsive laws and legal/institutional structures and capabilities; and
6. generate and utilize sound and appropriate scientific knowledge and technology.

The plan was developed by a multidisciplinary team of experts under the direction of a National Steering Committee composed of representatives from various government agencies. The planning process involved a comprehensive review and elaboration of:

- the coastal zone environment and resource utilization;
- current and potential coastal zone management (CZM) issues;
- functional management components of the plan (consisting of actions and projects packaged into programs) in response to the issues; and
- appropriate plan implementation arrangements.

It is an issue-based action plan containing long-term strategic thrusts and medium-term programs.

The plan adopts an intermediate approach between general-strategic and detailed-operational. It takes the form of an issue-based action plan containing long-term strategic thrusts (e.g., plan goal and objectives) and medium-term programs of sufficient detail for adoption and operational programming by implementing agencies.

COASTAL ZONE ENVIRONMENT AND RESOURCE UTILIZATION

The plan lays a series of programs and implementation arrangements over the medium term to realize these guiding objectives. For purposes of this plan, the geographical boundaries of the coastal zone include: (1) the marine area from the mean high water spring tide (MHWST) level of the shore out to the 200-m isobath offshore; (2) all land and water areas 1 km inland from the MHWST level of the shore; and (3) all estuaries and land areas reached by tides at any time of the year. The coastal zone so defined encompasses an areal extent of 9,400 km^2. Its aquatic portion is roughly 9,000 km^2. The bottom substrate consists principally of mud and sand with the exception of very limited raised areas covered by corals. The coastal waters, typical of tropical, equatorial areas, are relatively warm, less saline and nutrient-poor. Climatic and oceanographic conditions are dominated by the monsoon winds. Primary productivity mirrors the seasonality of rainfall and river runoff which peak during the intermonsoon periods around April-May and November-December. Such a seasonal pulse in coastal productivity flows sequentially through the food chain. The faunal assemblage is typical of that in soft-bottom, coastal tropical areas of the Indo-Pacific.

The terrestrial portion of the coastal zone is about 400 km^2 in area. It consists principally of flat and gently rolling slopes covered by mangroves, peat swamps, raised beaches and sand deposits. The coastal lands have no agricultural value with very minor exceptions. Considerable land developments (i.e., urban, residential, recreational and industrial) have taken place particularly along the stretch between Kuala Belait and Sungai (or Sg., i.e., river) Liang and the coast of Brunei-Muara District. Most land development activities occur in the coastal zone, given the relative concentration there of the country's population and urban centers.

A number of habitats within the coastal zone are valuable for their contribution to its biodiversity, productivity and functional integrity. About 45 km^2 of coral reef areas represent very productive yet fragile habitats of highly diverse biotic communities. Mangrove forests spanning 184 km^2 provide coastal protection, harbor unusual wildlife and export nutrients to nearby areas. Three large estuaries (Brunei, Tutong and Belait) covering 400 km^2 serve as important nursery/feeding grounds for fishery resources and are sites of significant fisheries and traditional human settlements (water villages). With an aggregate area of 79.4 km^2, the 33 coastal islands are home to unique and endangered wildlife.

Four river systems drain the country, namely: Belait, Tutong, Brunei and Temburong. The catchments of these rivers cover roughly 4,260 km^2 or 74% of the country's 5,765 km^2 total land area. In addition, Sg. Limbang and Sg. Trusan drain into Brunei Estuary from the east Malaysian state of Sarawak. Activities within these river catchments affect coastal water quality and hence, the functional integrity of the coastal zone. At least 20% of the country's land area has been subjected to clearing, urban development and cultivation. Increased land development and economic activities are foreseen to aggravate downstream impacts on the coastal zone.

Some sectoral economic activities are based in the coastal zone or highly dependent on its resources. The most important of these is the oil and gas sector whose production and processing facilities are almost exclusively found in the coastal zone. This industry has long dominated the country's economy, accounting for over 93% of export revenues from 1965-1989 and 58%-88% of gross domestic product (GDP) during the 1974-1990 period. The fisheries sector is significant as the country's main source of animal protein; aggregate fresh fish marketed averaged 4,600 t/year valued at B$28.4 million during 1985-1989.[1] Aquaculture currently makes a minor contribution but is programmed for accelerated development together with fisheries. Mangrove forestry is practised on a limited scale and gross production value reached B$1.76 million in 1989. Other activities include mining and quarrying (for beach sand and coarse aggregates), tourism and recreation (principally beach recreation), and shipping and water transportation.

Brunei Darussalam had a population of 256,500 in 1990, projected to grow at 2.6% per annum up to the year 2005. The bulk (85%) of the population resides immediately adjacent to, if not within, the coastal zone, site of almost all social, cultural and economic activities. Such relative concentration in population and activities is expected to persist to 2005. The country has embarked on an accelerated economic diversification strategy away from the dominant oil and gas sector. Reducing dependence on it requires simultaneous promotion of many small- and medium-scale industries and related social and physical infrastructure. Derived demand for primary coastal resources and land for development activities is expected to intensify. All of these, individually and collectively, can have adverse effects on the coastal zone in the absence of proper management measures.

No single agency or authority is at present responsible for environmental management in the country. In broad terms, most environmental and resource-related decisions pertaining to the coastal zone fall within the Ministry of Industry and Primary Resources (MIPR) and the Ministry of Development (MOD). Increased intersectoral and coordination efforts appear in order. The existing legal authority needs to be more fully enforced through its proper translation into relevant rules and regulations for effective CZM.

[1]November 1989: B$1.96 = US$1.00.

COASTAL ZONE MANAGEMENT ISSUES

The issues (problems and opportunities) that bear on sustainable development of the country's coastal zone emanate from a number of sources or may result from future socioeconomic activities. These existing and potential issues may be broadly categorized into the following major classes: environmental quality, resource utilization and institutional concerns.

Environmental quality issues consist of man-induced changes in the natural state of the coastal zone. Five specific issues are included here, namely: water quality, siltation/sedimentation, solid wastes, critical habitats and endangered wildlife. The water quality issue comprises domestic sewage, industrial effluents, agrochemical wastes, organic loading, chronic discharges of oil and oily wastes, and effluent and water quality data requisites. Siltation/sedimentation springs from erosion due to land clearing and mining activities in the coastal zone and river tributaries. The rest of the specific issues tackle increased garbage generation and mounting pressures on coastal habitats and rare/endangered wildlife resulting from economic development and population growth.

Resource utilization issues involve the proper rate and manner of exploitation of coastal resources, as well as threats to appropriate development of sectoral coastal activities. This category includes six specific issues, namely: oil spills, red tides, sustainable fisheries development, sustainable aquaculture development, sustainable coastal forestry and intersectoral/use conflicts.

Institutional issues deal with effective governance of the coastal zone and resources. Concerns are grouped into five specific issues: multisectoral integration/coordination, transnational cooperation, institutional capabilities/appropriate manpower, public awareness/participation and legal framework.

Most of the issues enumerated anticipate likely threats in the wake of the country's development thrust. The current issues are mainly limited and localized in scope, and thus, in their initial stages in terms of magnitude and gravity of impact. Efforts over the medium term, however, are essential to preempt or correct the issues and the high environmental restoration costs associated with them. It is acknowledged that cause-effect interlinkages obtain among the three major issues. The system of grouping the issues is intended primarily to facilitate presentation and logical interconnection with functional management components of the plan.

FUNCTIONAL MANAGEMENT COMPONENTS

A total of 68 projects grouped into 17 programs are outlined in the plan in response to existing and potential CZM issues (Table A.1).

Table A.1. CZM programs, the number of projects under each and their respective lead/coordinating agencies.

A.	Special concerns and sectoral management			
	Water Quality Management	A1	6	PWD (MOD)
	NRTCS	A2	4	DOF (MIPR)
	NOSCS	A3	6	MD (MOC)
	Capture Fisheries Management	A4	9	DOF (MIPR)
	Aquaculture Management	A5	3	DOF (MIPR)
	Mangrove Management	A6	5	FD (MIPR)
	Coastal Land Forest Management	A7	4	FD (MIPR)
	Coral/Artificial Reef Management	A8	5	DOF (MIPR)
	Island Management	A9	3	MuD (MCYS)
B.	General management			
	Integrated Zonation Scheme	B1	3	IAC
	EIA System	B2	3	IAC
	Public Awareness/Participation	B3	3	MOE
	Transnational Collaboration	B4	2	IAC
	Enactment of CZMA	B5	2	MOL
	Coastal Zone Research	B6	4	UBD
	Manpower Development	B7	3	IAC
	Facilities Upgrading	B8	3	IAC

The special concerns and sectoral management programs (consisting of 45 projects) address specific issues pertaining to sectoral coastal activities and resource utilization, as well as threats to such activities. The general management programs (consisting of 23 projects) are directed at issues of a more wide-ranging and comprehensive nature, and have multisectoral significance and impact. These include programs applicable to both the coastal zone and areas impacting it (such as river catchments), and those that address institutional issues.

The projects grouped into programs are presented in a manner as to facilitate detailed operational programming by implementing agencies. Table 4.2 summarizes the management issues and main programs for their resolution or mitigation.

Only the main program/s prescribed for each of the specific issues is/are listed. Some programs have beneficial effects in counteracting an issue apart from the main program/s designed to address it. For instance, all the general management programs (B1-B8) and several special concern programs (A1-A3) are vital for sustainable fisheries development. Moreover, the issue of multisectoral integration/coordination is further addressed in the plan's implementation arrangements. This explains the importance of the coverage of the plan programs and the need for their systematic and integrated implementation.

IMPLEMENTATION ARRANGEMENTS

The plan framework allows access to the highest national authorities but respects existing institutional setups and flows of authority.

Brunei Darussalam's small geographic size and its legal/institutional setting have resulted in a highly responsive and adaptive government machinery. The plan's organizational and management structure, therefore, capitalizes on this strength. This framework is a key strategy to achieve multisectoral integration. Intended to provide sufficient balance between comprehensive and sectoral focuses, it allows access to the highest national authorities but respects existing institutional setups and flows of authority. A schematic representation of the organizational structure and coordination/administration flows for plan implementation is given in Fig. 5.1.

An ICZM plan Interagency Committee (IAC) needs to be created with a strong Technical Secretariat to take charge of overall coordination, and monitoring and evaluation (M & E) of plan implementation. The IAC could be tasked with the lead/coordinating role for integrated zonation, environmental impact assessment (EIA) system, transnational collaboration, manpower development and facilities upgrading. Implementation of the rest of the programs (including budget programming) could be delegated to agencies with appropriate line functions and/or capabilities, under direct supervision of their respective ministries. The IAC would need to collaborate with these lead/coordinating agencies.

The Council on Environment (CE), preferably chaired by a minister and composed of the permanent secretaries of the relevant ministries could provide overall guidance and policy directions to IAC, and facilitate the latter's coordination efforts with cooperating ministries. Consultations with beneficiaries and stakeholders will ease participation and ensure desired results.

The plan is designed to be carried out over the medium term, spanning 5-10 years. A five-year fast-track implementation period is feasible.

The plan is designed to be carried out over the medium term, spanning five to ten years. A five-year fast-track implementation period is feasible. (See Table 5.2 for indicative costs.)

Two mutually reinforcing levels of M & E are prescribed during plan implementation. The first is at the plan level to be conducted by IAC, and the second is at the project/program level under implementing agencies of various programs. The logical framework (logframe) analysis is recommended to aid this function at both levels. As planning is a dynamic process, program revisions are encouraged through an annual review coordinated by IAC. Major plan revisions at five-year intervals should coincide with the government's National Development Plan (NDP) cycle of the same duration. This will allow incorporation of program components into NDP. Complementary to the development agenda of the latter, implementation of the ICZM plan must enhance the functional integrity of the coastal zone for the maximum benefit of the people now and in the years ahead.

CHAPTER 1

INTRODUCTION

THE NEED FOR THE PLAN

Brunei Darussalam is a coastal state in northwestern Borneo Island. The country is divided administratively into four districts--Brunei Muara, Tutong, Belait and Temburong--and shares a common border with the East Malaysian state of Sarawak (Fig. 1.1). A benevolent Malay Islamic Monarchy, a stable economy and prudent government expenditure patterns are prime ingredients that have made Brunei Darussalam "an abode of peace" as its name implies.

The main population centers are in the coastal zone, accounting for over 85% of the population (roughly 256,500 in 1990). Thus, almost all social, cultural and economic activities are concentrated here. The country's economy has been largely dependent on the exploitation of petroleum hydrocarbons, particularly in the past three decades. In the last 18 years, over 95% of exports and 58% (1989) to 88% (1974) of gross domestic product (GDP) have been contributed by the dominant oil and gas sector. The main oil and gas industry structures and facilities are situated within the coastal zone, particularly in Belait District.

Aware of the long-term problems associated with a heavy dependence on a single, nonrenewable commodity, the government of Brunei Darussalam has embarked on a broad-based strategy to develop and diversify its economy. It has implemented a series of Five-year NDPs that have spanned 25 years. The first of these plans was primarily oriented towards improvement of the country's infrastructure. The just concluded Fifth NDP (1986-1990) accelerated the development of a more diversified economy away from traditional dependence on oil and gas exploitation. At the same time, it is noteworthy that the Fifth NDP recognized the need "to have a clean and healthy environment" as its explicit ninth objective.

The government's interest in the plan springs from regional coastal degradation, the potential pressure on the coastal zone from economic activities, and the significance of the area to the people's well-being and quality of life.

The government has taken a keen interest in the development of an ICZM plan in the light of regional coastal degradation trends, the potential pressure on the coastal zone from development activities accompanying economic diversification, and the obvious significance of the coastal zone to the general well-being and quality of life of the people. Brunei Darussalam is in a favorable position to promote sustainable development of its coastal zone and resources. The dominance of the oil and gas sector has resulted in comparatively less pressure on its coastal zone and resources in general. For

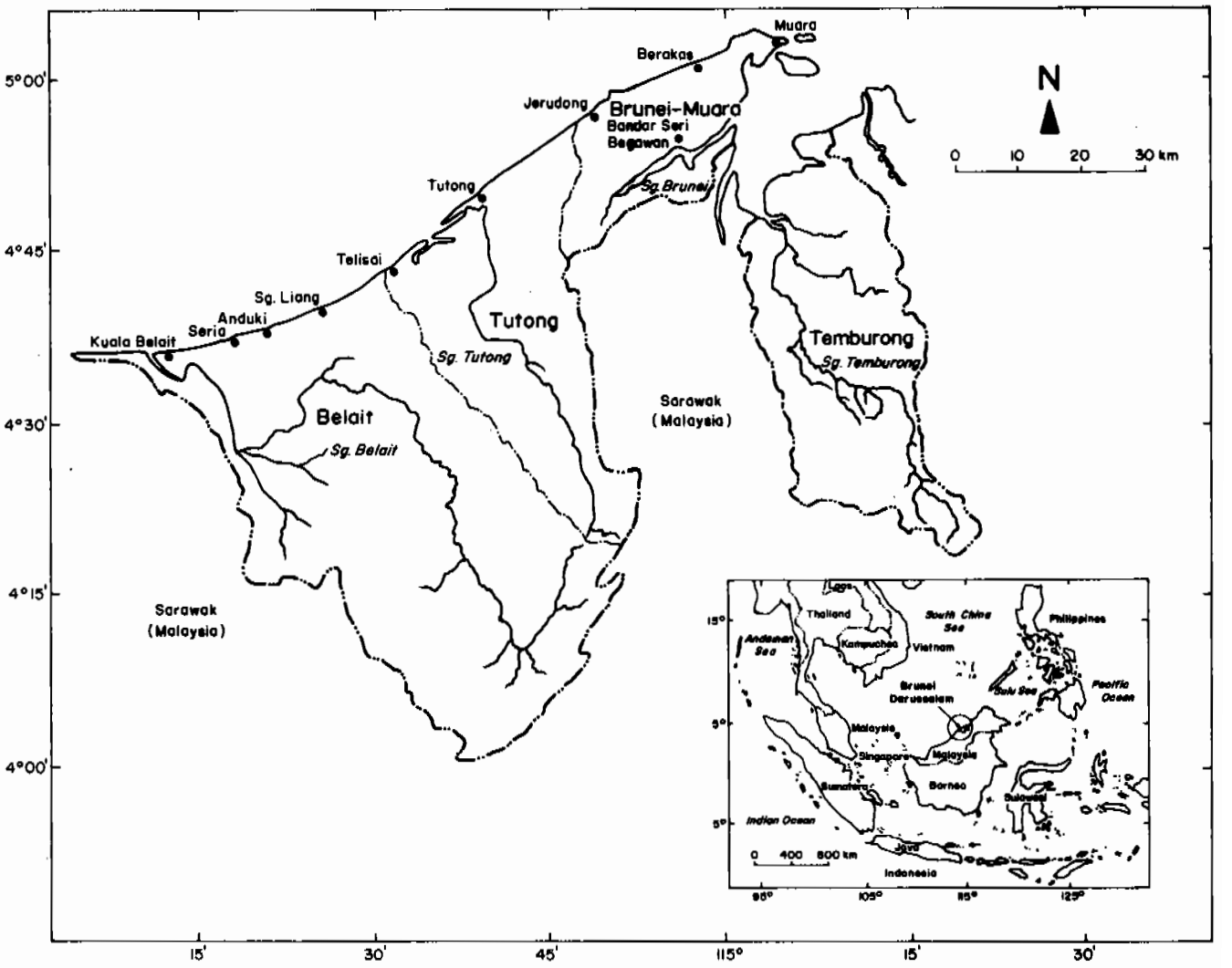


Fig. 1.1. Brunei Darussalam and its four administrative districts.

instance, about 80% of the country is still under some form of forest cover and its mangroves, coral reefs, and other coastal habitats/resources are in a relatively undisturbed condition in a region where their overexploitation or abuse is a common occurrence.

Problems within the country's coastal zone exist, albeit in a relatively small and localized scale, and the potential negative impacts are many given the country's accelerated development path. While the government has taken positive steps to alleviate or preempt many of the current and potential issues/concerns pertaining to the coastal zone, efforts have been primarily on a unisectoral basis. An integrated, multisectoral approach is needed for

sustainable development of the coastal zone and resources. This document, representing an ICZM plan for Brunei Darussalam over the medium term (five to ten years), sets the foundation and presents the essential elements toward this end.

PLAN PHILOSOPHY AND ASSOCIATED CONCEPTS

This plan draws primarily from principles associated with the concepts of sustainable development and ICZM for its guiding philosophy and hierarchy of goals and objectives. It recognizes the essential complementarity in "health" of the natural and human dimensions of the coastal zone and fosters increased integration of environmental considerations into socioeconomic development.

The concept of sustainable development embodies, among others, the essence of such complementarity in the development process. This has received much attention lately, with the increased concern for erosion of the natural world from mounting human activities. In this document, sustainable development is used in this context (FAO 1991):

> ... the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development... conserves land, water, and plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable.

An approach that has evolved over the years to promote sustainable development of the coastal zone, ICZM is defined as follows (CAMPNET 1989):

> ... the dynamic process in which a coordinated strategy is developed and implemented for the allocation of environmental, sociocultural and institutional resources to achieve the conservation and sustainable multiple use of the coastal zone.

The ICZM requires an expanded framework to adequately address the host of issues and realities in the coastal zone. Fig. 1.2 gives a generalized schematic representation of the framework. Integration of information is necessary relative to: (1) the various coastal resources; (2) the processes that sustain them and natural interlinkages; (3) the activities that impact on the resources; and (4) the socioeconomic parameters that influence the scale and intensity of the different activities. Thus, ICZM promotes a fuller understanding of the nature of the problems evident in the coastal zone and the plausible management interventions available at various levels that are difficult to discern using sectoral approaches. It promotes multisectoral

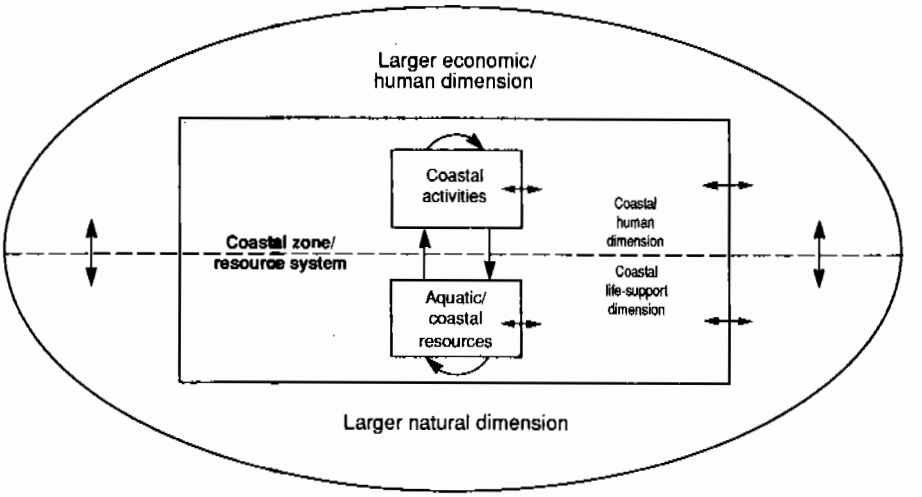


Fig. 1.2. Generalized schematic representation of the multisectoral ICZM framework. Arrows indicate processes and interlinkages.

integration, particularly on the following aspects: (1) spatial that addresses ecological integrity, optimal resource allocation and marine to upland compatibility; (2) legal/institutional from community/local to national level; and (3) policy relevant to environment and socioeconomic development.

The rationale for a broader framework and scope of action toward sustainable development of the coastal zone is evident. This includes, among others, interlinkages in the elements of the natural dimension and, therefore, of adverse impacts on them; and interlinkages in the human dimension (e.g., at the level of legal/institutional arrangements and development policy). Some characteristics of the coastal zone in this regard are presented below to briefly illustrate these points.

The Dynamic Interaction of High Energies in the Coastal Zone

The coastal zone is subjected to the influences of natural high-energy processes such as wave action, tidal and wind currents as well as river discharges intensified by high rainfall. The tidal flow and ebb in estuaries also play an important role. These energies in one way or another contribute to the biological richness and diversity of coastal resources such as coral reefs, mangroves, tidal swamps and estuarine complexes.

Wave and current energy of the sea can erode or build beaches and shorelines by transporting sediments. The same energy can carry offshore oil spills to vulnerable shorelines. Upwellings can supply nutrient-starved surface waters with much needed substances from nutrient-rich ocean depths. Tidal energy can carry nutrients and cleaner sea water into estuaries and flush out estuaries during ebb tide. Major river discharges possess sufficient energy particularly during heavy rainfall to carry materials from land into estuaries and the open sea.

The complex energy dynamics in the coastal zone is important in influencing not only biological richness but also other coastal environmental features. As such, their role in the coastal zone should be recognized and given due consideration in the management of coastal resources.

Interrelationships Among Coastal Resources

Coastal resources interact with one another and the environment in a complex manner resulting in a system in equilibrium. Critical disturbance to this intricate system could upset the balance and have serious or even irreversible detrimental effects. Important coastal ecosystems, such as mangroves, coral reefs and seagrass beds, provide habitats and food for a multitude of organisms including fish and shellfish. In addition to enriching diversity, they serve as breeding and nursery grounds to a large spectrum of marine organisms. These ecosystems are also known to play a part in controlling coastline erosion.

The indiscriminate removal of mangrove trees could thus have far reaching effects not only on the coastal fishery, but also on the stability of the coastline of the area. It could also adversely affect important endemic wildlife (such as the proboscis monkey) that depends on the mangroves for food and as a habitat. Other coastal ecosystems are also similarly vulnerable.

"Clean" or unpolluted water is essential for sustaining biodiversity and productivity of the marine environment as well as for important basic recreational activities such as bathing and swimming. Islands along the coastal zone are unique ecosystems in their own right. They often form buffers for storm surges and strong winds and protect the coastline. They also serve as abodes for wildlife. The ecological interrelationships in the coastal zone are important in maintaining the "health" of the coastal environment and need proper recognition during coastal development planning.

Land-water Interactions and Human Activities

The indiscriminate use of land and water by man can stress the natural energy processes and the delicate interrelationships which maintain an ecological balance in the coastal zone. Siltation from land due to erosion as a result of unplanned land clearance; untreated waste discharges; overexploitation of resources; conversion use of mangroves are a few but important causes of undesirable environmental impacts in the coastal zone.

Man's activities in the coastal zone and upland areas which influence the ecology need to be planned carefully. Plan implementation can minimize, if not prevent, negative consequences on the sustainability of the coastal environment and resources.

Climatic Changes

Predicted global warming as a result of the buildup of greenhouse gases and the depletion of the ozone layer could have devastating effects on the coastal zone. Although Brunei Darussalam might have very little to do with the cause of global warming, it could be adversely affected by the anticipated sea level rise. Its estimated range is 12-50 cm by the year 2025, and 30-180 cm by 2075. Many of the low-lying areas of the country, particularly in Seria, Belait District, prone to tidal flooding, would be extremely vulnerable to such a rise in sea level.

THE PLANNING PROCESS

The scope of activities undertaken during the planning process, together with the main executing groups, is illustrated in Fig. 1.3. The major thrusts included the following: (1) compilation, integration and publication of a coastal profile of the country to identify coastal zone management (CZM) issues and pertinent data gaps; (2) formulation and conduct of research to more fully characterize the nature of the issues and supply the missing information; and (3) formulation and adoption of the ICZM plan. The coastal environmental profile of the country (Chua et al.) was published in late 1987, while the range of biogeographical/technical, socioeconomic and legal/institutional research was finished by early 1991 and documented in Silvestre et al. (1992). This plan, which relies principally on the two publications cited above, is the end-product of the third major thrust of the planning process and largely sets the stage for implementation by national agencies. It is noted in this context, however, that selected programs, actions and projects comprising elements of this plan have already been adopted and implemented by various government agencies in the course of the planning process, particularly those with high urgency and priority.

GOAL AND OBJECTIVES OF THE PLAN

This plan explicitly lays the overall goal and objectives in the utilization and management of the coastal zone and resources of the country. The goal expresses the primary, long-term interest and aspiration of the state. The objectives specifically define the goal over the medium term in the light of the prevailing national situation and development priorities as contained in numerous government plans and documents.

In this context, the goal of the plan is sustainable development of the coastal zone and resources of Brunei Darussalam for the benefit of its present and future generations.

In pursuit of this goal, and consistent with the principles associated with such sustainable development, the plan adopts the following objectives:

1. ensure an optimally sustainable flow of economic, social and environmental benefits from the coastal zone and resources;
2. limit exploitation of renewable coastal resources within their natural regenerative capacity;

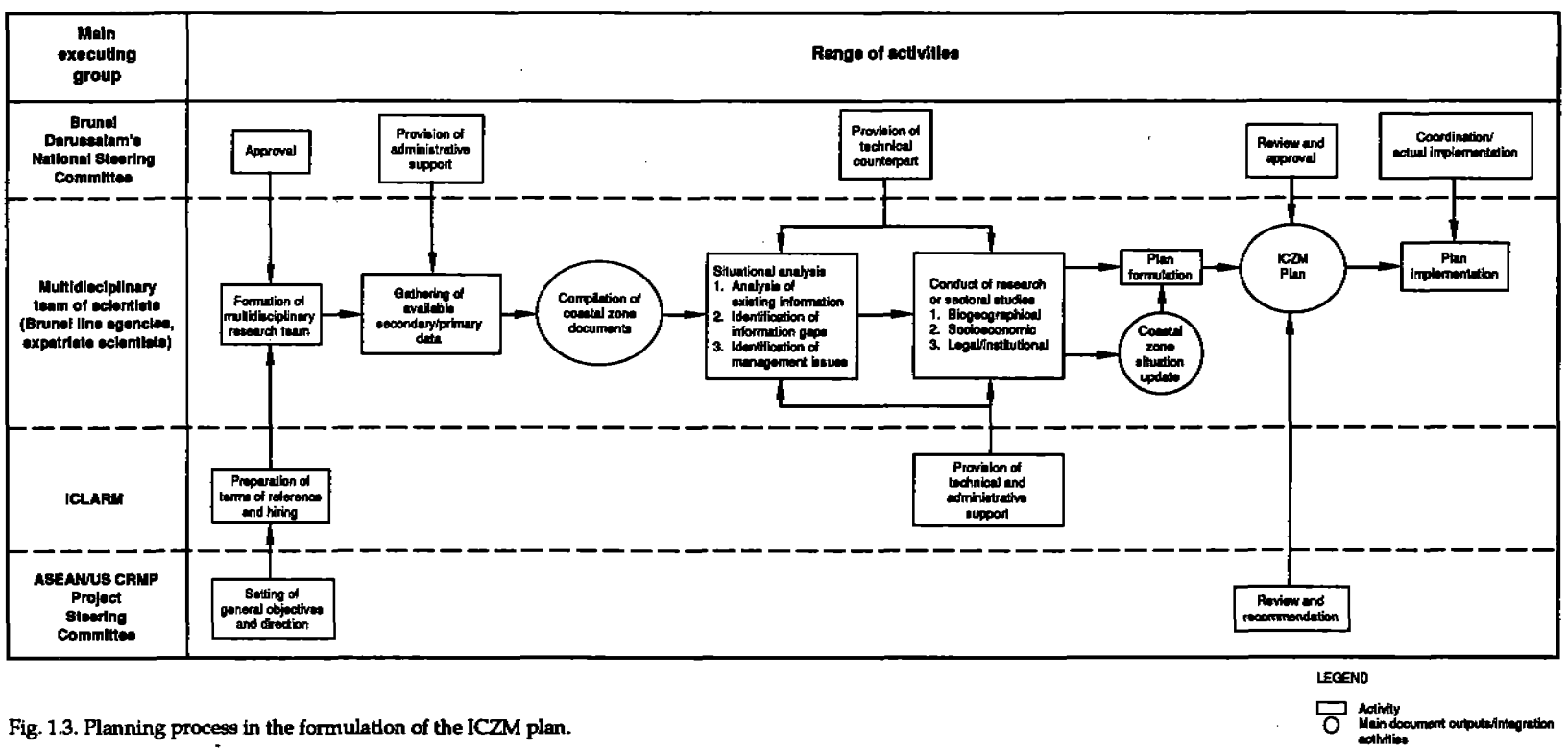


Fig. 1.3. Planning process in the formulation of the ICZM plan.

3. promote equitable distribution of benefits from utilization of the coastal zone and resources in a manner that prevents or minimizes incompatibilities and conflicts;
4. undertake conservation and protection measures to maintain or enhance the functional integrity, aesthetic quality and biodiversity of the coastal zone;
5. develop viable and responsive laws and legal/institutional structures and capabilities; and
6. generate and utilize sound and appropriate scientific knowledge and technology.

It is recommended that the government formulate its management policies to conform with the foregoing goal and objectives.

SCOPE AND LIMITATIONS OF THE PLAN

The present plan envisions to lay the foundation for sustainable development of the Brunei Darussalam coastal zone over the long term. It presents actions and projects organized into programs for implementation over the medium term by appropriate government institutions. Adopting an intermediate approach between general-strategic and detailed-operational, it takes the form of an issue-based action plan. In this context, it contains long-term, strategic elements (e.g., plan philosophy, goal and objectives) and medium-term program components of sufficient detail for adoption and operational programming by implementing institutions.

Plan Organization and Implementation Period

The document is organized as follows:

- Chapter 1 introduces the plan, the need for it, its guiding philosophy, the process of its formulation, goal and objectives over the medium term, and scope and limitations;
- Chapter 2 gives an overview of the coastal environment and resource utilization as well as relevant socioeconomic information;
- Chapter 3 identifies the critical management issues affecting the coastal zone given the current situation and the country's future development path;
- Chapter 4 outlines the various management programs for implementation over the medium term to mitigate and ultimately resolve the issues; and
- Chapter 5 delineates the implementation arrangements proposed over the medium term for integrated, multisectoral management of the coastal zone towards sustainable development.

Implementation period for the plan is targeted to be over a medium term of five to ten years, with annual reviews and major revisions at five-year intervals.

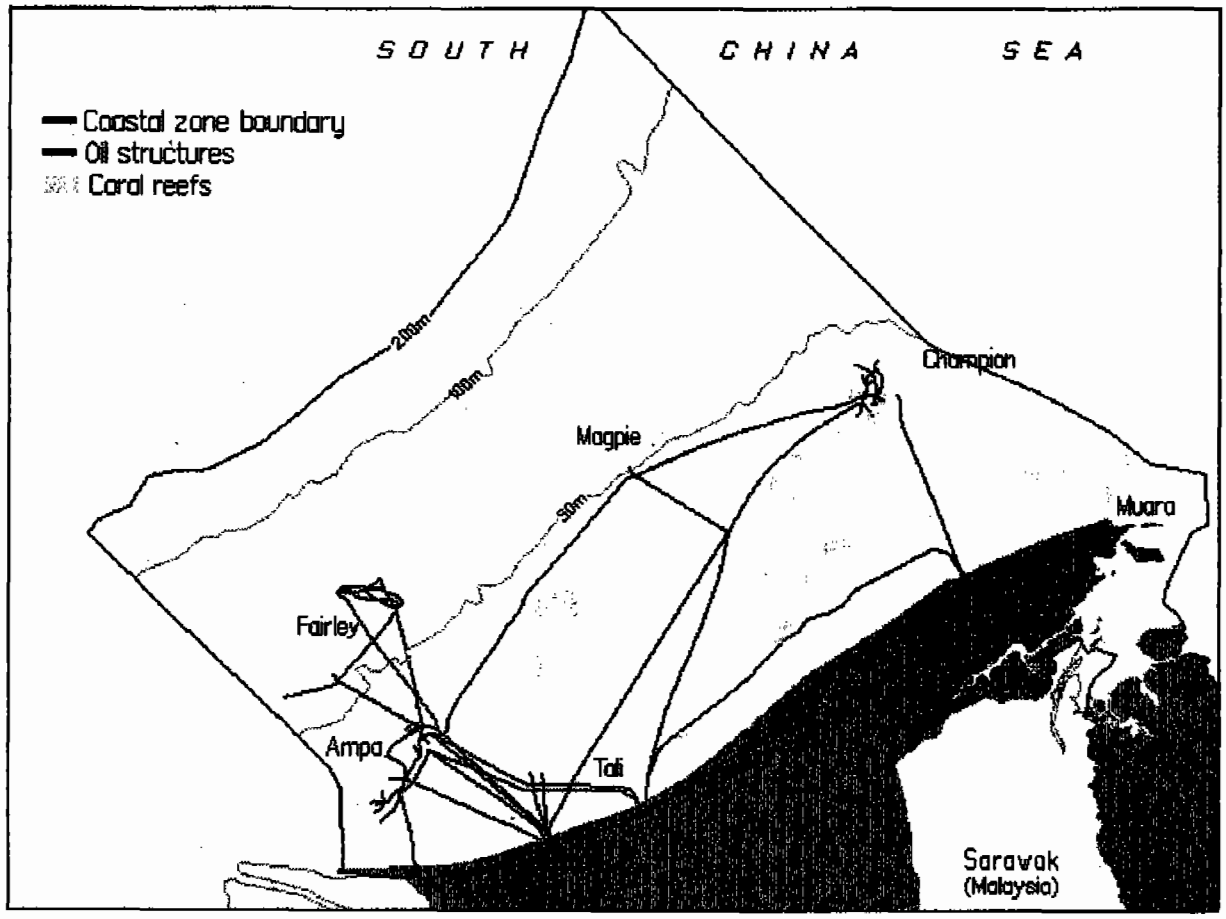


Fig. 1.4. Geographical boundaries of the Brunei Darussalam coastal zone as defined in this plan.

COASTAL ZONE BOUNDARIES AND PLANNING LEVEL

The geographical boundaries of the coastal zone for purposes of this plan are as follows:

1. the marine area from the mean high water spring tide (MHWST) level of the shore out to the 200-m isobath offshore;
2. all land and water areas 1 km inland from the MHWST level of the shore; and
3. all estuaries and land areas reached by tides which include Brunei Estuary or Inner Brunei Bay under the jurisdiction of Brunei Darussalam; the estuarine systems of Sungai (or Sg., i.e., river) Temburong, Tutong and Belait; and mangroves, nipa swamps and other low-lying areas inundated by tides at any time of the year.

Fig. 1.4 illustrates the extent and boundaries of the Brunei Darussalam coastal zone covered by such a delineation. The aquatic portion covers roughly 9,000 km^2 while the land portion is about 400 km^2. The management programs and projects in this plan are specific to the coastal zone and activities impacting it.

CHAPTER 2

COASTAL ZONE ENVIRONMENT AND RESOURCE UTILIZATION

This chapter highlights the country's biophysical coastal environment, related socioeconomic features and coastal economic activities. Detailed treatments are given in Chua et al. (1987) and Silvestre et al. (1992). The chapter is intended as a brief overview to set the tone for identification of the critical management issues and functional management components of the plan.

BIOPHYSICAL ENVIRONMENT

Brunei Darussalam has a land area of 5,765 km^2 and a 130-km coastline bordering the South China Sea (Fig. 2.1). The eastern district of Temburong is mountainous inland near the Sarawak border, becoming hilly toward the coastal area which is fringed by floodplains and swamplands of Sg. Temburong. The western districts of Belait, Tutong and Brunei-Muara are predominantly hilly lowlands, becoming alluvial, occasionally swampy plains toward the coast. Four river systems drain the country and affect coastal waters, namely: Belait, Tutong, Brunei and Temburong. The catchments of these rivers cover roughly 4,260 km^2. In addition, Sg. Limbang and Sg. Trusan drain into Brunei Estuary from Sarawak. Activities within the catchments of these rivers affect the functional integrity of the coastal zone.

A large part (over 80%) of the country's land area is still under some form of forest cover (Fig. 2.2). Forest types consist largely of mixed dipterocarp and secondary growth. Note, however, that most land developments (i.e., urban, cleared or cultivated lands) are adjacent to, if not within, the coastal zone. An additional 27.7 km^2 is projected to be required for urban development up to the year 2005. Moreover, 23 industrial estates (Fig. 2.3) are in various stages of completion as part of the country's economic diversification drive. These industrial estates require 4.9 km^2 and are located near, if not within, the coastal zone.

The terrestrial portion of the coastal zone (1 km inland from MHWST) is roughly 400 km^2. It consists mostly of flat (0°-2°) and gently rolling (2°-12°) slopes. From Kuala Belait to Muara, it is characterized by raised beaches and sand deposits with occasional mangroves and peat swamps. Within Brunei Estuary, the mostly flat slopes are dominated by mangrove forests; raised beach and sand deposits support land developments along the south of Muara promontory.

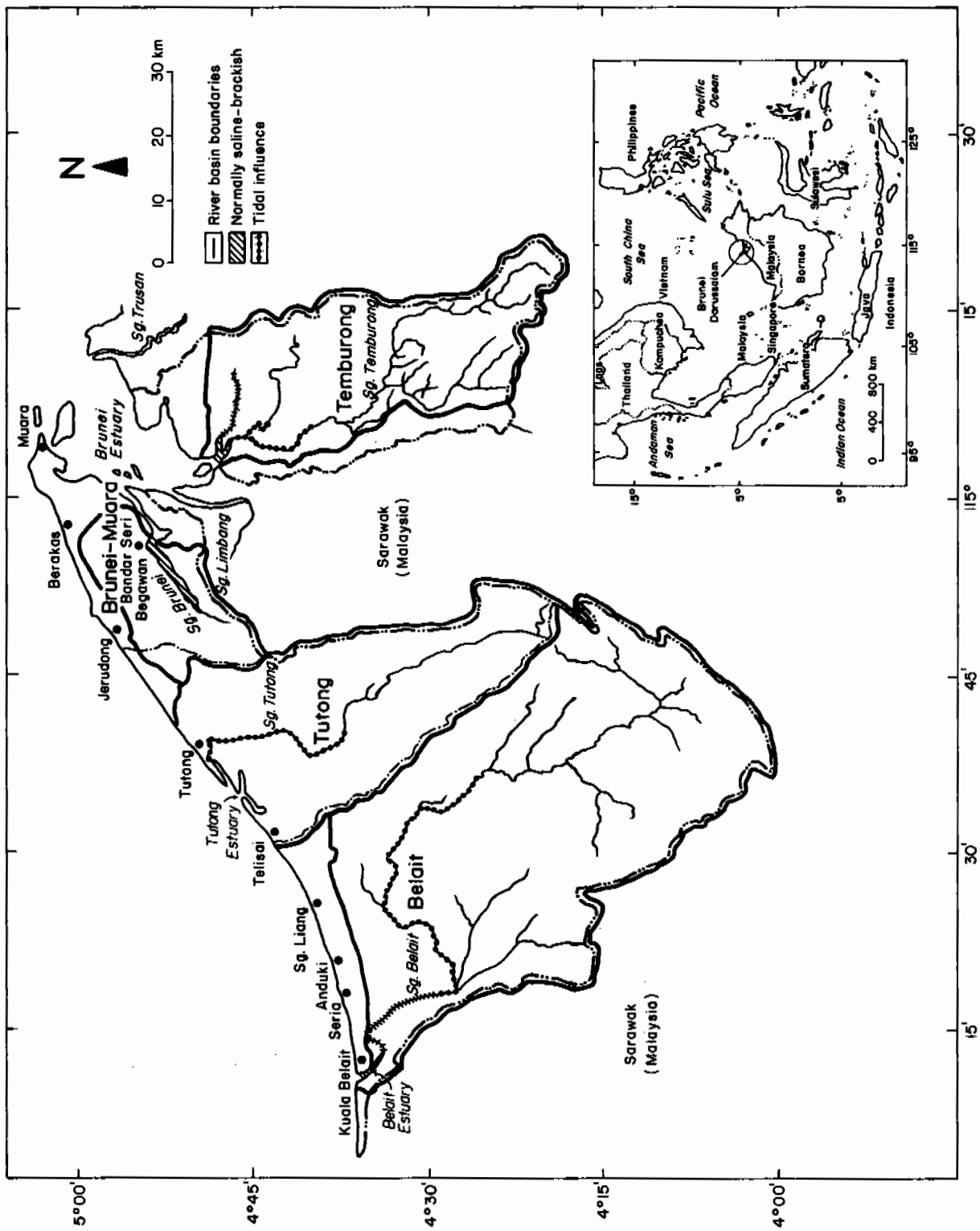


Fig. 2.1. Brunei Darussalam, its four districts and river systems and their basins draining into the coastal waters.

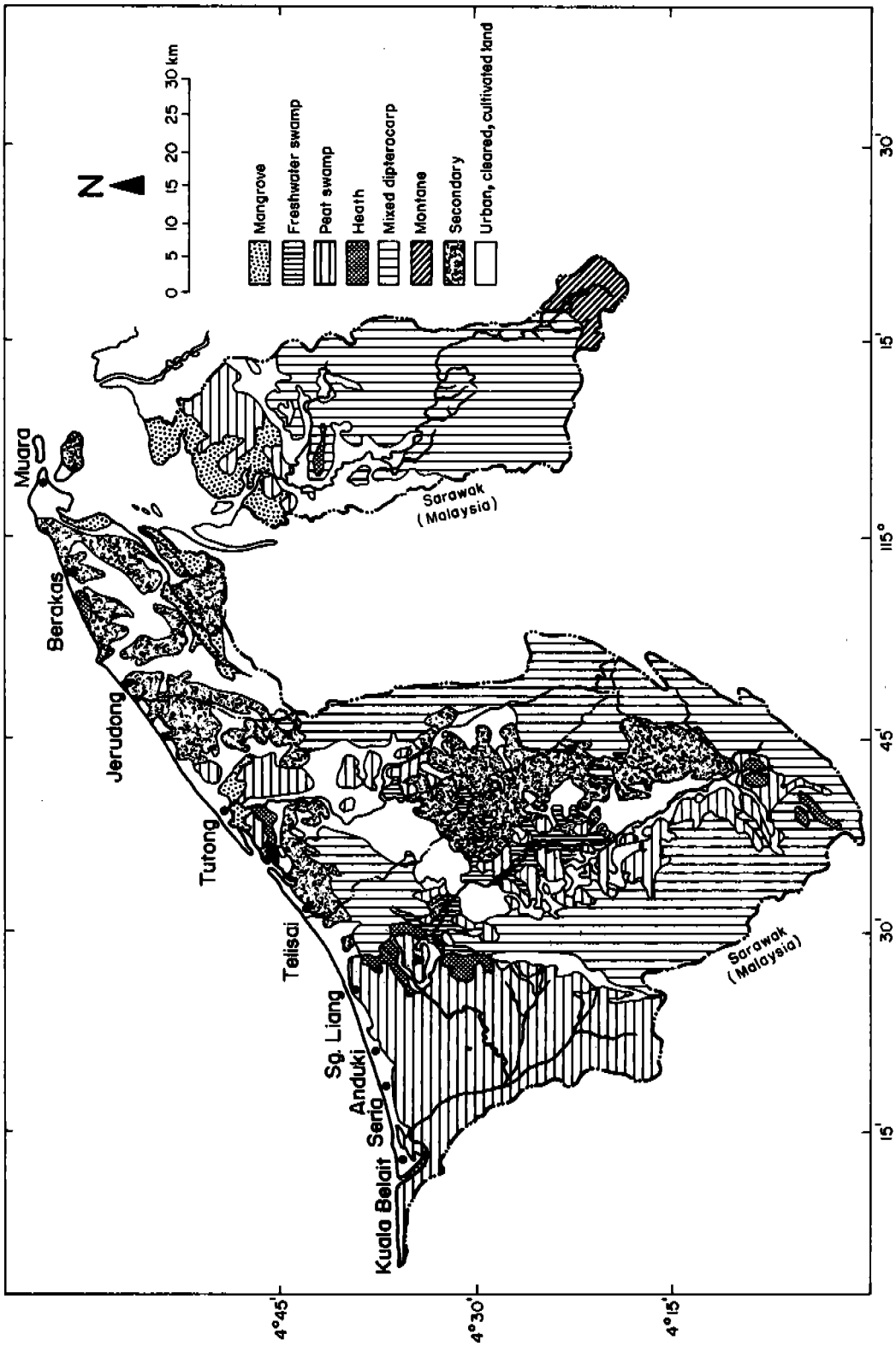


Fig. 2.2. Distribution of basic forest types in Brunei Darussalam.

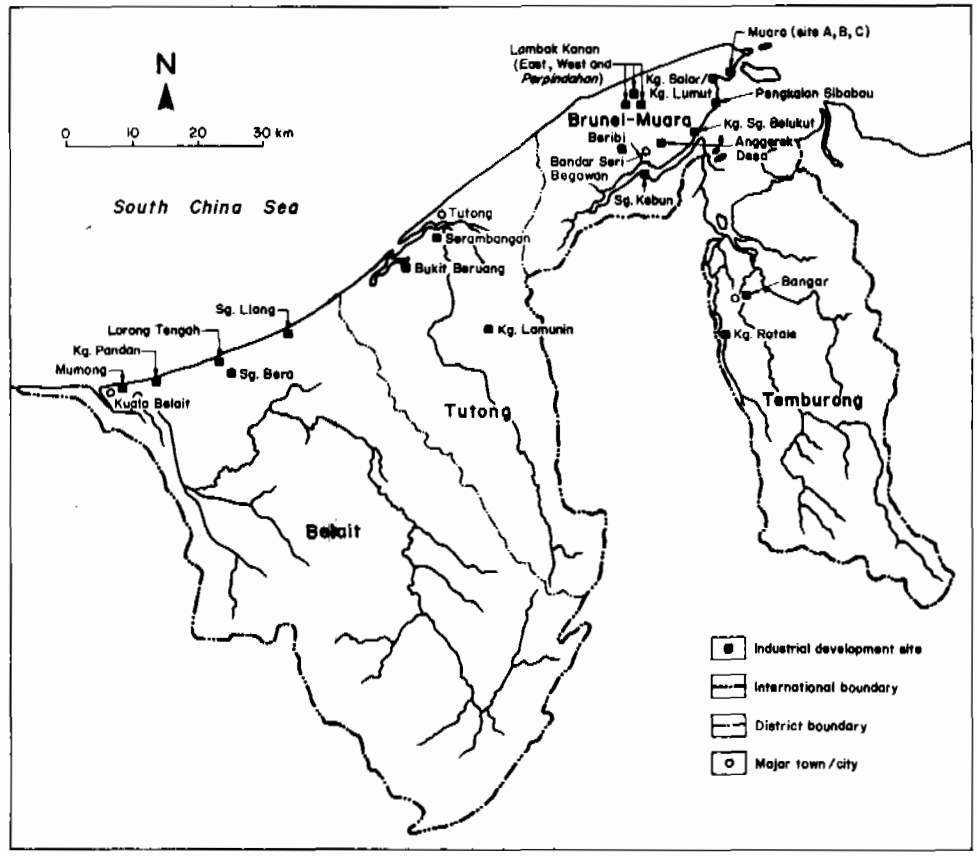


Fig. 2.3. Sites for industrial development estates in Brunei Darussalam.

The coastal lands have no agricultural value with the exception of some scattered smallholder cultivation (e.g., vegetables and fruit trees near Telisai). Their best use, therefore, is for urban, residential, recreational or industrial development. Considerable land developments in this direction have taken place, particularly along the stretch between Kuala Belait and Sg. Liang and the coast of Brunei-Muara District. Most land development activities occur in the coastal area (Fig. 2.4) given the relative concentration there of the country's population and urban centers.

The aquatic portion of the coastal zone (from MHWST seaward to the 200-m isobath) is roughly 9,000 km^2. Fig. 2.5 illustrates the bathymetry of the coastal waters. About 30% of the area is within the 30-m depth contour, 56% within 31-100 m and 14% within 101-200 m. The depth gradients are irregular due to sand deposition from longshore drifts and raised areas covered by coral/hard grounds (e.g., Champion and Ampa). The bottom substrate is sandy between the shoreline to around the 30-m depth contour (except bottom areas within Brunei Estuary) and around Ampa Patches. Apart from these, the substrate throughout is silty/muddy.

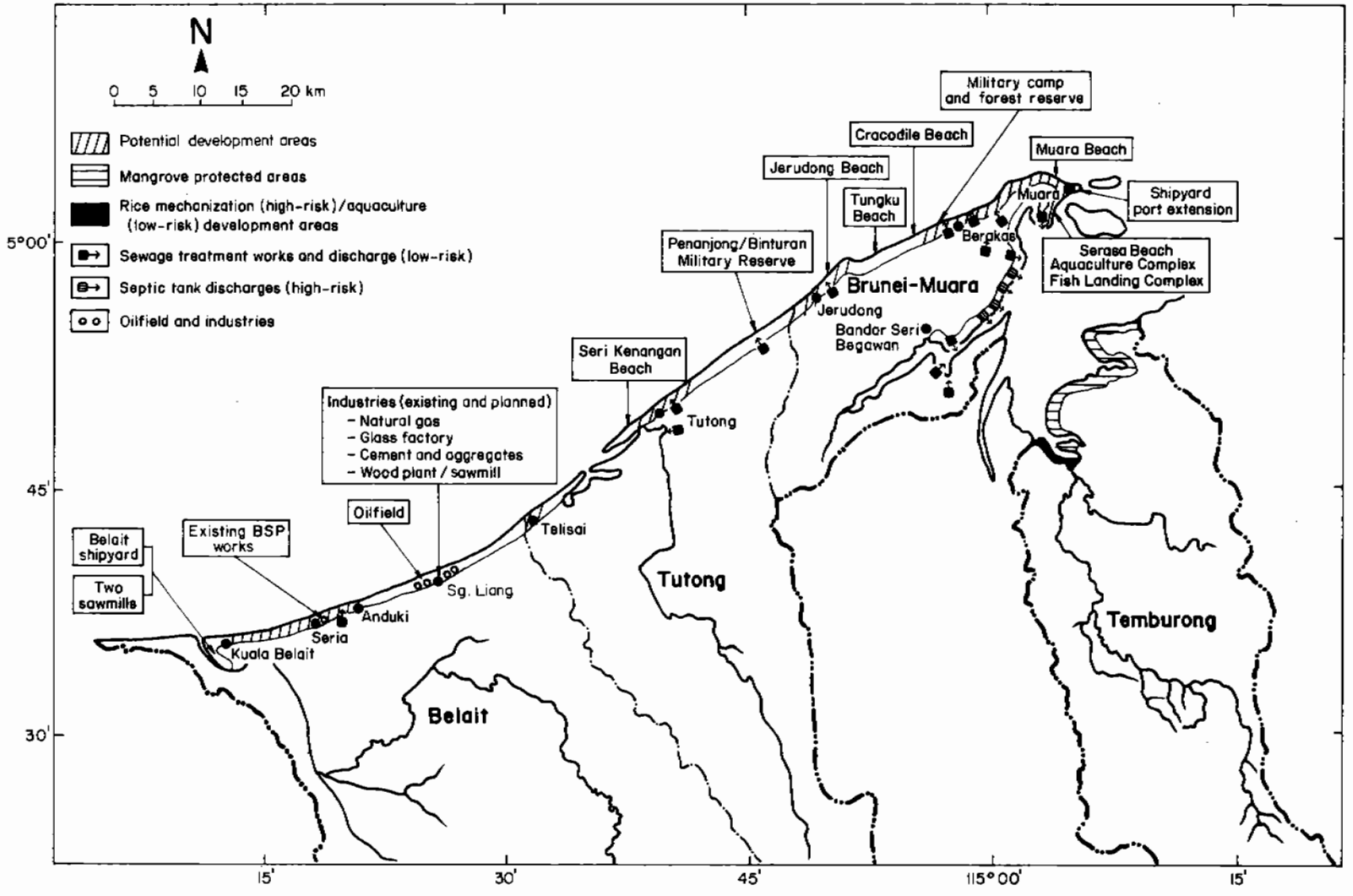


Fig. 2.4. Summary of existing, ongoing and planned land development activities along the coast, excluding the 23 industrial estate sites.

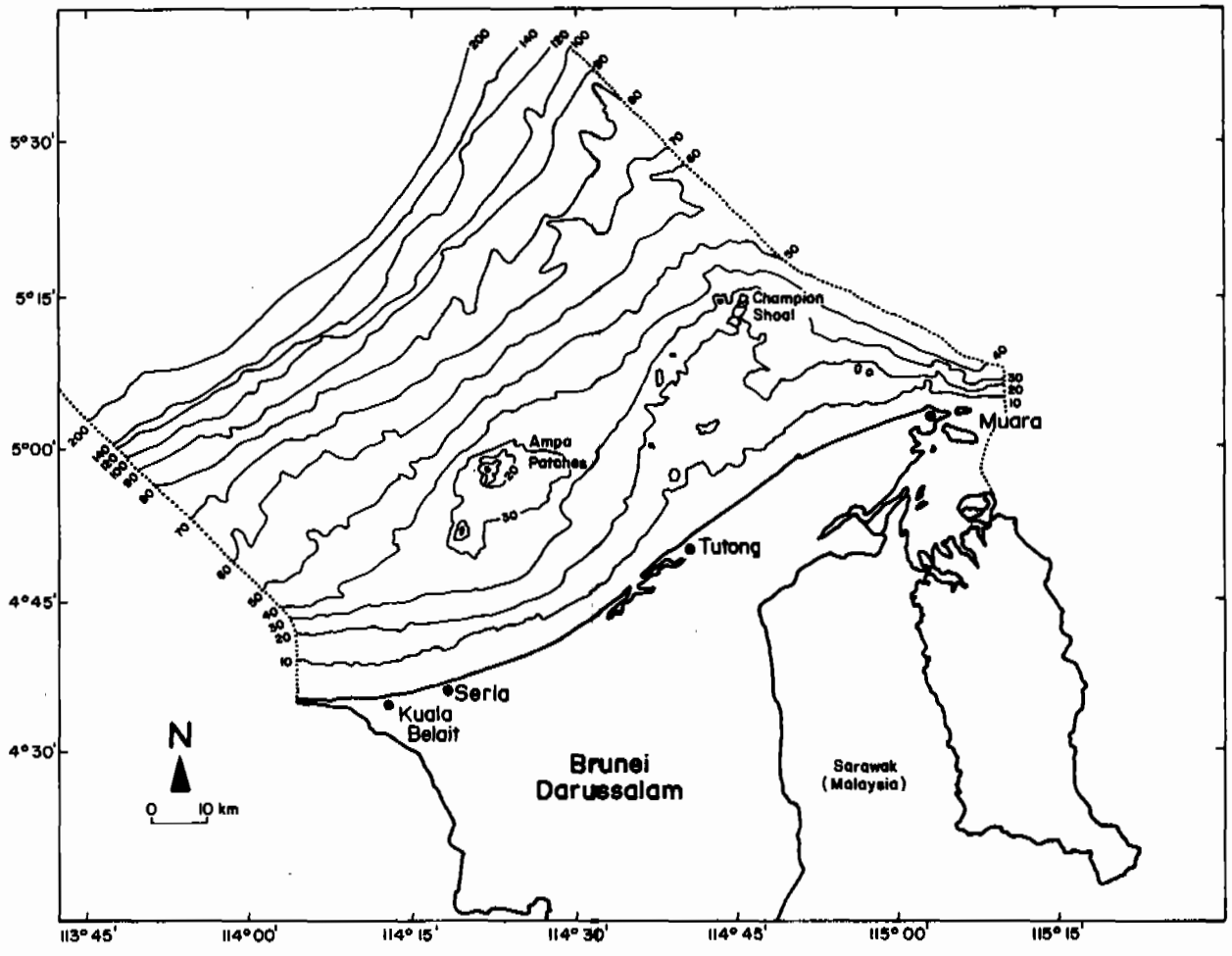


Fig. 2.5. Depth distribution in the coastal waters of Brunei Darussalam. Isobaths in meters.

Brunei Darussalam has a distinctly tropical, equatorial climate characterized by nearly uniform high temperature and rainfall. Thus, the country's coastal waters are relatively warm (29.5°C) and less saline (31 ppt) throughout the year. Climatic variation is minimal and dominated by the monsoon winds resulting from seasonal fluctuation of the Intertropical Convergence Zone in the South China Sea area. The northeast monsoon prevails from December to around March. The southwest monsoon occurs around June to October. Two transition periods occur around April-May and November-December, characterized by light, variable winds. These periods correspond to peaks in rainfall resulting in minimum salinity and maximum turbidity in the coastal area. Rainfall averages 255 cm annually but can be as high as 400 cm in inland areas. The high rainfall promotes tropical rainforest growth but at the same time induces heavy erosion of exposed soils.

Offshore surface currents generally have a southwesterly direction parallel to the coast during the northeast monsoon period and a northeasterly direction during the southwest monsoon. Currents in the aquatic portion of the coastal zone generally follow these seasonal trends but are complicated by coastal geomorphology, the tidal regime and the presence or absence of typhoons in the northern areas of the South China Sea. The coastal waters, typical of tropical areas, are relatively nutrient-poor. The lack of nutrients increases dramatically from the well-mixed and river-fed shallow waters to the deeper areas. Thermocline depth is roughly 60 m. Primary production is lowest in April (driest period) and highest around November-December (wettest period), attesting to the significance of river runoff to the annual enrichment process of coastal waters. Mean primary production is about 90 g C $m^{-2}year^{-1}$.

SIGNIFICANT COASTAL FEATURES OR HABITATS

Some coastal features or habitats are significant because of their contribution to the coastal zone's biodiversity, productivity and functional integrity (e.g., mangroves, coral reefs, islands, estuaries) or their current value to the national economy (e.g., offshore oil industry structures).

Mangroves

The mangrove forests of Brunei Darussalam have an areal extent of 18,418 ha representing 3.2% of the country's total land area. These occur in saline soils subjected to tidal inundation (Fig. 2.6). The main bulk is found in Temburong District (12,164 ha); the rest is located around Muara and along Sg. Brunei (3,937 ha), and along Sg. Tutong (1,784 ha) and Sg. Belait (533 ha). From an ecological standpoint, mangroves are known to:

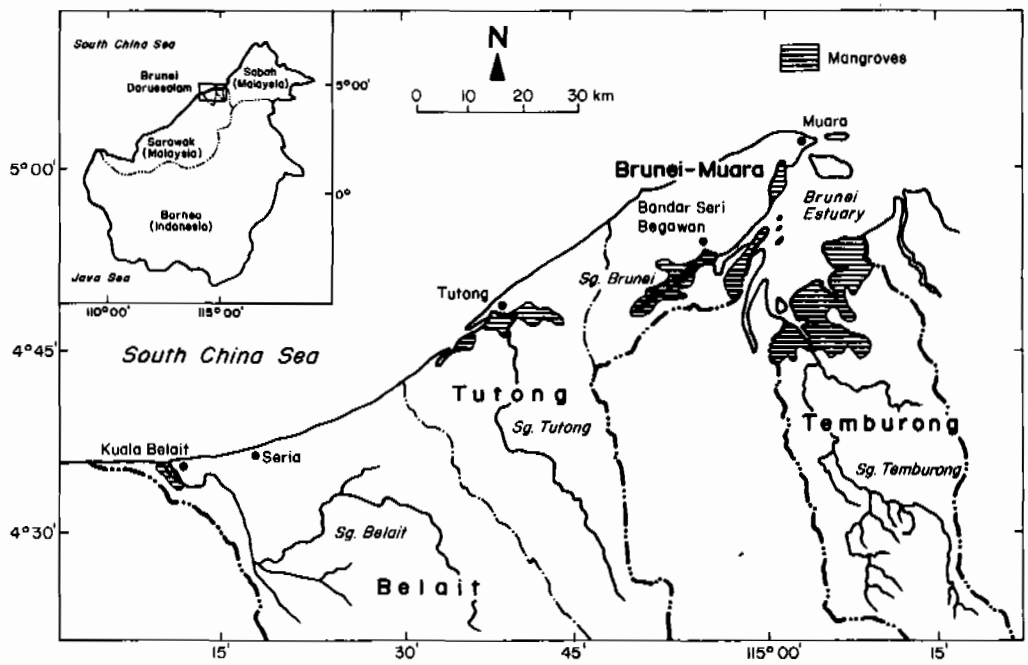


Fig. 2.6. Distribution of mangrove forests in Brunei Darussalam.

- export detritus and nutrients into nearby systems which form the food base of a complex of marine organisms, which in turn support valuable estuarine and nearshore fisheries;
- act as nursery and breeding grounds for many economically important fishes and crustaceans;
- reduce surges and strong winds associated with storms;
- help prevent erosion of riverbanks which in turn protect adjacent properties; and
- harbor unusual wildlife which provides valuable opportunities for education, scientific study and tourism.

The mangroves of Brunei Estuary and associated rivers are particularly important to maintain the high fisheries potential in the area and adjacent coastal waters. The country's mangroves are home to several unique and endangered wildlife including the proboscis monkey (*Nasalis larvatus*), crab-eating macaque (*Macaca fascicularis*), silver leaf monkey (*Presbytis cristata*) and large fruit bat (*Pteropus vampyrus*). The mangroves and associated mud-flats are also used by migratory birds as wintering habitats.

Islands

There are 33 islands with an aggregate area of 79.4 km^2 in the coastal zone of Brunei Darussalam (Table 2.1). Of these, only two, namely, Pelong Rocks and Pulau (P., i.e., island) Punyit are found in the open sea, surrounded by the only fringing coral reefs in the country. The rest of the islands are located in river/estuarine environments of Sg. Brunei, Sg. Temburong and Sg. Tutong. These islands possess varying extents of mangroves with some smaller islands almost entirely covered by them.

The islands provide protection to coastlines from strong wind and wave action. The associated mangroves enhance productivity and species diversity of surrounding waters. Being separated from the mainland, they harbor unique flora and fauna and help preserve endangered wildlife (e.g., proboscis monkey). Pelong Rocks and P. Punyit are noted as habitats of seabirds (e.g., terns and seagulls). Many of the islands remain undisturbed and only three (Baru-Baru, Berbunut and Berambang) are inhabited. However, proximity to population centers makes many of the islands vulnerable to development.

Estuaries

Brunei Darussalam has three main estuaries: Belait, Tutong and Brunei (see Fig. 2.1). They have an aggregate area of about 400 km^2 and are of particular interest for their role as nursery grounds for fishes and invertebrates. The extensive (325 km^2) and mangrove-fringed (85% of the country's mangroves) Brunei Estuary is of major significance as site of the local fishery for shrimps. The estuaries of Belait and Tutong are also important artisanal fishing grounds.

Table 2.1. The islands within the coastal zone of Brunei Darussalam.

Brunei-Muara				
Islands in Brunei Estuary	Muara Besar	940	Primary forest, mangroves	Migratory water/shorebirds
	Pelompong	64	Primary forest	Probable turtle nesting site
	Berbunut	112	Mangroves, swamps, mudflats	Proboscis monkeys, shorebirds
	Baru-Baru	86	Mangroves, swamps, mudflats	Migratory water/shorebirds
	Pepatan	39	Mangroves, swamps, mudflats	Migratory water/shorebirds
	Kaingaran	25	Primary forest, mangroves	Unknown
	Chermin	5	Sundry vegetation, fringing mangroves	Unknown
	Silipan	6	Mangrove forest	Unknown
	Silama	6	Mangrove forest	Unknown
	Salar	5	Mangrove forest	Unknown
	Pasir Tangah	4	Mangrove forest	Unknown
	Bedukang	20	Mangrove forest	Unknown
	Simangga Besar	4	Mangrove forest	Unknown
Islands in Sg. Brunei	Berambang	1,939	Mangrove and secondary forests	Proboscis monkeys, birds, etc.
	Ranggu	199	Mangrove forest, swamps	Proboscis monkeys
	Sibungor	8	Mangroves, swamps	Proboscis monkeys
	Lumut Lunting	1	Mangroves, swamps	Proboscis monkeys
	Luba	50	Sundry tree cultivation	Unknown
Offshore islands	Pelong Rocks	2	Rocky, fringing coral reef	Birds, coral reef species
	Punyit	8	Rocky, fringing coral reef	Birds, coral reef species
Temburong				
Islands in Brunei Estuary	Selirong	2,566	Mangrove forest, swamps	Proboscis monkeys
	Siarau	393	Mangrove forest, swamps	Flying foxes, proboscis monkeys
	Kitang	12	Mangrove forest, swamps	Unknown
	Selanjak	329	Mangrove forest, swamps	Unknown
	Tarap	128	Mangrove forest, swamps	Unknown
Islands in Sg. Temburong	Kibi	569	Mangrove forest, swamps	Unknown
	Pituat	369	Mangrove forest, swamps	Unknown
	Batu Mas	4	Shifting vegetation	Unknown
	Langsat	2	Shifting vegetation	Unknown
	Amo	6	Sundry vegetation	Unknown
Tutong				
Islands in Sg. Tutong	Salawat	13	Mangroves, swamps	Unknown
	Bakuku	9	Mangroves, swamps	Unknown
	Tanjong Maya	16	Mangroves, swamps	Unknown

Source: Silvestre et al. (1992).

Mudflats characterize most estuaries and the major ones are located adjacent to mangroves. Mudflats serve as habitats for many molluscs and crustaceans and a variety of worms. Different birds feed on the biotic community during low tide. During high tide, various fishes, shrimps, crabs and molluscs forage for food on mudflats. Several mudflats, particularly those in Seria, are known to be important wintering habitats for migrating birds.

Because of tidal effects, materials that enter an estuary take time to get flushed out to sea. These form the basis for accumulation of nutrients and for estuaries to be regarded as nutrient traps of high productivity. The same tidal effects can also store up waste materials and pollutants. These make estuaries and their associated river systems highly vulnerable to human activities.

Human settlements (water villages) have been established over estuaries or adjacent to them. The largest of these is Kampong (Kg., i.e., village) Ayer along Sg. Brunei in the capital city of Bandar Seri Begawan with a population of about 25,000. Smaller water villages are found in other river estuarine systems.

Coral Reefs

Coral reefs, productive yet fragile ecosystems, dot the shallow coastal waters within the 40-m isobath (Fig. 2.7). The country is not well endowed with reefs and reef formations due to the turbid nature of coastal waters. The total known reef area is about 45 km^2, the major ones being Chearnley, Ampa, Iron Duke, Brunei Patches and Champion. The major reefs are situated relatively farther offshore, away from the effects of low salinity from river outflows, sedimentation and physical perturbations.

Coral reefs serve as important habitats of biotic communities that support fish resources. Recent surveys show a high diversity; 185 species belonging to 71 genera of stony corals and over 150 fish species from more than 30 families have been reported thus far. The country's reefs have remained in a near-pristine state in a region where they have been subjected to numerous pressures (e.g., fishing, coral extraction, aquarium fish collection, tourism). The potential of the reefs for sportfishing and ecotourism is under investigation. Artificial reefs made up of tires and redundant oil well-jackets have also been placed near Two Fathom Rock to enhance productivity of coastal waters.

Offshore Oil Industry Structures

A significant feature of the coastal waters is the presence of oil and gas pipelines/structures (Fig. 1.4). The country's economy is dominated by the oil and gas sector and any development activity must ensure the prime consideration of safety and unhampered operation of the industry's offshore installations. The major structures are in Champion, Magpie, Fairley, Ampa and Tali Field with pipeline interconnections among the fields and the onshore facilities concentrated in Belait District.

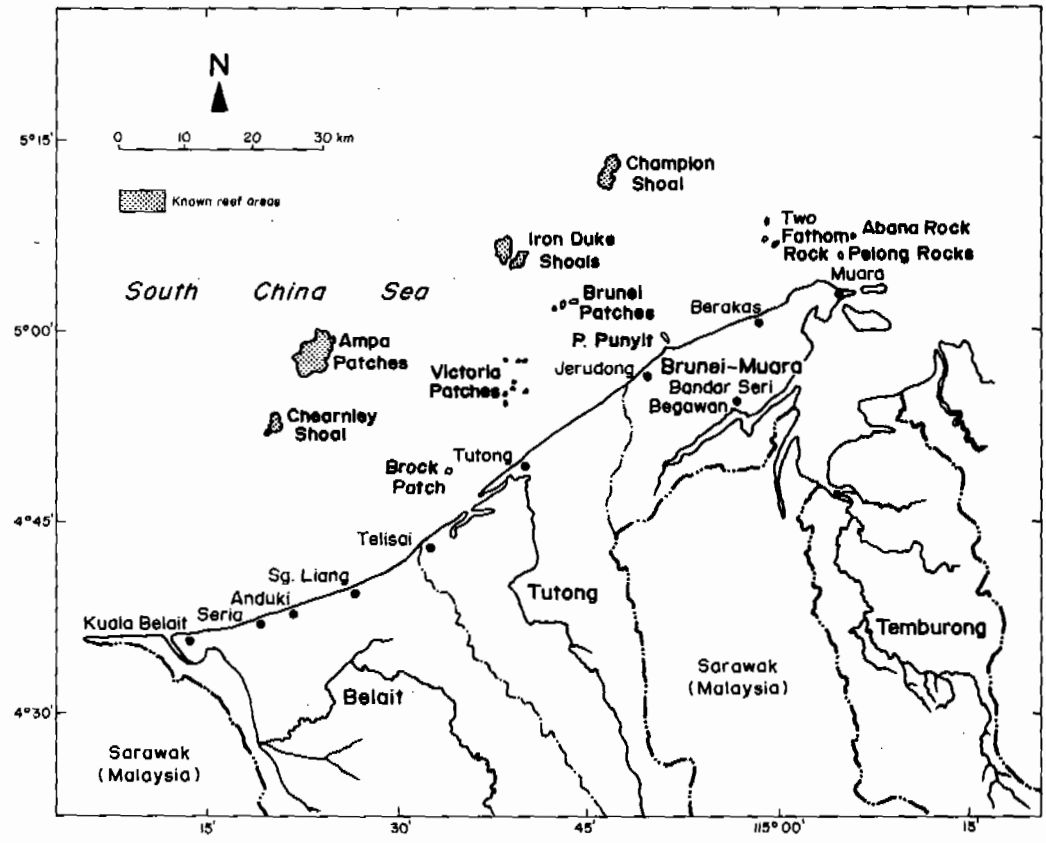


Fig. 2.7. Distribution of known reef areas in the coastal waters of Brunei Darussalam.

SOCIOECONOMIC FEATURES

The socioeconomic features relevant to the coastal zone are highlighted in this section.

Population and Labor Force

Brunei Darussalam had an estimated population of 256,500 in 1990 projected to grow at an annual rate of 2.6% up to the year 2005. Population distribution by district has been stable with about 60% in Brunei Muara, 25% in Belait, 12% in Tutong and 3% in Temburong. The ethnic composition in 1981 was 65% Malay, 20% Chinese, 8% other local indigenes and 7% expatriate workers. The population is relatively young with 37% and 42% of the 1986 population belonging to the below 15 and 15-34 age group, respectively. Male to female ratio averages 1.1:1.0. Literacy rate is high at 87% for persons aged 9 years and above.

The country's population is highly concentrated in the coastal areas where most urban centers and economic activities are also located (Fig. 2.8), namely, Bandar Seri Begawan (Brunei-Muara District), the Kuala Belait-Seria corridor (Belait District), the district capitals of Tutong (Tutong District) and Bangar (Temburong District), and the port town of Muara.

People aged 15 years and above who work or seek employment are considered the economically active sector or labor force. This excludes students, housewives and retired persons. People who are actually gainfully employed comprise the working population. The difference between the labor force and working population consists of the unemployed.

In 1986, the labor force was 83,050 (37% of the total population) 81,100 of whom composed the working population. This implied an unemployment rate of 2.3%, down from 2.6% in 1971 and 3.6% in 1981. About 37% of the working population was in the private sector; the rest was in government service. Roughly 65% in the private sector consisted of expatriates while 30% in government service were expatriates or permanent residents. Statistics indicate that 75% of the labor force were males.

Table 2.2 gives population and labor force estimates for 1985, 1995 and 2005. The considerable dependence on expatriate labor is expected to persist. The labor force structure has changed dramatically from the 1960s when employment was primarily in the productive or primary sector (e.g., agriculture, fisheries, forestry and mining) to the 1980s when employment shifted to the service sector.

Institutional and Legal Profile

Brunei Darussalam is one of the oldest kingdoms in Southeast Asia. The water village of Kg. Ayer, cradle of the country's history, was for a long time the urban center of the kingdom and Borneo Island. Accounts as early as 600 A.D. note that it was then already an important trading center. The coastal zone and resources in the river-based settlement were of traditional significance, particularly in the areas of food supply, human habitation, water transport and handicrafts.

Islamic traditions and customs are widely observed in the country. It is a Malay Islamic Monarchy with a legal system based primarily on English common law. The English legal system was retained after full independence on 1 January 1984; before, the country was a British protectorate with full autonomy apart from defense and foreign affairs. Like the laws of England, the country's laws tend to be brief and general and provide broad grants of authority to ministries and departments.

The government is headed by His Majesty the Sultan who presides over a cabinet of ministers with responsibility over Communications; Culture, Youth and Sports; Defense; Development; Education; Finance; Foreign Affairs; Health; Home Affairs; Industry and Primary Resources; Law; and Religious Affairs. Various advisory and legislative councils assist the Sultan in administration of government. The country is divided into four administrative districts, and district councils assist in local administration. The country's highest court is the Supreme Court headed by a chief justice and composed of several commissioners.

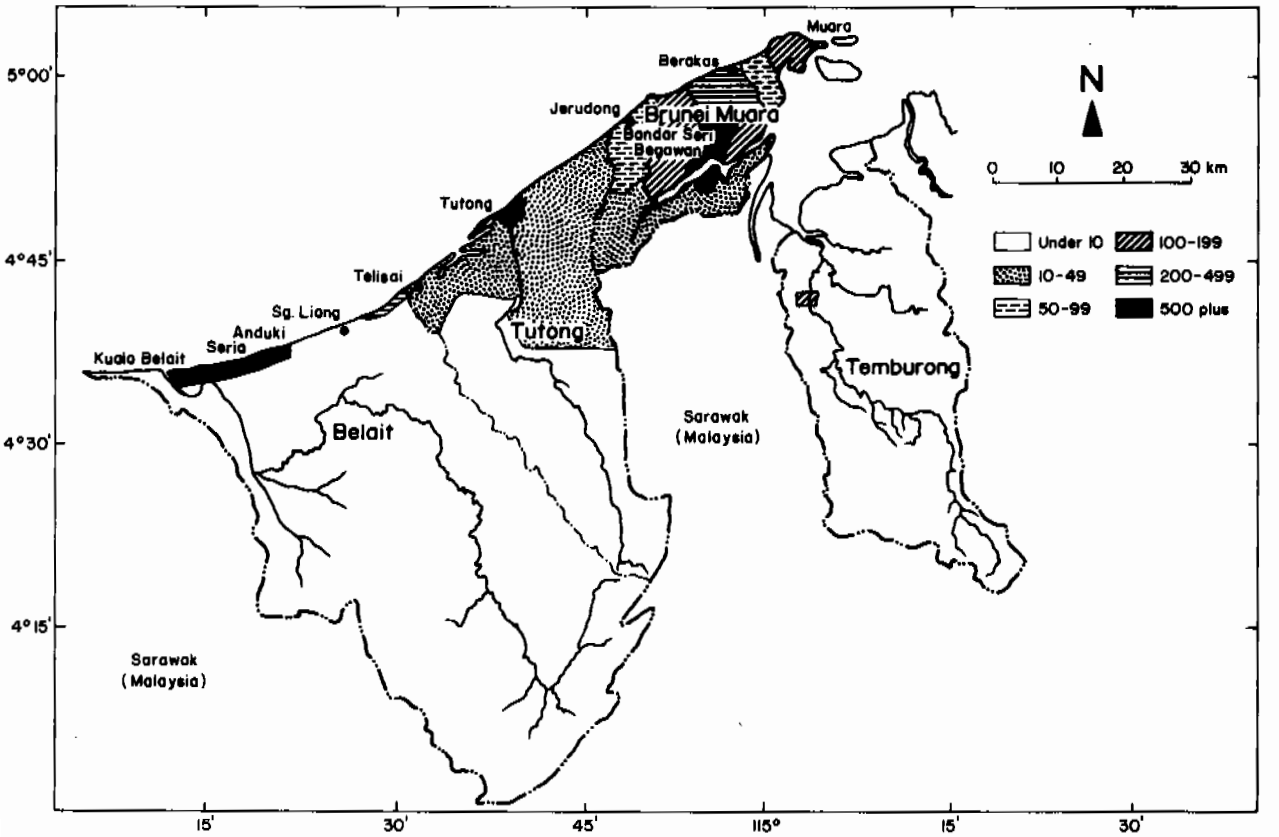


Fig. 2.8. Distribution of population density, 1981. (MOD-DOTCP 1987).

Table 2.2. Population and labor force projections for 1985, 1995 and 2005.

Local population	165,500	213,000	262,000	2.3
Local labor force	51,400	77,200	104,200	3.6
Total demand for labor	81,500	116,500	161,500	3.5
Expatriate labor required[a]	30,100	39,300	57,300	3.3
Expatriate population[b]	55,500	72,300	105,300	3.3

[a]Total demand for labor less local labor force.
[b]Based on 1981 demographic characteristics.
[c]Local plus expatriate population.
Source: MOD-DOTCP (1987).

No single authority or agency is at present responsible for environmental management in the country. In broad terms, most environmental and resource-related decisions pertaining to the coastal zone fall within the Ministry of Industry and Primary Resources (MIPR) and the Ministry of Development (MOD). The government has already recognized the importance of the environment, manifested by the number of environmental units and committees established at various levels. Recent studies, however, note some concerns particularly with respect to CZM: highly sectoral and insufficiently coordinated efforts; overlapping or duplication of functions; and lack of agencies assigned with some statutory responsibilities.

The existing legal authority is adequate to meet acceptable levels of environmental quality. Administrative agencies, however, have yet to use the full authority that the legal code provides through its proper translation into relevant rules and regulations.

Public awareness of environmental issues is good but can be improved by formal incorporation of environmental education into the school curriculum at all levels. This is particularly significant with regard to coastal issues. Several nongovernmental organizations (NGOs) (e.g., Brunei Nature Society, Brunei Yacht Club, Brunei Sub-Aqua Club) can play an important role in this endeavor.

Economic Performance and Development Path

The main feature of the economy of Brunei Darussalam is the dominance of the oil and gas sector in terms of contribution to GDP, export earnings and labor productivity. The government has exerted concerted efforts to promote economic diversification within the following constraints: modest natural resource base, small size of the domestic market; concentration of the local working population in the government sector; and high dependence on expatriate labor.

Table 2.3 gives the contribution to GDP by kind of economic activity for 1974, 1985 and 1990. The GDP had increased from about B$2.62 billion to B$3.76 billion in 1990. Contribution of the oil sector to GDP had declined considerably from 88% in 1974 to 58% in 1990. This is due primarily to regulation of the oil extraction rate to conserve reserves, the drop in the real price of oil, and the growth of the non-oil sector (particularly service industries, notably personal services, transport and communications, and banking and finance). The share of productive industries had increased in absolute terms from B$60.1 million in 1974 to B$74.7 million in 1990 but declined in relative terms from 2.3% to 2.0% of GDP. The role of the government in economic development has been considerable and in 1990 was 62% of the non-oil sector's GDP contribution of B$1.58 billion.

Table 2.3. Contributions to GDP (B$ x 10^6) by kind of economic activity for selected years.[a]

Economic activity	1974 (B$ M)	1974 (%)	1985 (B$ M)	1985 (%)	1990 (B$ M)	1990 (%)
Oil sector	2,301.7	87.98	2,573.5	72.79	2,178.6	57.92
Non-oil sector	314.6	12.02	961.7	27.21	1,582.6	42.08
Government	115.8	4.43	524.6	14.84	975.4	25.93
Private	198.8	7.60	437.2	12.37	607.2	16.14
Productive industries	60.1	2.30	67.9	1.92	74.7	1.99
Agriculture and hunting	27.3	1.04	29.3	0.83	35.7	0.95
Forestry and logging	3.1	0.12	7.9	0.22	5.7	0.15
Fishing	4.8	0.18	5.9	0.17	4.6	0.12
Mining, quarrying and manufacturing	24.9	0.95	24.8	0.70	28.7	0.76
Service industries	267.8	10.24	966.4	27.34	1,587.5	42.21
Electrical	7.0	0.27	17.4	0.49	15.5	0.41
Construction	35.1	1.34	72.9	2.06	77.2	2.05
Wholesale trade	11.5	0.44	32.0	0.91	44.3	1.18
Retail trade	41.0	1.57	70.8	2.00	90.0	2.39
Restaurants and hotels	6.5	0.25	16.7	0.47	18.6	0.49
Transport, storage and communication	14.1	0.54	73.7	2.08	169.4	4.50
Banking and finance	12.8	0.49	85.9	2.43	101.1	2.69
Insurance	0.9	0.03	7.7	0.22	52.4	1.39
Real estate and business services	12.3	0.47	60.9	1.72	79.2	2.11
Ownership of dwellings	12.0	0.46	17.7	0.50	20.4	0.54
Community, social and personal services	114.6	4.38	510.7	14.45	919.4	24.44
Less bank charges[b]	(13.3)	-0.51	(72.6)	-2.05	(79.6)	-2.12
GDP	2,616.3	100.00	3,535.2	100.00	3,761.2	100.00

[a]Monetary unit at 1974 constant prices. Minor discrepancies in figures are due to rounding off.
[b]Bank charges arise from loans extended to firms in individual industries. Generally, bank charges are built in or deducted from each sector. In Brunei Darussalam, however, they are represented as a separate account to be deducted from the final computation of overall GDP.
Source: Silvestre et al. (1992).

Prudent government management and expenditures have resulted in high per capita income and living standards, considerable gains in infrastructure development and economic diversification, and substantial foreign financial reserves and investment holdings of the country. The series of five-year NDPs have traditionally set the direction and pace of economic growth and overall development. The three most recent plans (i.e., Third NDP for 1975-1979, Fourth NDP for 1980-1984, and Fifth NDP for 1986-1990) have all emphasized economic diversification. Although job generation was the primary concern in the Third NDP, the thrust towards economic diversification

began to surface then. This focus sharpened in the Fourth NDP, strengthened by continued development of industrial estates and related infrastructure, a move begun in the Third NDP to implement the country's industrial program.

The Fifth NDP accelerated diversification efforts via more definite industrial development strategies and policies. The goal was to develop export-oriented and import-substituting industries and to put in place and strengthen institutional mechanisms that will effectively eliminate constraints to such a development. It provided financial support through the Fund for Industrial Promotion worth B$187 million over and above line agency budgetary allocations. The Fifth NDP envisioned a huge 20% growth in fishing, non-oil manufacturing and insurance for the period. High growth rates were also expected in the following industries: restaurants and hotels (12%); banking and finance (13%); real estate and business services (15%); and community, social and personal services (12%).

Current government plans continue to stress economic diversification and the establishment of foundations upon which the private sector will thrive. This is attested by the continued focus on development of industrial estates and projects to improve public utilities, roads and buildings. Emphasis remains on continued promotion of small- and medium-scale industries which enjoy competitive advantage.

Three development scenarios to the year 2005 are largely considered in the country's five-year planning cycle. Briefly, these scenarios are as follows:

- Scenario A projects continuation of rapid economic and population growth experienced in the first half of the 1980s; 6% and 4% annual growth in GDP and per capita income, respectively; high employment rate; diversification through rapid development of the non-oil sector; low inflation; less disparity in income distribution; increased resources into productive industries and active government participation; and high reliance on expatriate labor to fill the labor supply and demand gap.

- Scenario B assumes parameters similar to Scenario A but incorporates higher local labor productivity (via capital-intensive investment and manpower development) and tighter control on the entry of expatriate labor.

- Scenario C, most favored by the government, assumes parameters similar to Scenario B but emphasizes industrial development through non-oil manufacturing industries. It involves removal of demand, supply and labor constraints through various procedural and institutional policies as well as viable financial support.

Under all three scenarios, the relative contribution of the oil sector is programmed to decline.

It is recognized that reducing dependence on the oil sector requires simultaneous promotion of many small- and medium-scale industries and related social and physical infrastructure. Industries will necessarily have to build on primary (extractive) activities. Derived demand for primary coastal resources and land for development activities is expected to accelerate. All of these, individually and collectively, can have adverse effects on the coastal zone in the absence of proper management and mitigating measures. Given the socioeconomic significance of oil and non-oil coastal economic activities, then management efforts for the coastal zone appear well warranted.

COASTAL ECONOMIC ACTIVITIES

This section discusses sectoral activities based in the coastal zone or highly dependent on its functional integrity for their viability.

Oil and Gas Industry

Since its initial development in 1929, oil and gas has been the leading sector in the Brunei economy. Despite such local prominence, however, the country's contribution to world supply and its holdings of known oil and natural gas reserves are small. Between 1987 and 1989, the country produced an average of 7 million t/year of oil and 24.9 million m^3/day of natural gas, or about 0.2% and 0.5% of world supply of oil and gas, respectively. The country's proven reserve of oil in 1989 was roughly 200 million t (1.4 billion barrels) or 0.1% of proven reserves worldwide. The ratio of proven reserve to annual production rate (R/P ratio) for oil indicates that the country's proven oil reserve could last at least 27 years given current rates of extraction. Proven natural gas reserve is about 320 billion m^3 in 1989 (0.3% of proven reserves worldwide) with an R/P ratio of 39 years. Several new oil and gas reserves have been discovered recently and are expected to prolong substantially the R/P ratios for oil and natural gas exploitation.

Almost all of the country's oil and natural gas production comes from offshore or onshore wells within the coastal zone. All offshore oil and gas wells are connected by pipelines to onshore processing and refining facilities concentrated in Belait District, particularly around Seria. Employment in the oil and gas sector was about 5,000 persons in 1990. The sector is not labor intensive, accounting for about 5% of the work force but 58% of GDP in 1990. Labor productivity was highest (B$435,700 per worker) compared to other sectoral activities, and its workers among the highest paid in the country.

The oil and gas industry has consistently accounted for the bulk of the country's export revenues since the 1930s. Table 2.4 gives export revenues from crude oil, natural gas and petroleum products for 1965-1989. Throughout this period, the sector accounted for over 93% of total exports. The significance of the oil and gas sector to the economy is overwhelming. It is responsible for

Table 2.4. Exports of crude oil, natural gas and petroleum products (B$ x 10^3) for the period 1965-1989.

Year	Crude oil	Petroleum products	Natural gas	Total exports	Oil and gas % of total exports
1965	190,585	1,463	555	199,750	96.42
1966	213,028	2,624	741	225,540	95.94
1967	235,511	2,313	1,121	248,260	96.25
1968	268,356	2,848	1,095	281,420	96.76
1969	254,792	2,573	832	270,140	95.58
1970	276,538	2,515	840	292,060	95.83
1971	304,815	2,520	537	323,640	95.13
1972	462,054	3,141	1,952	497,380	93.92
1973	762,376	18,627	46,511	852,060	97.12
1974	1,970,248	86,579	291,094	2,388,310	98.31
1975	1,939,913	97,857	424,969	2,494,810	98.71
1976	2,428,442	146,368	685,215	3,293,150	98.99
1977	2,704,684	126,812	1,121,284	3,999,980	98.82
1978	2,618,654	165,185	1,320,809	4,195,210	97.84
1979	3,936,427	285,635	1,480,439	5,796,490	98.38
1980	6,090,173	577,113	3,045,410	9,852,940	98.58
1981	4,777,823	322,869	3,397,243	8,591,730	98.91
1982	4,572,515	226,269	3,274,997	8,153,260	99.02
1983	4,000,206	199,959	2,891,413	7,170,680	98.90
1984	3,840,137	35,714	2,852,385	6,813,940	98.74
1985	3,552,295	99,259	2,782,699	6,532,890	98.49
1986	1,619,934	146,656	2,110,701	3,990,100	97.17
1987	1,953,986	177,198	1,772,130	4,005,600	97.45
1988	1,460,326	181,357	1,717,792	3,463,400	97.00
1989	1,732,900	1,645,900	179,500	3,693,500	96.34

Source: Silvestre et al. (1992).

the country's wealth and high living standards, the main stimulator of the domestic economy, and the source of funds for its development programs. Future revenues from the sector together with earnings from financial reserves and investments will provide the capital for the country's economic growth and development.

Fisheries

The fisheries of Brunei Darussalam are broadly categorized into artisanal (small-scale) and commercial (large-scale) sectors. In 1991, there were 548 full-time and 1,195 part-time artisanal fishermen. Part-time fishermen are employed in land-based activities and fish only during weekends and holidays. Artisanal fishermen use small boats with 40-60-hp outboard motors and employ simple gear, mainly hook-and-line, gill net, beach seine, cast net, ring net and various traps. Trammel nets (*andang karan*) and conical tidal traps (*tugu*) are used to catch shrimps, principally in estuarine areas. Artisanal fishing is confined primarily to nearshore areas within 3 miles of the coast and the estuaries and their associated major rivers. Most artisanal fishermen belong to the older age groups (56% were 36-50 years and 38% over 50 years in 1988).

The commercial sector consisted of 11 demersal trawlers and 4 purse seiners in 1991 which employed about 100 commercial fishermen. They used wooden boats of 18-20 m overall length powered by 150-250-hp inboard diesel engines. Commercial fishing operations are allowed only in areas beyond 3 miles from the coast. Most commercial fishermen are expatriates from Malaysia and Thailand.

Table 2.5 gives the mean quantity of fresh fish marketed in the country during the 1965-1989 period. Note that local production statistics exclude catches taken home for consumption by artisanal fishermen. Shortfalls in local supply were filled by importation of fishery products. The share of local production to the total supply of fresh fish marketed in the country had declined continuously from about 80% in 1965-1969 to about 44% in 1985-1989.

Table 2.6 gives the quantity and value of fresh fish marketed for the 1985-1989 period. During this period, local production averaged about 2,000 t/year valued at B$11.5 million while imports were about 2,600 t/year at B$16.9 million. The commercial sector averaged about 540 t/year in 1985-1989 (all of which was marketed) or over 25% of local fresh fish marketed during the period. The rest came from artisanal fisheries. Recent studies indicate that catches taken home for consumption by artisanal fishermen are between 500 and 2,300 t/year, mostly from part-time fishing.

Table 2.5. Mean quantity of fresh fish marketed in Brunei Darussalam by source.

Period	Local production (t/year)	Imports (t/year)	Total (t/year)	(% local)
1965-1969	2,244	563	2,807	79.9
1970-1974	2,166	1,068	3,234	67.0
1975-1979	2,225	1,325	3,550	62.7
1980-1984	1,933	2,118	4,051	47.7
1985-1989	2,007	2,602	4,609	43.5

Source: Silvestre et al. (1992).

Table 2.6. Quantity and value of fresh fish marketed in Brunei Darussalam for the period 1985-1989.

Year	Local production (t)	(x10^{6}B$)	Imports (t)	(x10^{6}B$)	Total (t)	(x10^{6}B$)
1985	2,401	13.8	3,085	19.5	5,486	33.3
1986	2,187	11.9	2,085	13.6	4,272	25.5
1987	2,071	10.3	1,828	11.9	3,899	22.2
1988	1,548	10.2	2,523	16.5	4,071	26.7
1989	1,826	11.4	3,489	23.2	5,315	34.6
Mean	2,007	11.5	2,602	16.9	4,609	28.5

Source: Silvestre et al. (1992).

The potential yield of fishery resources from the coastal waters has been estimated at 25,700 t/year, broken down into 500 t of shrimps (mostly *Metapenaeus brevicornis* and *Penaeus merguiensis/indicus*), 15,400 t of demersals, and 9,800 t of small and large pelagics. The fishery for shrimps is strictly an artisanal one. Preliminary assessments indicate that the shrimp resources may be overfished. Further investigations would be required to clarify the situation. The rest of the fishery resources are very lightly exploited and hold considerable potential for effort expansion.

In 1988, studies indicated that artisanal fishermen's incomes varied from B$590 to B$1,040 per month. Net monthly incomes of trawlers ranged from B$780 to B$9,980. The earnings of purse seiners were higher and averaged B$13,500 monthly.

The country's economic diversification program targets the development of commercial fishing as one priority. The Department of Fisheries (DOF) has adopted a Five-point Plan to expand and support capture, culture, processing, marketing and extension activities for the fisheries sector. Constraints to development of commercial fishing and relevant corrective measures are receiving increased attention.

Mangrove and Coastal Forestry

Mangroves have been exploited on a limited scale for several uses in Brunei Darussalam and there are no known serious conflicts among users. Nonetheless, conversion use of mangroves is a major area of concern.

In the past (from 1901 to 1952), the mangrove bark was used in making cutch, a dye extract used in the tanning industry. Mangrove wood is used for making charcoal, and poles are used for piling and other purposes in the construction industry. In recent years, the availability of cooking gas and electricity has considerably diminished the use of mangroves for firewood and charcoal. However, there has been an increase in the use of mangrove poles, particularly for piling purposes. The rising and declining trends in mangrove pole and charcoal production, respectively, are given in Table 2.7. More than 90% of the poles are extracted from the Selirong Forest Reserve (SFR) and Labu Forest Reserve (LFR) in Temburong District. Charcoal is produced mainly in Berbunut. Gross production value from mangrove exploitation was B$1.76 million in 1989.

The only forest reserves in the country with major mangrove components, SFR and LFR are administered by the District Forest Office in Bandar Seri Begawan. About 90% (5,124 ha) of SFR and 36% (2,409 ha) of LFR comprise mangroves. These are exploited commercially under licenses issued by the Forestry Department (FD). A total of 10 licenses for pole extraction and 5 licenses for making charcoal were issued in 1988, covering a controlled exploitation area of about 2,700 ha of mangrove forest.

Table 2.7. Estimated gross production value (B$) for mangrove products.

1977	61,200						303.5	394,550	
1978	55,200						270.5	351,650	
1979	100,400						291.1	378,430	
1980	107,600						255.8	332,540	
1981	91,100						265.1	344,630	
1982	92,900						195.8	254,540	
1983	154,200						223.8	290,940	
1984	176,900				1.30	229,970	230.6	299,780	529,750
1985	168,100				1.30	218,530	275.8	358,540	577,070
1986	192,200				1.30	249,860	212.3	275,990	525,850
1987	164,400	1.90	3.90	7.75		742,540	145.2	188,760	931,300
1988	292,700	1.90	3.90	7.75		1,322,028	55.9	72,670	1,394,698
1989	362,500	1.90	3.90	7.75		1,637,292	97.4	126,620	1,763,912

[a]Based on constant price of B$1,300/pc.
Source: Silvestre et al. (1992).

At present, FD is not legally responsible for mangroves other than those within forest reserves. Some illegal cutting of mangroves outside the forest reserves has been reported. Although this may not be a major threat at present, proper authorities should guard against its possible intensification due to the increasing demand for mangrove poles in the construction industry.

Approximately 8 ha of mangroves have already been converted to brackishwater aquaculture use. Human occupancy has used up at least 187 ha (154 ha for housing sites and 33 ha for industrial sites). Several other areas have been identified for future conversion use.

The coastal land forests are not exploited for commercial purposes. However, some forest areas have been cleared and converted to sites for housing and industrial projects, evident along the coastal road in Berakas and Jerudong and along Muara and Kota Batu roads.

Aquaculture

Aquaculture appears a good prospect in terms of fish production and economic contribution to Brunei Darussalam. It is of recent origin, with only a few small-scale fish ponds totalling an area of less than 10 ha in operation.

The DOF has identified 1,530 ha of potential sites for brackishwater pond culture targeted for commercial shrimp farming. Among these are: 90 ha in Kg. Keramut and Telisai in Tutong District, 50 ha in Pengkalan Sibabau and 200 ha in P. Muara Besar in Brunei-Muara District and in Temburong District, approximately 1,000 ha. Most of these areas to be developed are sparsely vegetated with some fringes of mangroves, except Pengkalan Sibabau which is entirely covered with mangrove forest. The DOF has implemented a 50-m buffer of mangrove belt in mangrove areas.

At present, there are only two operators of brackishwater ponds for shrimp culture having a combined total of six developed hectares. The main cultured species is the tiger shrimp (*Penaeus monodon*). More operators are expected to start soon as new licenses to operate have been issued under the Five-point Plan.

Hatchery capability is being developed by DOF through their pilot hatchery at Muara Fisheries Station where *P. monodon* postlarvae are produced. The first batch of some 7,000 homebred sea bass (*Lates calcarifer*) fingerlings was turned out in 1991. Prior to this, fry procured from overseas were nursed to fingerling size for distribution. A total of 1.8 million shrimp and fish larvae were produced in the hatchery in 1989. The *P. monodon* and sea bass larvae and fingerlings are cultured in pilot net cages in Serasa Bay near Muara.

Aquaculture in open waters (estuary and sea) using pens and cages is feasible in Brunei Darussalam. Net cage culture of *P. monodon* has been successfully piloted with the shrimp growing from postlarvae to 30-35 gm in about four months using artificial feed. The culture of seabass, grouper (*Epinephelus* sp.) and red tilapia (golden hybrid tilapia) is also being piloted at the Serasa Bay cage culture facility of DOF. The pilot hatchery at Muara Fisheries Station supports the pen and cage culture projects. Construction of a better and larger hatchery at Meragang, southwest of Muara, with improved facilities and provision for better quality seawater, is scheduled to start soon.

The economics of open-water culture, especially of shrimp in net cages, seems promising even if the product is sold in the local market. Water pollution and red tides could be constraints to aquaculture development in the coastal zone.

At present there is only one commercial and four small-scale net-cage culture facilities for finfishes owned by the private sector. More units are expected to be established soon, as new licenses have been issued. Assistance in the form of technical advice is provided by DOF.

Mining and Quarrying

Gravel and sand mining and quarrying for aggregate material and landfilling are economic activities that support construction, infrastructure and land development. On the other hand, these activities can cause soil erosion which in turn increases siltation and sedimentation of the open sea. Silt and sedimentation can interfere with photosynthetic activities of phytoplankton and benthic organisms and decrease the productivity of coastal waters. In excessive amounts, they are fatal to species of reef-building corals as well as to sedentary benthic organisms.

Beach sand mined in Berakas has led to severe beach erosion and sedimentation of adjacent coastal waters. Quarrying for landfill by cutting hilly areas is relatively extensive in the country and contributes significantly to silt and sediment load in the coastal zone. The heavy sediment load of Sg. Temburong could partly be attributed to gravel mining activities.

Beach sand in Brunei Darussalam is primarily used in the construction industry and as landfill material. Beach sand extraction was 162,648 m^3 in 1988. Approximately 300 million m^3 of sand, including those below the water table, are believed to be exploitable. However, because of inherent flooding and other problems of mining beach sand below the water table, extraction is allowed only from above the water table. This reduces the potentially exploitable beach sand resources to 12 million m^3. The current annual demand for landfill alone has been estimated at 0.77 million m^3.

The major domestic source of coarse aggregates is the alluvial gravel deposit in Temburong Valley. In 1982, yield was between 54,000-77,000 m^3/month. As of 1985, the gravel deposit was estimated to be down to 5.3 million m^3.

In 1990, mining and quarrying contributed B$28.7 million to GDP. Benefits accrued to 5,400 people in the industry, and labor productivity per worker was B$5,300 annually. Government revenue from sand mining based on the royalty fee of B$0.50/$yd^3$ amounts to B$105,000/year. The royalty fee for gravel mining is B$28/t.

Tourism and Recreation

The beaches of the coastal zone are important recreational areas in Brunei Darussalam. Long tracts of fine sand, shallow water and easy accessibility make some of the beaches (Serasa, Muara, Meragang, Tunku, Jerudong, Tutong, Seria and Belait) ideal for picnics, walking, bathing, swimming, fishing and other water-based recreational activities. The adjoining forests also enhance the attraction of the beaches by providing shade and resting places. Most accessible and popular beaches get crowded particularly during weekends and public holidays. Several popular beaches have been provided with shelter, seating and other basic amenities. Scuba diving, wind surfing, yachting and sportfishing are carried out on a limited scale but have good potential for further development. Some coastal forest parks are also used for recreation.

Accommodation facilities of hotels are hardly used by local residents as most coastal zone recreational facilities could be reached in less than one hour's travel time. The few hotels that cater to foreign tourists are mainly found in urban centers. During the past five years, tourist arrivals were about 9,000/year.

The government has shown an interest to develop "ecotourism" or tourism based on Brunei Darussalam's near-pristine ecosystems such as the rain-forests, mangroves and coral reefs. Aware of the negative aspects of unmanaged tourism, the government has taken several steps to counteract them.

Shipping

Muara Port, the main port of Brunei Darussalam, and two minor ones in Bandar Seri Begawan and Kuala Belait, come directly under the jurisdiction of the Ports Department (PD), Ministry of Communications (MOC). The BSP operates a single point buoy mooring facility in Lumut, Belait District, to receive tankers for transporting crude and liquefied natural gas.

Muara Port is the most important port-of-entry for sea-going traffic. The transit warehouse, the container marshalling yard and the container freight station are all situated within its 24-ha area. The main commercial berth is 611 m in length with a maximum draft of 10 m. An additional berth of 87 m

with a maximum draft of 5.2 m is also available for smaller craft. The port also provides facilities for discharge of bulk cement and bitumen. In 1989 and 1990, the port handled cargo traffic in excess of 1 million t of freight/year.

The only approach to Muara Port for ocean-going vessels is through the dredged channel of Tanjong Pelompong. The channel is 9.1 m deep and enables average-sized ships to enter the port directly from the South China Sea.

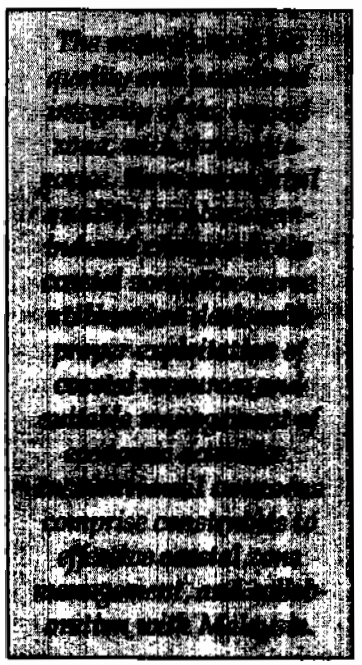
Other than air transport by helicopter, water transport is the only means of travel between Temburong and the other districts, and the main conveyance to and from water villages, particularly Kg. Ayer. The so-called "water taxis" outnumber land taxis by a ratio of at least 25:1.

CHAPTER 3

COASTAL ZONE MANAGEMENT ISSUES

A number of issues (problems and opportunities) evidently affect the sustainable development of the coastal zone of Brunei Darussalam. The nature and extent of these issues have been elaborated on during the course of the planning process and documented in detail in Chua et al. (1987) and Silvestre et al. (1992). This chapter attempts to present the main management issues briefly and systematically. It is limited only to the critical ones that need to be addressed in an integrated fashion over the medium term. As mentioned previously, issues that could be addressed immediately had been acted upon by various agencies during the planning process. These have been largely excluded from the plan, together with issues for which government activities are already ongoing and being implemented satisfactorily, consistent with plan goals and objectives.

MAJOR ISSUES



The main or general issue identified here is the maintenance of the quality and functional integrity of the coastal zone. Its existing and potential degradation emanates from a number of sources or can result from future activities given the country's development path. The major issues may be broadly categorized into: environmental quality, resource utilization and institutional concerns (Fig. 3.1).

It is acknowledged that cause-effect interlinkages obtain among the elements of the three major issues although these are not reflected in Fig. 3.1. For example, there is considerable overlap between environmental quality and resource utilization issues (e.g., oil spill, red tide, sectoral economic activities); the latter generically poses threats to the former. The systems presentation adopted here is intended primarily to facilitate discussion and logical interconnection of the issues with the functional program components of the plan. As will become evident, most of the issues are potential constraints and anticipate likely threats considering the country's diversification thrust. Most of the current issues are of limited scope and localized in extent, and thus are largely in their initial stages in terms of magnitude or gravity of impact.

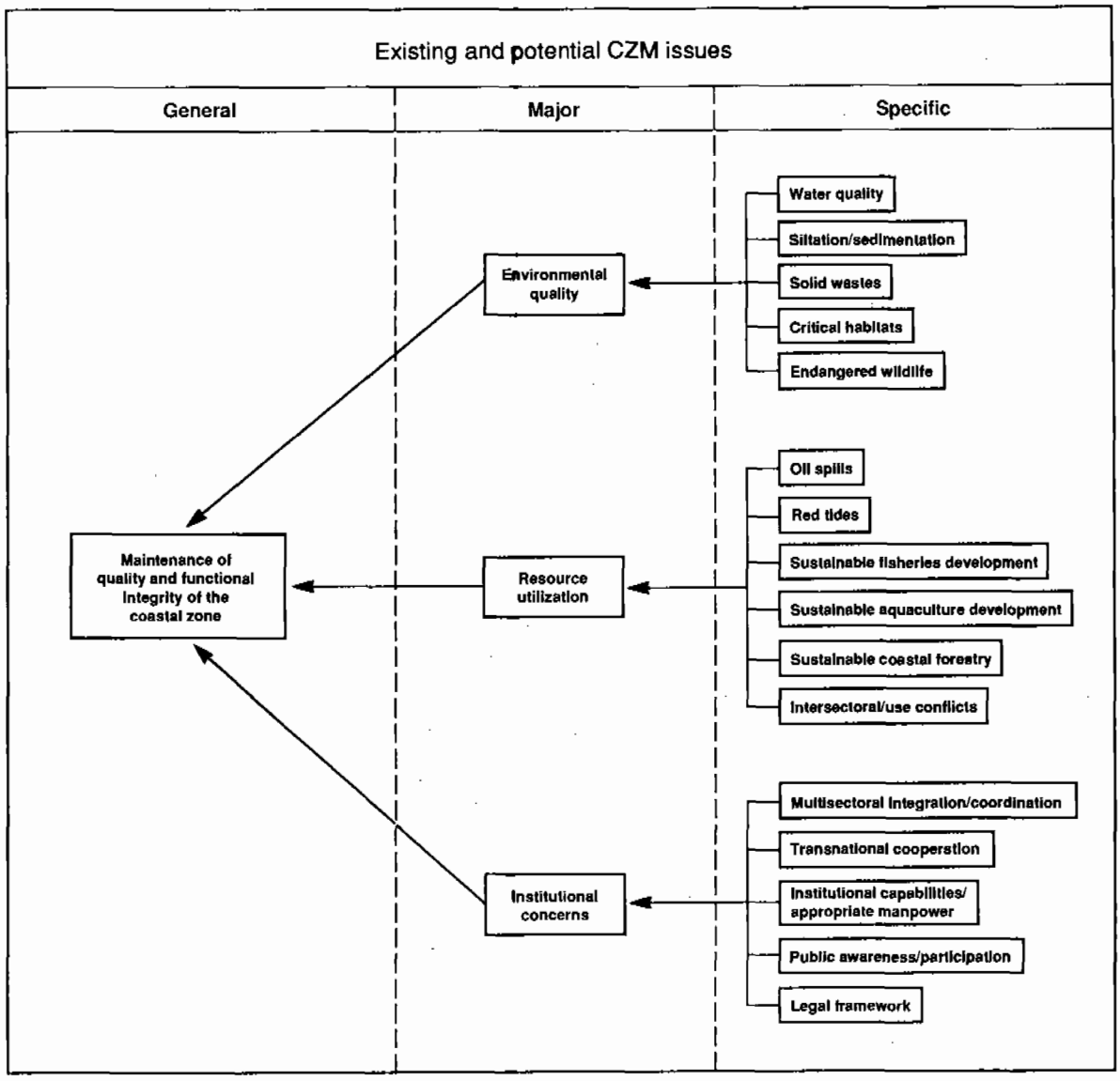


Fig. 3.1. System framework of existing and potential CZM issues in Brunei Darussalam.

Environmental Quality

These issues involve man-induced changes in the natural state of the coastal zone such as pollution, threats to critical/important habitats and rare/endangered wildlife. Coastal pollution issues were grouped into threats to water quality, siltation/sedimentation and solid wastes. Although the last two affect water quality, they are discussed separately to highlight their significance.

Water quality

The water cycle or dynamics is the most wide-ranging of factors inherent in the coastal zone. Hence, there is a variety of issues and a broad extent of impacting activities on water quality in coastal areas. In Brunei Darussalam, the major threats to water quality are the following:

- inadequately treated or untreated domestic sewage and effluents from industrial/manufacturing activities;
- agricultural runoff or agrochemical wastes (i.e., fertilizers and pesticides);
- organic loading from livestock activities;
- chronic discharges of oil and oily waste from Brunei Shell Petroleum Co. (BSP), shipping, workshops/ garages and service stations; and
- limited effluent and water quality monitoring.

Indiscriminate discharge of untreated or semitreated sewage and sullage water into rivers and coastal waters results in environmental pollution due to their high organic and bacterial loads. Domestic sewage is the largest organic pollution source in Brunei Darussalam; currently it contributes 50% of 12.2 t/day of biological oxygen demand (BOD) load discharged into watercourses. The sewerage system services a major part of the urban population and the available sewage treatment plants (STPs) largely provide secondary treatment of domestic wastes. With the anticipated population growth rates, there is a need to accelerate development of adequate sewage treatment facilities.

Industrial activities have been dominated by the oil-based sector. Onshore and offshore oil industry operations produce various types of liquid wastes. The largest quantity of wastewater generated is formation water discharged at the rate of 5 million m^3/year into Sg. Bera at a point close to its discharge point into the South China Sea. Other liquid wastes currently generated are comparatively insignificant in terms of volume and pollution load. These are from non-oil-based sources such as softdrink manufacturers and abattoirs. Estimated BOD load from industrial effluents is low at 11% compared to that of domestic wastes. This would change considerably in the near future given the government's economic diversification drive.

The estimated contribution of surface runoff to total BOD load discharged into watercourses is a high 29%. Unlike other discharges, the control of pollution resulting from surface runoff is much more difficult because of the diffused nature of contributing pollution sources. Pollutants found in non-urban runoff are mainly sediments, agricultural wastes and agrochemical residues. Principal pollutants carried in urban runoff include effluents from scattered small industries and discharges from garages, workshops and petrol stations. Chronic discharges of oily waste from ships and boats also require attention.

Livestock farming activities include those for buffalo, cattle, goat, poultry and pig. Livestock manure is highly polluting. The BOD load generation from livestock waste is 10% of the total discharged into watercourses. Other than poultry farming, very few large-scale commercial operations at present involve substantial numbers of animals. For most farms, the animals are allowed to graze freely on land. Hence, only a small proportion of generated pollution load reaches watercourses. However, effluents from an anticipated increase in commercial-scale production farms could cause very serious water pollution problems, unless adequate precautions to mitigate adverse effects are implemented.

Systematic and up-to-date data on the quality of waste discharges and watercourses are essential for proper management of water quality. Monitoring produces data which make it possible to gauge water quality and its changes with time. Water quality data are essential for classification of river and coastal waters into beneficial uses. Data on effluent quality are important for ensuring compliance with regulations. There exists a comprehensive set of water quality data for Sg. Brunei but very limited data for the other major rivers and coastal waters. The two ongoing water quality monitoring programs for coastal waters are confined to very small areas and for very specific purposes (i.e., Serasa Bay for the Muara sewage treatment works [STWs] and Brunei Estuary plus adjacent coastal waters for red tide monitoring). The Sewerage Section of the Public Works Department (PWD) monitors the quality of sewage effluents from the various STPs. The BSP monitors discharges for oil content from its tank farm in Seria and the quality of sewage at its Sg. Belait discharge point. There is none or very limited monitoring of effluent quality of non-oil-based industries, although admittedly the pollution load from these are currently not significant. Future development plans, however, require increased emphasis on monitoring of industrial effluents.

Siltation/sedimentation

Land clearing activities due to industrial and residential development have removed natural ground vegetation and exposed soils to erosional forces of wind and rainfall. Unprotected soils are eroded in due course and washed into rivers and coastal waters as silt and sediment. The doubling of suspended solids in Sg. Brunei in the past five years increases its turbidity and interferes with normal biological processes. Silt and sediment brought down by runoff from land development sites may contain heavy metals and other toxic materials which pollute coastal waters. The increased land development activities expected to occur with economic diversification require increased soil erosion control and enforcement measures.

Siltation and sedimentation of river and coastal waters also result from sand mining of beaches (e.g., Berakas), quarrying for landfill (e.g., cutting of hill areas in Brunei-Muara District) and mining of alluvial gravel deposits (e.g., Temburong Valley). Appropriate mitigation or control measures are in order, particularly with increased demand from construction activities.

Solid wastes

Solid waste disposal issues in Brunei Darussalam pertain specifically to direct garbage disposal into Sg. Brunei around the Kg. Ayer area and the littering of the beaches near Serasa, Lumut and Belait. Apart from these isolated problems, the Municipal Boards (MBs), District Offices (DOs) and private entities (e.g., BSP) have handled effectively the management of solid waste disposal. The solid waste problem in Kg. Ayer affects the country's main urban center of Bandar Seri Begawan. Appropriate solid waste collection and disposal projects and related public education activities for Kg. Ayer are for implementation during the Sixth NDP period. Pilot activities indicate that the problem can be reduced to a minimum in the very near future. Cleanup initiatives by the government have restored the beaches to their previous state. Sustained government efforts, however, relative to efficient solid waste disposal are needed given the projected increase in the country's population and scale of economic activities.

Critical habitats

A number of habitats within the coastal zone are important in enhancing its aesthetic quality and functional integrity. These include the large islands, limited (45 km^2) coral reef areas, and mangrove and coastal land forests. Apart from their direct economic contributions via the activities they support, they provide enormous environmental services which are difficult to quantify in monetary terms. Damage to these coastal habitats beyond their natural capacity to withstand stress could redound to enormous costs for environmental repair or restoration.

Endangered wildlife

The country's mangrove islands and coastal land forests harbor about four species of mammals, two of reptiles and nine of birds that are in the international list of endangered wildlife. The coral reefs support a wide diversity of fauna including 185 species distributed among 71 genera of stony corals and over 150 species of fish belonging to more than 30 families. The impact of development activities on these habitats should be considered in the light of the wildlife that should be conserved.

Resource Utilization

These issues involve the proper rate and manner of exploitation of the coastal resources such as fisheries and coastal forests. They also include specific concerns related to suitable development and management of selected coastal sectoral economic activities.

Oil spills

The potential for oil spill incidents in the coastal waters of Brunei Darussalam is quite high considering the large-scale petroleum exploration and production activities as well as tanker traffic in the area. Similar activities in neighboring Sarawak and Sabah could impact the country's coastal zone. Three major potential sources of oil spills could occur, namely:

- accidental release of oil from oil wells and underwater pipelines;
- maritime accidents due to collision, fire, explosion or grounding of ships; and
- accidental spillage on board ships or at oil terminals, or while transferring cargo from ship to shore or vice versa.

The last major oil spill incident in Brunei Darussalam was in 1971 when a drill barge sank after a blowout and fire. The oil spilled continuously for several months but drifted out to sea without affecting the coastline. Since then, only minor cases of oil spills have been recorded.

The government has now approved the draft of a National Oil Spill Contingency Plan (NOSCP) submitted by the Marine Department (MD). Prior to the approval, what was available and operational was that developed by BSP in response to spills emanating from its oil facilities. The BSP's current in-house response capability is designed for spills of no more than 5,000 barrels of oil/day over a period of three days. Any spill in excess of this will require resources within and/or outside the region. Apart from BSP, MD has limited capabilities that can combat only small spills. The urgency of developing capabilities for a National Oil Spill Contingency System (NOSCS) cannot be overemphasized. This is in view of potential negative impacts of oil pollution on the coastal environment (including important coastal fisheries and sensitive areas such as coral reefs and mangroves), as well as the associated high cleanup and social costs.

Red tides

Red tides occurred in Brunei Darussalam once in 1976 and 1980, and twice in 1988. Red tide in the country is caused by blooms of *Pyrodinium bahamense* var. *compressum*, a dinoflagellate that causes paralytic shellfish poisoning (PSP) and paralytic fish poisoning (PFP). Red tides cause losses to the fisheries industry and are a deterrent to mollusc aquaculture development.

Toxic red tides in the country are managed through several procedures that have been built into a National Red Tide Contingency Plan (NRTCP). The plan identifies appropriate actions, responsibilities and procedures in the event of red tides. It is supported by a monitoring and surveillance program that is continuously implemented by DOF and Department of Medical and Health Services (DMHS). Despite high PSP and PFP toxins recorded during occurrences of red tides, the government has been successful in preventing public health problems. This success is due to effective measures taken by authorities and public cooperation. Other issues related to effective red tide management include appropriate government support to fishermen and aquaculture ventures during red tide outbreaks; continuous refinement of contingency plan components; and further development of appropriate local manpower skills.

Sustainable fisheries development

The capture fishery resources of Brunei Darussalam have a potential yield of 25,700 t/year consisting of 500 t of shrimps, 15,400 t of demersals and 9,800 t of pelagics. With the exception of shrimps, there is a considerable potential for expansion of fishing given current exploitation levels. The DOF has launched a comprehensive plan to hasten the development of capture fisheries. The issues that need to be addressed to ensure sustainable development of the sector are as follows:

- overexploitation of shrimp resources;
- refinement of estimates of potential shrimp and pelagic yield;
- growth overfishing of shrimps and demersals from concentrated artisanal activities within Brunei Estuary;
- underutilization or discarding of low-value fish species;
- slow development and underperformance of commercial fishing operations (i.e., trawlers and purse seiners);
- elaboration of species/product cross-substitution relative to phased expansion plans for commercial fisheries;
- expansion of trawling versus use of fish aggregating devices (FADs) and fish traps (i.e., in purse seine and some artisanal operations);
- improved fisherman participation in development and management;
- enhancement of information inputs into the management process (i.e., statistical baseline, resource information and monitoring);
- reliance on expatriate manpower in commercial fishery operations;
- considerable seasonality in shrimp and fish availability and its effect on incomes of fishermen;
- disparity of preferred species for human consumption and composition of trawl catches;
- increased labor cost and living standards versus manpower availability for commercial fisheries expansion; and
- effective licensing control and monitoring of gear efficiencies.

The DOF has instituted measures in response to these issues which have to be implemented over the medium term.

Sustainable aquaculture development

Aquaculture in Brunei Darussalam is still in its infancy with operational brackishwater ponds totaling only 6 ha (all for *P. monodon* culture). Pen and cage culture is feasible in the estuaries and sheltered coastal waters, and the growing of tiger shrimps, seabass and red tilapia has been piloted. In 1991, floating cage culture of marine fish (mainly seabass) produced 10.7 t. At present, there are 7 commercial-scale floating cage culture operators each with a capacity to produce at least 12 t. The DOF anticipates accelerated development of aquaculture activities. A total of 1,530 ha are being considered for brackishwater pond culture of shrimps, and appropriate sites for pen and cage culture development have similarly been identified. Initial licenses have been released for this purpose under the Five-point

Plan of DOF. Relevant issues raised pertaining to programmed development of aquaculture include the following:

- conversion of mangrove areas to brackishwater ponds that sacrifices considerable environmental services provided by mangroves;
- impacts of water pollution, oil spills and red tides on commercial viability of aquaculture ventures;
- insecurity of land tenure;
- high development cost of ponds;
- high cost of unskilled labor and technical expertise;
- added cost associated with acid sulfate soils;
- added cost from imported inputs into aquaculture production (e.g., fertilizers, feeds, fish/shrimp seeds); and
- organic loading and agrochemical wastes from aquaculture production activities.

Relative to the first issue, only the 50-ha Pengkalan Sibabau site has considerable mangrove stands while the rest of the 1,530-ha potential sites for ponds are sparsely vegetated. Moreover, DOF has mandated a strict maintenance of a 50-m buffer of mangrove belt for all pond sites. The rest of the issues are clear challenges that need to be addressed over the medium term if aquaculture in the country is to prosper.

Sustainable coastal forestry

Coastal forestry consists of exploitation and management of mangrove and the limited land forests along the coastal strip. Coastal land forests are not exploited commercially for their products but serve important roles in containing siltation and providing habitats to wildlife. They also hold considerable potential for tourism and recreation. The main issues concerning coastal land forests include:

- frequent occurrence of forest fires;
- conversion activities into residential and other land development sites;
- localized felling for firewood and other household uses; and
- littering and isolated dumping of garbage and used vehicles.

The existing and potential issues regarding mangrove forestry are:

- conversion to aquaculture, residential, industrial and other land development sites;
- unauthorized harvesting of mangroves for construction and various household uses, particularly those fringing major rivers;
- harvesting of mangrove timber with authorized permits but without an appropriate silvicultural management scheme and active monitoring system;
- need for increased public awareness and participation in mangrove management;

- limited available research on mangrove flora and fauna, structure and dynamics; and
- limited available local expertise relative to mangrove management.

These issues need critical attention over the medium term to promote appropriate utilization of the coastal forestry potential of the country. Enforcement of forest laws and regulations is now being given high priority by FD.

Intersectoral/use conflicts

Several use conflicts are evident given existing and potential coastal economic activities. These include:

- safety and unhampered utilization of offshore oil and gas facilities given expansion of commercial fisheries and ship traffic;
- navigational or water transport hazards from increased use of FADs and fish traps;
- conversion uses of mangroves, coastal land forests and islands for residential, commercial, industrial and other land development sites;
- degree of cross-product substitution among fisheries, aquaculture and livestock activities; and
- ecotourism and recreation versus beach sand mining, mangrove utilization and fishing in coral reefs.

Appropriate measures are needed over the medium term to resolve or mitigate these issues. The foregoing covers only reconciliation of sectoral development objectives and spatial considerations in the coastal zone. Aspects related to water impacts or use have been tackled under the specific issues on water quality and siltation/sedimentation. Moreover, the institutional aspects of intersectoral use conflicts are discussed under multisectoral integration/coordination in the next section.

Institutional Concerns

This category comprises five specific issues related to existing and potential constraints to effective management of the coastal zone and resources. It covers in-country legal and institutional concerns and the need for enhanced bilateral collaboration with Malaysia to effect sustainable development of the coastal zone.

Multisectoral Integration/ coordination

The country's move to speed up socioeconomic progress demands striking a delicate balance with environmental considerations. Expansion of the non-oil-based sector implies a greater complexity of intersectoral linkages and impacts, and therefore intensified efforts to ensure compatibility or minimize conflicts in sectoral development plans and activities. Integration components fostered by the ICZM approach include policies, sectoral objectives and spatial aspects that address land-water use compatibility and optimal resource allocation.

Currently, no single agency or authority is responsible for environmental management or CZM in Brunei Darussalam. This is because environmental concerns and the need for increased intersectoral coordination are antedated by the legal and institutional system. This has resulted in, among others, the following:

- highly sectoral and inadequately coordinated development and management efforts;
- overlapping and duplication of functions; and
- problems regarding statutory mandates on CZM issues.

While various committees at different levels have been established in response to these, ample opportunity exists for a more comprehensive and properly institutionalized multisectoral approach. A more viable and responsive coordinating mechanism and appropriate actions (e.g., integrated zonation, environmental impact assessment [EIA] system) are clearly in order for implementation over the medium term.

Transnational cooperation

A number of transnational CZM issues (e.g., pollution, protection of endangered wildlife, red tides, oil spills) require regional and global collaboration. Brunei Darussalam should take active steps in this direction. The most critical issue, however, pertains to enhanced bilateral cooperation with Malaysia (particularly Sarawak) in view of the following:

- Malaysia's Limbang Plain physically separates Temburong District from the rest of the country.
- Sg. Trusan and Sg. Limbang drain into Brunei Estuary or Inner Brunei Bay from Sarawak.
- The country's coastal waters have a dynamic relationship with those of Sarawak due to their physical proximity.

Thus, it is in the best interest of both countries to collaborate for effective management of their respective coastal zones.

Institutional capabilities/ appropriate manpower

Brunei Darussalam relies on a mix of in-country and expatriate manpower resources and facilities to implement and manage its coastal zone development thrusts. There is considerable strategic and practical utility in maintaining local institutional facilities and manpower for CZM, albeit at their absolute minimum. Areas of concern include facilities and/or manpower relevant to:

- combatting oil spills and maintaining oil spill readiness;
- monitoring red tides and updating the national contingency system;
- pursuing appropriate development and support of coastal economic activities (e.g., fisheries, aquaculture, coastal forestry);
- establishing a viable coastal zone research program; and
- multisectoral/coastal environmental planning and management.

All these require appropriate financial resources and support over the medium term.

Public awareness/ participation

Public awareness on environmental issues is relatively high. There is considerable room, however, for improvement of education and awareness about coastal zone features, resources, issues and the role that the public can play. Public participation is an essential element in the success of the programs in this plan. Formal and informal education opportunities should be provided, and the assistance of NGOs encouraged with respect to the following:

- red tide contingency system;
- sewage and solid waste disposal;
- chronic discharge of pollutants;
- public role in management and enhancement of coastal activities (e.g., fisheries, beach recreation; and
- maintenance of important coastal habitats (e.g., coral reefs, mangroves, beaches, estuarine systems, islands) and wildlife.

Legal framework

Available studies on the legal framework for an integrated, multisectoral management of the coastal zone reveal that the existing legal code predates such concern and many of the existing environmental issues. Despite this, the existing legal authority is adequate to meet acceptable levels of environmental quality. The main concern, however, is that administrative agencies have hardly used the full authority emanating from broad grants of power that the laws have vested in them. Appropriate translation of laws into relevant rules and regulations should cover the following:

- water quality standards;
- effluent standards;
- EIA system/guidelines;
- sectoral and integrated zonation scheme;
- career path for scientific civil servants;
- statutory mandates for agencies concerned with environmental management and CZM;
- current exemption of government agencies from compliance with a large part of environmental laws;
- effective royalties and penalties on the use of coastal resources (e.g., fisheries, mangroves); and
- appropriate land use and tenure to spur proper development of coastal economic activities (e.g., aquaculture, mangrove forestry).

Pertinent rules and regulations should be evaluated and compiled into a Coastal Zone Management Act (CZMA) to strengthen and systematize the legal code pertaining to the coastal zone and its sustainable development.

CHAPTER 4

FUNCTIONAL MANAGEMENT COMPONENTS

This chapter gives the projects packaged into programs that need to be adopted by the government in response to CZM issues. These functional management components are presented in a manner as to facilitate logical interconnection with the issues addressed.

COASTAL ZONE MANAGEMENT PROGRAMS

Special concerns and sectoral management programs address specific issues arising from sectoral coastal activities and resource utilization. General management programs are directed at wide-ranging issues, and have multisectoral significance and impact.

A total of 17 programs are proposed for implementation over the medium term. These consist of nine special concerns and sectoral management programs and eight general management programs (Table 4.1). The first group addresses specific issues arising from sectoral coastal activities and resource utilization, as well as special concerns relevant to such activities. This includes sectoral programs on capture fisheries, aquaculture, mangrove and coastal land forest management, and special concerns on water quality, oil spills, red tides, coral/artificial reef and island management. The general management programs are directed at issues of a more wide-ranging or comprehensive nature, and have multisectoral significance and impact. These comprise programs specific to the coastal zone (e.g., research, facilities and manpower development), as well as areas impacting it (e.g., integrated zonation, EIA).

A summary of the CZM issues and the main program/s corresponding to each is given in Table 4.2. Some programs have beneficial effects in counteracting an issue apart from the main program/s designed to address it. For instance, all the general management (B1-B8) and several special concern programs (A1-A3) are vital for sustainable fisheries development. Moreover, the issue of multisectoral integration/coordination, aside from the programs listed in Table 4.2, is also addressed in the chapter about implementation arrangements. This explains the importance of the coverage of the plan programs and the need for their implementation in a systematic and integrated fashion.

Background information leading to the formulation of the programs (and projects comprising them) are given in Chua et al. (1987) and Silvestre et al. (1992), as well as in the various documents in the ASEAN/US CRMP

Table 4.1. CZM programs in this plan and their respective lead/coordinating agencies.

Management program	Program code	Lead/coordinating agency and subunit
A. Special concerns and sectoral management		
Water Quality Management	A1	PWD (MOD)
NRTCS	A2	DOF (MIPR)
NOSCS	A3	MD (MOC)
Capture Fisheries Management	A4	DOF (MIPR)
Aquaculture Management	A5	DOF (MIPR)
Mangrove Management	A6	FD (MIPR)
Coastal Land Forest Management	A7	FD (MIPR)
Coral/Artificial Reef Management	A8	DOF (MIPR)
Island Management	A9	MuD (MCYS)
B. General management		
Integrated Zonation Scheme	B1	IAC
EIA System	B2	IAC
Public Awareness/Participation	B3	MOE
Transnational Collaboration	B4	IAC
Enactment of CZMA	B5	MOL
Coastal Zone Research	B6	UBD
Manpower Development	B7	IAC
Facilities Upgrading	B8	IAC

Table 4.2. Management issues and programs in the plan for their resolution or mitigation. (See also Table 4.1).

Management issue	Major program prescription/s
A. Environmental quality	
1. Water quality	Water Quality Management
2. Siltation/sedimentation	Water Quality Management
3. Solid wastes	Water Quality Management, Public Awareness/Participation
4. Critical habitats	Coral/Artificial Reef, Island, Mangrove and Coastal Land Forest Management
5. Endangered wildlife	Island, Mangrove and Coastal Land Forest Management
B. Resource utilization	
1. Oil spills	NOSCS
2. Red tides	NRTCS
3. Sustainable fisheries development	Capture Fisheries Management
4. Sustainable aquaculture development	Aquaculture Management
5. Sustainable coastal forestry	Mangrove and Coastal Land Forest Management
6. Intersectoral/use conflicts	Integrated Zonation Scheme, Capture Fisheries, Aquaculture, and Mangrove and Coastal Land Forest Management
C. Institutional concerns	
1. Multisectoral integration/coordination	Integrated Zonation Scheme and EIA System
2. Transnational cooperation	Transnational Collaboration
3. Institutional capabilities/appropriate manpower	Facilities Upgrading, Manpower Development and Coastal Zone Research
4. Public awareness/participation	Public Awareness/Participation
5. Legal framework	Enactment of CZMA

Secretariat in DOF, Bandar Seri Begawan. The individual programs are summarized below to facilitate detailed operational and financial programming of activities by the lead/coordinating agencies. This should commence as soon as the plan is approved by the proper authorities.

A1: Water Quality Management

Background

The quality of river and coastal waters is crucial to sustain various economic activities and beneficial uses ascribed to these waters. The deterioration of water quality can entail not only serious economic losses in sectoral activities such as fisheries, aquaculture, tourism and recreation, but also considerable resources for restoration of beneficial uses and aesthetic quality. A number of existing and potential detrimental impacts on water quality in the coastal zone are evident in various degrees. These include contamination from domestic sewage, industrial effluents, livestock wastes and chronic discharges or runoff of agrochemical, oil and other wastes. Siltation and sedimentation, and to a lesser extent solid wastes, constitute additional concerns.

Objectives

The main objective of the program is to safeguard, if not enhance, the quality of the country's river and coastal waters consistent with existing and potential beneficial uses. Toward this end, the program aims for the following specific objectives over the medium term:

1. classify river and coastal waters into compatible beneficial uses;
2. adopt and enforce appropriate effluent and water quality standards, as well as a corresponding monitoring system;
3. accelerate development and upgrading of sewerage systems, particularly STWs;
4. zone industrial activities and corresponding joint waste treatment and disposal for polluting industries;
5. adopt and implement a system of collection, treatment and/or disposal for livestock wastes and nonpoint sources of water contaminants;
6. strictly implement soil erosion control measures;
7. sustain implementation of solid waste disposal projects; and
8. increase public awareness and participation to reduce adverse effects on water quality.

Description

The maintenance or enhancement of water quality requires execution of activities in this program together with those in EIA, integrated zonation and public awareness/participation. As the impacts on water quality are quite diverse and emanate from various sources, the projects in this program are

equally comprehensive in their application. Geographically, program components should cover pollution sources within the catchment basins of the four major rivers (i.e., Sg. Brunei, Sg. Tutong, Sg. Belait and Sg. Temburong) with an area of 4,260 km^2, in addition to the 9,400 km^2-areal extent of the coastal zone as defined in Chapter 1.

PROJECT A1.1: Reduction of environmental impacts from domestic wastes.

It is proposed that the government accelerate its expansion of the sewerage system and improvement of STWs. In particular, the Pintu Malim STW should be upgraded to provide secondary treatment and achieve the effluent quality of 20 mg concentration of BOD/l and 30 mg of suspended solids (SS)/l. This is due to the significant BOD and bacterial loads it discharges into Brunei Estuary. Maturation ponds for effective fecal bacteria reduction must be installed. Several STWs along the South China Sea coast, moreover, discharge treated effluents in the vicinity of recreational areas. These should be provided with long submerged sewage outfalls to convey and discharge effluents far out from shore for rapid dilution and dispersal.

Direct discharge of domestic waste into watercourses is still very common in rural and semirural areas where sewerage is not economically justified. The following corrective measures are recommended: provision of incentives for installation of appropriate sewage facilities; education programs for residents on the importance of sanitation and hygiene; use of septic tanks as a treatment system in areas where the water table is low and the soil characteristics are suitable; and regular inspection of septic tanks and similar private sewage facilities by sanitation authorities to ensure proper working order and adequate treatment. Specifically, in addition to the present on-request desludging service, a regular one should be introduced as a long-term measure. Sewage sludge must be treated so that it can be disposed of with minimal environmental impacts. The commonly used anaerobic digestion of sludge converts some organic matter to gaseous end products. The digested sludge can be used as a soil conditioner or disposed of in suitable landfills.

The proposed sewerage scheme for Kg. Ayer will make possible complete cessation of the discharge of toilet wastes into Sg. Brunei and Sg. Kedayan. The project is scheduled for implementation in the immediate future and would reduce pollutant load in the two rivers and potential health problems. The solid waste disposal system should be sustained, together with a public education campaign for residents, then extended on a nationwide scale given the projected increase in population and economic activities.

PROJECT A1.2: Zonation of industrial activities and waste treatment.

Based on the potential for causing pollution, industries may be classified into: (1) light (nonpollutive), (2) general (pollutive) and (3) special (highly pollutive) (Table 4.3). Sites for wastewater-producing industries should be away from areas where the requirement for good water quality is essential (e.g., aquaculture and ecologically important/sensitive areas). As far as practical, no polluting industries should be allowed in the Sg. Brunei catchment basin and estuarine areas. In case it is absolutely necessary to have a pollutive industry in such areas, all pollution-preventing measures, including an EIA, prior to project approval are recommended. Heavy and polluting industries should be concentrated on fixed areas (e.g., industrial estates in the Kuala Belait-Seria corridor) rather than spread out so that less of the coastal area is affected. This also makes centralized or joint waste treatment and disposal economical and feasible. Siting alternatives should be included in EIAs that will be required for any proposed industrial development.

Within industrial estates, similar industries (e.g., food manufacturing) should be sited together so that centralized wastewater treatment facilities can be set up. It may not be economically viable for small-scale industries to provide waste treatment facilities individually. However, all polluting industries should be required to provide facilities, either private or centralized, to properly treat effluents discharged. Treatment of industrial wastewater with sewage in STWs must be avoided. Otherwise, pretreatment processes are needed to remove all pollutants that cannot be eliminated by STWs or which may interfere with the biological treatment processes that STWs employ.

PROJECT A1.3: Reduction of environmental impacts from soil erosion.

Two categories of erosion control (i.e., vegetative and mechanical) currently used should be actively encouraged, together with a viable monitoring and enforcement system. Vegetative control involves provision of vegetated buffer strips to trap sediments, and temporary cover using rapidly growing plants to protect cleared areas. Mechanical control includes the use of detention basins to trap sediments and reduce runoff peaks, as well as construction of diversions or troughs to intercept and divert runoff around exposed areas. Administrative controls such as restriction of earthwork activities to drier months; imposition of limits on cleared land area and duration of exposure; and erosion control measures for beach sand mining and gravel quarrying activities must be explored and implemented when feasible.

Table 4.3. Types of industries based on their pollutive capacity.

Light (nonpollutive)
Manufacturing
Bakery products
Textile goods
Wearing apparel other than some types of footwear
Office computing and accounting machines
Radio, television and communications equipment
Photographic and optical goods (excluding films)
Watches and clocks
Jewelry and related articles of precious metal
Sporting and athletic goods except firearms, rubber and plastic products
Wooden and cane containers and cane ware
Wood and cork products
Furniture and fixtures
Containers
Printing, publishing and allied industries
Knitting mills
Pollutive
Manufacturing
Paints, varnishes and lacquers
Tires and tubes
Animal feeds
Tobacco
Carpets and rugs
Chemical products
Glass and glass products
Cocoa, chocolate and sugar confectioneries
Drugs and medicines
Mills
Grain products
Spinning, weaving and finishing textiles
Sawmills, planing and other woodmills
Shipbuilding and repair
Highly pollutive
Manufacturing
Petroleum and coal products
Synthetic resins, plastic materials and man-made fibers
Fertilizers and pesticides
Pulp, paperboard and paper
Soap and cleaning preparations
Perfumes and cosmetics
Cement, lime and plaster
Dairy products
Vegetable and animal oils and fats
Soft drinks
Petroleum refineries
Sugar factories and refineries
Tanneries and leather finishing
Iron and steel industries
Basic nonferrous metal industries
Slaughter, preparing and preserving meat
Canning and processing fruits, vegetables, fish, crustaceans and similar foods

Source: De Silva et al. (1992).

PROJECT A1.4: Mitigation of environmental impacts from livestock wastes and nonpoint pollution sources.

A system of collection, treatment and/or disposal of livestock wastes from high-density animal farms should be established. Similar efforts are in order for nonpoint sources of oil and oily wastes in cooperation with BSP and other private entities (e.g., garages, workshops, petrol stations, boat operators). Public education, particularly on the proper use of agrochemicals and promotion of viable yet environment-friendly alternatives, is essential to mitigate chronic discharges of water contaminants.

PROJECT A1.5: Adoption of water quality and effluent standards.

Brunei Darussalam should implement appropriate water quality standards for various beneficial uses of its river and coastal waters. Several government studies with suitable recommendations should be promptly reviewed, considering expanding economic activities. Lim (1992) suggests initial adoption of Malaysian standards for river waters applicable to Sg. Temburong, Sg. Tutong and Sg. Belait; Philippine standards for estuarine/coastal waters applicable to Sg. Brunei; and U.S. standards for recreational and fishing waters applicable to the country's open coastal waters. Appropriate classification of the country's water areas based on existing and future beneficial uses would facilitate adoption of national water quality standards.

Discharge or effluent standards should be set consistent with prescribed beneficial uses discussed above. Table 4.4 gives proposed standards for adoption by government based on available documents. It is suggested that discharge standards be simplified to only two classes--those applicable to discharges affecting potable water abstraction or otherwise. This is in view of various existing limitations (e.g., lack of laboratory facilities, skilled manpower and monitoring system). However, amendments to these should be made periodically to make the standards more responsive and effective in controlling pollution, and as existing limitations are overcome.

The legal basis for water quality and effluent standards should be critically examined and streamlined. Appropriate public consultation/participation in the process of standards adoption and periodic review would be helpful. The legal basis and public education aspects must be properly coordinated with the lead/coordinating agencies assigned to these programs.

PROJECT A1.6: Adoption and implementation of appropriate water quality monitoring system.

A monitoring system on the water quality of major rivers and coastal waters, as well as effluent quality from major point sources (e.g., STWs, septic tanks,

Table 4.4. Proposed effluent/discharge standards for Brunei Darussalam.

Parameter	Discharge area	
	Affects potable water abstraction	Does not affect potable water abstraction
pH	6-9	6-9
Temperature (°C)	40	40
Color	No change	Not objectionable
BOD_5	20	20
Chemical oxygen demand (COD)	150	150
SS	30	30
Total dissolved solids	2,000	2,500
Aluminum (as Al)	5	5
Arsenic (as As)	0.1	0.5
Barium (as Ba)	2	5
Beryllium (as Be)	0.5	1
Cadmium (Cd)	0.05	0.1
Chromium (as Cr^{3+})	0.5	1
Chromium (as Cr^{6+})	0.1	0.2
Chloride (as Cl^-)	500	750
Free chlorine (as Cl_2)	0.5	0.5
Cobalt (as Co)	0.1	0.2
Copper (as Cu)	0.5	0.5
Cyanide (as CN^-)	0.1	0.2
Synthetic detergents	1	1
Fluoride (as F^-)	1.5	2
Grease and oil	2	5
Hydrocarbons (as HC)	5	5
Iron (as Fe)	1	5
Lead (as Pb)	0.1	0.5
Lithium (as Li)	5	5
Manganese (as Mn)	1	5
Mercury (as Hg)	0.005	0.005
Molybdenum (as Mo)	0.5	1
Ammonia nitrogen (as NH_3-N)	5	50
Nickel (as Ni)	0.2	0.5
Nitrate nitrogen (as NO_3-N)	10	20
Nitrite nitrogen (as NO_2-N)	0.5	1.0
Total nitrogen (as N)	50	50
Phenols	0.1	0.5
Total phosphorus (as P)	30	30
Radioactive material	In accordance with limits and regulations laid down by the International Atomic Energy Agency	
Selenium (as Se)	0.05	0.1
Sulfate (as SO_4^{2-})	200	400
Sulfide (as S^-)	0.5	1
Vanadium (as V)	0.1	0.2
Zinc (as Zn)	1	2

All limits are given in mg/l except pH, temperature (°C), color and radioactive material.
Source: Lim (1992).

industries) needs to be instituted. The basic parameters to be monitored are listed in Table 4.5. Recommended monitoring frequencies are weekly for STWs and coastal waters; and monthly for rivers and industries. Water quality monitoring stations for river and coastal waters have been identified (Lim 1992). Those for industries and treated sewage sources need critical review. As the monitoring system progresses, new sampling stations may be added.

At present, several government laboratories attached to various departments are equipped for specific functions, but are fully utilized. New laboratory facilities may have to be provided particularly for the monitoring system and to enforce discharge standards. The capability for determining all parameters in Table 4.5 in a timely fashion is essential.

Agencies and administration

The lead/coordinating agency for this program should be PWD. Cooperating and/or implementing agencies should include, among others, DOF; Scientific Services Laboratory (SSL), Ministry of Health (MOH); MD; Department of Town and Country Planning (DOTCP); Agriculture Department (AD); Industrial Unit, MIPR; Land Department (LD); MBs; and DOs. Program activities related to legal mandate and public awareness and participation should be limited largely to technical inputs for consideration by lead agencies assigned specifically to these programs. It is recommended that activities related to facilities upgrading and manpower development be properly collaborated with the lead agencies tasked with overall coordination of these plan programs.

Table 4.5. Basic parameters to be monitored for various sources and receiving waters.

	BOD	COD	SS	VSS	NH_3-N	NO_3-N	NO_2-N	TP	Cl	Temperature	pH	TC	FC	HC	Heavy metals
STWs/STPs	x	x	x	x	x	x	x	x	x	x	x	x	x	+	+
Septic tanks	x	x	x	x	x	x	x	x	x	x	x	x	x	-	-
Industrial wastewaters	x	x	x	-	+	+	+	+	+	x	x	-	-	+	+
Watercourses (rivers)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	+
Coastal waters	-	-	x	-	-	-	-	-	-	-	-	x	x	x	-

VSS = volatile suspended solids
TP = total phosphorus
TC = total coliform
FC = fecal coliform

HC = hydrocarbon
x = routine analysis
+ = analysis only if suspected to be present
- = analysis not required

Source: Lim (1992).

A2: National Red Tide Contingency System

Background

Red tides occurred in Brunei Darussalam in 1976, 1980 and twice in 1988. They result in economic losses for the fisheries industry and are a considerable deterrent to mollusc aquaculture development. A monitoring system is in place and a National Red Tide Contingency Plan (NRTCP) involving various agencies is activated during occurrence of red tides. Several issues remain and require attention over the medium term, including: appropriate support to fisheries and aquaculture during red tide outbreaks; further development of local manpower skills relative to red tide concerns/requirements; expansion of monitoring system; enhanced public awareness and confidence on response capabilities; and sustained refinement of contingency plan components. Progress on these remaining issues together with elements of the current NRTCP should be incorporated into a National Red Tide Contingency System (NRTCS).

Objectives

Similar to the current red tide plan, the main objective of the program is to provide timely and adequate responses to safeguard public health and minimize economic losses during red tide outbreaks. In this effort, program activities intend to enhance the effectivity of the current plan towards the following specific objectives:

1. safeguard public health;
2. minimize resulting economic losses;
3. reduce response time; and
4. provide accurate and timely information to the public and build up confidence in the ability of authorities to mitigate red tide effects.

Description

The current red tide contingency plan has successfully averted public health problems during red tide outbreaks. Regular review and update of contingency procedures and elements as prescribed in the current plan should be continued. Close cooperation with Sabah and Sarawak authorities must be maintained. Public education and participation are indispensable to the success of any red tide contingency scheme.

PROJECT A2.1: Mitigation of economic dislocation from the outbreak of red tides.

The outbreak of red tides can cause substantial economic losses to fishermen, aquafarmers and individuals involved in the marketing chain. The economic viability of seafood production and marketing ventures can be gravely

affected and cause social dislocation. The government should examine an appropriate system of support for sectors of the population and business community affected by banning of consumption of selected aquatic products during red tide occurrences. A system of minimal livelihood allowances for workers in fish production, processing and marketing ventures should be explored, together with possible suspension of loan repayments for affected enterprises. The cost of the support system should be weighed against gains in social security and removal of disincentives to accelerated fisheries production that the government is pursuing.

PROJECT A2.2: Mitigation of impacts on seafood supply.

Per capita consumption of seafood in Brunei Darussalam at about 40 kg/person/year is one of the highest in the world. Red tide outbreaks can have adverse impacts on the supply of certain fishery products. Viable alternative (e.g., regional) sources of seafood (particularly molluscs) preferred in the country should be examined for situations when red tides persist for long periods. The list of such sources must be continuously updated, and would also prove useful in cases of oil spills that affect fish production activities and consequent supply of fishery products.

PROJECT A2.3: Development of local technical manpower capabilities.

It is in the country's best interest that local scientific and technical expertise on red tides be further developed over the medium term. Personnel should be sent abroad for graduate studies and training in advanced scientific institutions.

PROJECT A2.4: Expansion of red tide monitoring activities.

The outbreaks of red tides in Brunei Darussalam are often not accompanied by unusual water discolorations. Currently, plankton monitoring for toxic red tides is conducted every two weeks using ten stations in Inner Brunei Bay and the coastal waters in the vicinity of Pelong Rocks. The number of stations should be increased to cover the coastal waters of Belait and Tutong. The systematic sampling and testing of gills and stomachs of planktivorous fishes in the fish market should be continued. Ways should be explored to obtain samples (e.g., at landing places) for the purpose before the fishes reach the markets. A regular procedure of fish sampling and testing that is independent of the increased number of red tide organisms detected by plankton monitoring can serve as a useful second check.

Agencies and administration

The lead/coordinating agency for this program should be DOF. It has developed considerable capabilities in monitoring red tides and should continue to take a major role. Among the recommended cooperating agencies are the Department of Broadcasting and Information (DBI), DMHS, MBs, DOs and SSL. Program activities related to public education in mitigating the adverse effects of red tides should be limited to technical inputs for consideration by the coordinating agency for the public awareness/participation program in this plan.

A3: National Oil Spill Contingency System

Background

An immediate, effective response to oil spill incidents will safeguard human life and minimize environmental damage, economic losses and social dislocation.

The government has now approved the draft of a National Oil Spill Contingency Plan (NOSCP) submitted by MD. The plan outlines a system of communication, evaluation, coordination, responsibilities and action guidelines in response to oil spills. It consists of three components, namely: (a) Ports Oil Spill Contingency Plan for spills within the limits of any port in the country; (b) BSP Oil Spill Contingency Plan for spills from any operations or installations of BSP; and (c) the National Contingency Plan for spills not covered by the two other components. The NOSCP and related improvements from this program's activities should be incorporated into a National Oil Spill Contingency System (NOSCS) for Brunei Darussalam.

Objectives

Similar to the goal of NOSCP, the main objective of the program is to provide an effective response to oil spill incidents within the shortest possible time in a manner that safeguards human life and minimizes long-term environmental damage, economic losses and social dislocation. Specifically, program activities are intended to enhance the effectivity of NOSCP and incorporate gains into an NOSCS for the country.

Description

The NOSCS should cover spills within the Brunei Fishery Limits, although priority in establishing response capability is reserved for spills affecting the coastal zone. Adoption of NOSCP should receive priority attention and its improvement over the medium term needs continuous support. The potential high-risk areas from which oil spills can emanate include over 180 offshore oil industry structures and pipeline interconnections, and the ports and oil storage facilities in Belait, Muara and Seria. Sustained monitoring and enforcement of safety rules and regulations pertaining to these high-risk oil spill sources are essential. Preventive measures and contingencies will prove to be more cost-effective over the long term. Strict enforcement of the merchant shipping safety zones and fishery buffer zones around oil industry

structures is an important part of preventive measures. Moreover, other programs in this plan (particularly zonation, EIA and capture fisheries management) are useful in ensuring the unhampered operation and safety of oil industry and storage facilities.

PROJECT A3.1: Inventory of in-country and regional response capabilities.

An inventory of existing equipment, manpower and materials in the country and region is essential for determining adequate response capability levels that have to be built up. Appropriate development of in-country response capabilities should follow. Field operations in spill containment and cleanup require specialized personnel and should be built into the manpower development program. The BSP has extensive experience in oil spills and access to environmental experts worldwide. It is advisable to fully utilize this strength.

PROJECT A3.2: Oil spill trajectory field experiments and refinement.

Simulation studies of oil spill trajectories from various likely sources have been conducted under the auspices of ASEAN/US CRMP. Refinement of simulation results is in order with a critical view of the assumptions made and improvement in data inputs from field experiments. Field validation of likely trajectories (using colored dyes or plastic bobbins) for various times of the year or marine conditions is necessary. Coverage of studies must be extended to all high-risk potential sources of oil spills. Necessary adjustments in reporting, confirmation, containment, dispersal and removal guidelines should be made contingent on the results of the refinement studies.

PROJECT A3.3: Design and implementation of detailed action/response guidelines.

Decisions concerning appropriate containment, dispersal and removal measures are to be referred to an evaluating group under NOSCP. Timely response requires detailed steps and action guidelines already prepared beforehand to clarify choices for the evaluating group. These include guidelines specific to source and magnitude of spills, time of year or marine conditions, spill trajectory and speed, and impact on ecologically and economically sensitive areas. Detailed containment, dispersal (including use of chemical dispersants) and removal procedures specific to the above situations should be set and periodically reviewed. Public confidence in national response capabilities deserves attention and should be part of the public awareness/participation program.

PROJECT A3.4: Oil spill identification and reporting scheme.

The procedures for identification and reporting of oil spills should be reviewed and accurately communicated to all interested parties and the general public. These procedures must be made clear particularly to mariners, offshore oil industry personnel, port and marine authorities, and naval and air force personnel. A properly manned oil spill hotline or call number should be made known. It is imperative that communication channels among oil spill response authorities be clarified and periodically updated. The NGOs should also be informed.

PROJECT A3.5: Inventory of environmentally and economically sensitive areas.

An initial inventory to determine the composite sensitivity index (C) for the coastal areas was undertaken under the auspices of ASEAN/US CRMP (Fig. 4.1). The C scores incorporate the extent of environmentally sensitive areas (e.g., mangroves, corals, nipa swamps) and selected economic considerations (e.g., coastal population, number of fishermen, potential aquaculture area, beachfront length). The results indicate that the Brunei Estuary area is most sensitive (C=76%) followed by the Tutong area (C=68%). Detailed refinement of this inventory should encompass a wider range of ecologic-economic considerations. Appropriate cleanup and potential damage costs which are location-specific must be included in detail and updated periodically. Consideration of future uses in addition to existing activities may give a more correct assessment of potential damage and long-term effects.

PROJECT A3.6: Mitigation of economic and social dislocation resulting from oil spills.

Considerable economic losses and social dislocation can result from oil spills, depending on their magnitude and geographical impact. A suitable system of investigation procedures should include a damage inventory and confirmation scheme, claims handling procedure and immediate support to the affected population/business sectors during the course of an oil spill's impact. The legal basis and corresponding rules and regulations for claims handling and appropriate compensation need review and should be made a part of the legal framework program of this plan.

Agencies and administration

The lead/coordinating agency for this program should be MD. It has actively participated in drafting NOSCP and is the only government agency with a certain degree of oil spill response capability. Suggested cooperating agencies, among others, are PD, Royal Brunei Armed Forces (RBAF), DOF, Civil Aviation Department, BSP, DBI, Fire Services Department (FSD) and the Royal Brunei Police Force (RBPF). Public education, legal aspects, manpower

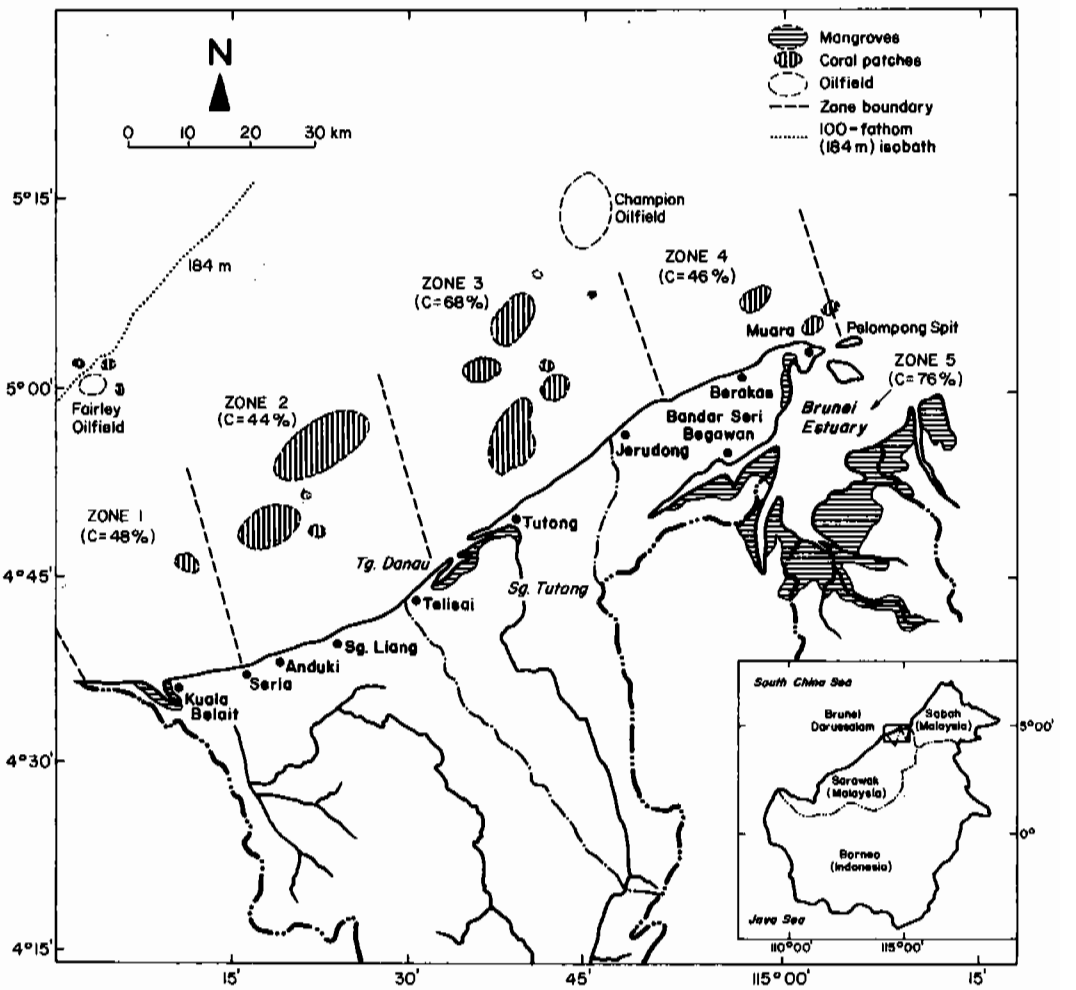


Fig. 4.1. Zone boundaries for the coastal waters of Brunei Darussalam and their composite sensitivity index (C) scores.

capabilities and development activities under the program should be coordinated with the lead/coordinating agencies designated for such programs. The integrated zonation and EIA programs in this plan are also intended to reduce the possibility of oil spills in the coastal zone and ought to be pursued parallel to activities in this program.

A4: Capture Fisheries Management

Background

The capture fishery resources of Brunei Darussalam have a potential yield of 25,700 t/year. Current marine fish and shrimp harvests of about 3,000 t/year indicate considerable room for expansion. The Five-point Plan of DOF envisions an accelerated growth of the sector, particularly commercial

fishing, and details activities toward this end. The activities in this program complement those in the Five-point Plan and address issues with potential impact on sustainable development of capture fisheries.

Objectives

Similar to the Five-point Plan, the main objective of the program is to promote sustainable development of capture fisheries for the benefit of the present and future generations of the country. In this effort, the program's activities target the following specific objectives over the medium term:

1. increase the production and efficient utilization of capture fishery resources towards self-sufficiency;
2. enhance the viability of capture fisheries and the socioeconomic well-being of participants; and
3. provide a stable supply of fish and fishery products at reasonable prices.

Description

The fishing sector is of considerable importance in Brunei Darussalam in view of current food preferences and the long fishing tradition in the country; the heavy dependence on imported fresh food supply and potential for self-sufficiency; and the economic diversification thrust of the government. Development of capture fisheries requires implementation of the projects discussed below as well as the other programs in this plan. Fisheries are usually at the downstream end of impacts from various activities in the coastal, lowland and upland areas. Programs on water quality management, integrated zonation, EIA system, oil spills, red tides and sectoral management (e.g., for aquaculture, mangroves) have wide-ranging significance in minimizing adverse influences on fisheries. The maintenance/enhancement of environmental quality is essential to the development of capture fisheries.

Given this background, the projects below delve solely on specific sectoral concerns. They broadly cover the following elements:

- resource-based management guidelines which define exploitation patterns and limits consistent with stated objectives, resource characteristics and status of capture fisheries on specific resources; and
- implementation strategies which define appropriate measures; and review of objectives and resource-based guidelines.

Details of these activities and strategies are given in Silvestre et al. (1992).

PROJECT A4.1: Shrimp fisheries management.

Available assessments (which need refinement) indicate maximum sustainable yield (MSY) levels of 350-800 t/year at 500-600 trammel net units under various rainfall regimes. Available local shrimp resources appear inadequate

to meet current demand and the country may continue to import the commodity in the future. Refinement of shrimp assessments is in order, particularly stock identity relative to other stocks in nearby Sarawak. Pending results that MSY is higher than currently estimated, it is recommended that effort levels be limited to 500 standard trammel net units. This gives maximum yield under minimum rainfall regimes. Effort reduction is mandatory and should be initiated with part-time fishermen. Full-time artisanal fishermen should be given priority in issuance of licenses. It is necessary to monitor gear design and specifications that lead to improved shrimp-catching efficiency. Requisite adjustment of the appropriate number of licenses to be issued annually should be made in this context.

Growth overfishing using *tugu* cannot be effectively solved by increasing cod-end mesh sizes due to clogging effects. It is proposed that no new *tugu* licenses be issued and that the existing units be phased out gradually through nonreplacement of older units. A five-year phase-out appears reasonable, giving enough time for operators to recover investments and other gear to take up the slack in supply.

PROJECT A4.2: Demersal fisheries management.

The estimated maximum economic yield (MEY) level for demersal resources from "accessible" and exclusive artisanal grounds within the coastal zone totals 11,900 t/year at 75.7 thousand standard trawl hours or 57 standard demersal trawlers. Harvest levels over the long term should not exceed MEY. Operating around MEY avoids uncertainties associated with harvesting resources near their maximum potential; maintains incomes and prices at reasonable levels; and is consistent with supply stability and diversification policies. Effort expansion from current levels should be done in phases that allow the resources and market sufficient time to stabilize (e.g., 4-5 boats every 3-5 years). Priority in effort expansion should be given to resources in shallower areas within the 50-m isobath. It is advisable to encourage value-added fish processing activities to reduce the volume of discards. Monitoring of gear designs and specifications should be conducted so that adjustments in standard effort units and licenses for issuance could be periodically assessed. Enforcement of a lower limit of 4.5 cm for cod-end meshes and banning of cod-end liners that interfere with fish escape are strongly recommended. Phasing out of *tugu* units will also contribute to alleviation of growth overfishing. The MEY and MSY estimates for the resources should be refined as effort expansion proceeds.

PROJECT A4.3: Pelagic fisheries management.

Available assessments indicate that pelagic resources are lightly fished overall. Potential yield of 9,800 t/year from onshelf pelagics is very preliminary

and requires confirmation by more rigorous assessments. Offshelf pelagic resources also need assessment of potential. As an initial step to guide effort expansion, a maximum harvest limit (approximating MEY) of 6,000 t/year for small pelagics and 1,600 t/year for large ones is recommended for onshelf pelagic fishing activities. Similar to demersals, expansion of effort should be done in phases to allow the resources and market sufficient time to stabilize. Close monitoring of landings will allow refinement of resource potential figures. There is considerable potential for cross-product substitution between demersals and pelagics. Thus, effort expansion on pelagics should complement that on demersals particularly since the aggregate harvest limits for both groups exceed demand up to the year 2005. Growth overfishing of pelagics need not be an issue if the *tugu* units inshore are phased out.

PROJECT A4.4: Zonation scheme to minimize sectoral and gear conflicts.

Minimizing spatial conflict among sectors and fishing gear requires attention with the projected expansion of commercial fisheries. Sectorally, the potential issues are those between commercial fisheries and oil and gas industry, commercial versus artisanal fisheries, and fisheries versus navigation. It is recommended that DOF continue strict enforcement of the ban on commercial fishing activities within 3 nautical miles of the shoreline and within a 1-nautical mile radius of any oil industry structure and navigation cautionary area (Fig. 4.2) to prevent potential conflicts. Note that coral reefs are effectively protected as they are treated as navigation cautionary areas.

The issues on gear/technological conflicts concern (1) trawling versus the use of FADs and (2) trawling versus the use of fish traps. Restriction of the use of FADs within the 1-nautical mile limit off pipelines (exclusive of oil platforms and other structures) and coral grounds should be explored. This gives purse seiners and artisanal fishermen using FADs enough grounds without interference to trawling. Moreover, restriction of deployment of fish traps within the exclusive artisanal grounds (from the coast to 3 nautical miles offshore) and 1-nautical mile limit off pipeline/coral grounds should be examined. All FADs and fish traps must be properly marked and set only in designated areas to preclude danger to navigation and expanded trawling activities.

PROJECT A4.5: Streamlining of extension and information services.

The programmed effort expansion requires formation of fishing associations and expanded information and extension services to the private sector. Several units within DOF perform extension functions, particularly the Fisheries Business Promotion Unit created in November 1990. The various extension activities should be centralized under a single unit manned by qualified extension service officers. Such would have to emphasize service delivery and attainment of targets set in the Five-point Plan.

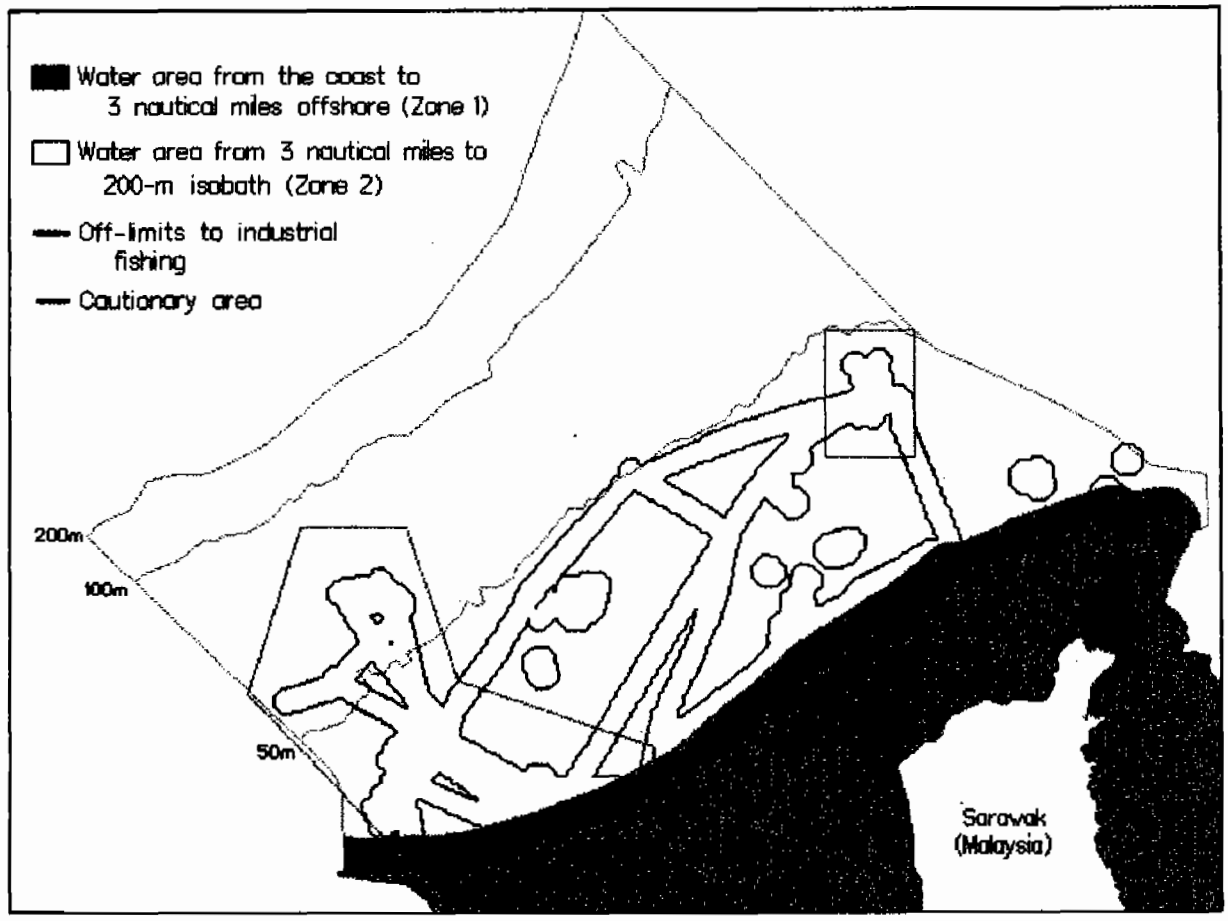


Fig. 4.2. Distribution of areas where commercial fishing (trawlers and purse seiners) is prohibited due to the presence of oil industry structures, navigation cautionary areas and exclusive artisanal fishing grounds (coast to 3 nautical miles offshore).

PROJECT A4.6: Improvement of inputs to management decisionmaking process.

Three sets of activities are envisioned in this project, namely: (1) improvement of available statistical baseline; (2) establishment and operation of a fisheries assessment group; and (3) establishment of a fisheries management council. Currently, several units routinely collect statistics and estimation of total catch/landings is problematic. A small Statistics Unit under the office of the director of DOF is required to publish historical data and annual statistics in a suitable format; design and implement a new statistical data collection system to improve and streamline the existing one; and computerize the available statistical data base.

A fisheries assessment group is essential to: improve the timeliness and reliability of biological/management advice; monitor and refine assessments on the major resource groups; conduct ecosystem/multispecies fisheries

research; address information gaps about the resources; and make socio-economic studies of consequence to resource allocation, social equity, market efficiency and cross-product substitution.

A fisheries management council with advisory functions to the director of DOF will ensure a wide consultation in the management process. Artisanal and commercial fishermen's associations, producers, marketing and consumer groups, the academe and concerned agencies should be represented. This formal consultative process will improve feedback from affected sections, data collection, law enforcement and overall program implementation. Periodic review of guidelines versus objectives is best addressed within the framework of the management council.

PROJECT A4.7: Increased efficiency in utilization of resources.

Efficient utilization of fishery resources is constrained by: (1) the disparity between preferred species for human consumption and species composition of trawl catches (given the projected expansion of this sector) and (2) the high seasonality of shrimp, pelagic and (to a lesser extent) demersal resource catches/availability and its effect on incomes and fish prices. Reduction of discards through value-added fish processing activities is recommended. Moreover, the feasibility of canning and/or storage facilities should be studied to complement commercial fisheries development.

PROJECT A4.8: Development of specialized manpower skills.

The lack of qualified manpower for some specialized tasks would require reliance on expatriate experts in the immediate future. A scheme for the development of local expertise is clearly urgent. For management and extension activities, local staff need to be trained in the following fields: resource economics, stock/resource assessment, information, fishing gear/boat technology, fish processing technology, extension services and aquatic ecology/environmental management.

Private sector manpower needs are also a prime concern due to the projected expansion of the commercial fisheries sector. Currently, most of the crew of trawlers and purse seiners are expatriates from Malaysia and Thailand. Apart from the challenge of attracting local youth, a training program to provide locals with sufficient skills is necessary over the medium term to facilitate programmed sector development. Efforts towards this end have been initiated but require more effective implementation and continuous support.

PROJECT A4.9: Mitigation of the effects of rising labor costs.

Accelerated development activities in other economic sectors are bound to reduce manpower availability in the fisheries industry. Currently, the number of fishermen is on the decline due to more comfortable, land-based alternatives. The effect of rising labor costs and standards of living on the programmed expansion of commercial fisheries should be evaluated and remedial measures formulated. The ultimate solution is maintenance of high economic efficiency of fishing operations to allow fishing incomes to compare favorably with those in other sectors. Operators need to be organized to ensure that imported inputs (e.g., gear, spare parts) and services (e.g., vessel and equipment repair and maintenance) are readily available at reasonable cost. Proper combination of capital intensity and access to skilled expatriate labor for fishing operations needs to be explored. Vertical and horizontal integration measures to increase efficiency must be studied.

Agencies and administration

The prospects for sustainable development of the capture fisheries of Brunei Darussalam are bright. It is in a very favorable position compared with other countries in the region where overcrowded fisheries are common. This is due in large part to efforts of DOF, designated as lead/coordinating agency for this program. Cooperating agencies should include, among others, MD, RBAF and Flotilla, RBPF, PWD and Universiti Brunei Darussalam (UBD). Activities covering public education, legal basis (e.g., for zonation elements) and manpower development should be coordinated properly with lead agencies assigned to these programs.

A5: Aquaculture Management

Background

Aquaculture is programmed for accelerated development in Brunei Darussalam and potential sites for this purpose have been identified. Those located in the coastal zone are 1,530 ha for brackishwater ponds, 16 ha of deep brackishwater areas for floating cage culture, and 6 ha of shallow brackishwater areas for bottom cage and pen culture. Species of interest are the tiger and white shrimps for pond culture, and the tiger shrimp, sea bass and tilapia for cage and pen culture. The Five-point Plan of DOF details various extension and support activities for its aquaculture thrusts. Activities in this program are intended to complement those of the Five-point Plan and address potential concerns with impacts on sustainable development of aquaculture.

Objectives

Similar to that of the Five-point Plan, the program's main objective is to promote sustainable development of aquaculture in the country for the maximum benefit of the people and their progeny, aided by these specific objectives:

1. promote the culture of commercially important species using appropriate aquaculture systems in suitable areas;
2. provide appropriate start-up and operations support to both small- and commercial-scale aquaculture ventures;
3. facilitate reliable supply of fry, feeds and other inputs for ease of operations; and
4. promote the profitability, growth and security of aquaculture projects via provision of necessary incentives at various stages of operations.

Description

Sustainable development of aquaculture requires implementation of related programs in this plan (e.g., integrated zonation, water quality management, red tides, oil spills, EIA system). Efforts over the medium term in pursuit of the four specific objectives are already incorporated in the Five-point Plan. Thus, the projects below address equally significant concerns for integration into DOF activities.

PROJECT A5.1: Mitigation of environmental impacts from aquaculture.

Aquaculture activities could result into severe pressure on water quality unless proper measures are implemented. Organic loading and agrochemical wastes (e.g., fertilizers, pisciscides, pesticides) can impact capture fisheries and recreational activities in the coastal zone. Appropriate effluent standards for aquaculture discharges need to be enforced. Proper dilution and waste treatment facilities should be incorporated into aquaculture development projects. As the proposed development is clustered around specific areas, centralized treatment schemes could render them cost-effective. A suitable system for monitoring compliance should be effected.

Adequate training of aquaculture personnel on appropriate levels and application of feeds, fertilizers and agrochemicals should be sustained to mitigate water quality impacts. Optimal and cost-effective feeding systems for cage and pen culture activities could be installed to minimize waste and organic loading.

While potential sites being developed have minimal impacts on mangrove forests, future pressure for conversion of additional areas brought about by the success of aquaculture projects could create problems. Valuation studies on long-term cost of mangrove conversion should be initiated as soon as possible in anticipation of future pressure.

PROJECT A5.2: Development of local manpower skills.

Given the lack of aquaculture tradition in the country, technical expertise in aquaculture projects in both government and the private sector is highly dependent on expatriate manpower. While advantageous in the initial stages, it is in the country's long-term strategic interest to develop its local pool of experts. This is particularly significant for the government sector that envisions sustained support for small-scale producers and is responsible for long-term aquaculture development. Possible areas of expertise needed are finfish and shrimp nutrition, disease control, hatchery production and aquaculture systems.

Economic efficiency of operations is the ultimate solution to increasing competition for, and cost of, labor in the country. Appropriate combination of capital inputs and expatriate labor in production activities need careful study.

PROJECT A5.3: Development of support activities.

The DOF is currently operating facilities (e.g., hatchery for fish/shrimp seeds) in support of aquaculture development. Tapping local sources of other aquaculture inputs such as feeds, fertilizers and agrochemicals will reduce production costs. The private sector, particularly the incoming large-scale commercial ventures, should be encouraged to take over from the government these support activities for small-scale producers. This should be more cost-effective in the long run.

Agencies and administration

The lead agency for this program should be DOF. Program activities need to be incorporated into the aquaculture elements of its current Five-point Plan. Cooperating agencies would be the Establishment Office of the Ministry of Labor, PWD, MD and DOTCP. Activities related to manpower development and legal basis should be properly coordinated with lead agencies designated for these programs.

A6: Mangrove Management

Background

The mangrove forests of Brunei Darussalam are exploited for charcoal, poles and other beneficial uses. Mangroves constitute an important coastal habitat for wildlife and provide considerable environmental services (e.g., land protection from erosion, contribution to water productivity, protection of water quality). A number of activities (e.g., aquaculture, residential and industrial site development) and use pressure (e.g., unauthorized harvesting) present existing and potential adverse consequences on the country's mangrove forests. This program's activities over the medium term address these issues.

Objectives

The main objective of the program is to promote sustainable development of the mangrove resources of Brunei Darussalam to optimize benefits to its present and future generations. In efforts toward this, the program pursues the following specific objectives:

1. preserve mangrove systems needed for the protection of genetic resources and biological diversity and as sources for restoring areas where management has failed or accidents have occurred;
2. conserve mangrove resources (plants, animals, physical space or land) for the maximum benefit of the people; and
3. minimize or avoid conversion uses (e.g., housing, aquaculture, agriculture) that eliminate mangrove resources.

Description

The programs on water quality management, EIA system, integrated zonation, island management and aquaculture development are essential to sustain mangrove forests and should be implemented in conjunction with the activities in this program.

An appropriate mangrove zonation scheme should integrate various uses based on the resource's particular characteristics, and consider existing and potential land uses.

PROJECT A6.1: Zonation scheme for mangrove areas.

Given their limited area and vulnerability to development pressures, mangrove areas should be zoned in a way that would integrate various uses based on the mangroves' particular characteristics and consider existing and potential land uses. Under the auspices of ASEAN/US CRMP, a mangrove use zonation scheme (Zamora 1992) proposes to allocate the 18,418-ha mangroves of the country as follows:

- 58% (10,686 ha) for conservation and environmental protection (i.e., ecologic);
- 41% (7,533 ha) for wood production (poles, charcoal) on a sustainable basis (i.e., ecologic-economic); and
- 1% (199 ha) for conversion uses into brackishwater aquaculture and human occupancy (i.e., economic).

The distribution of the major zones is given in Fig. 4.3. Refinement (where necessary) and adoption of the zonation scheme should receive urgent priority. Examination of the legal basis and pertinent rules and regulations applicable to each zone is needed. A silvicultural management scheme where deemed necessary for the wood production areas ought to be designed and implemented. Cabahug and Garces (1992) make specific recommendations for incorporation into a silvicultural scheme. Clear designation of zone boundaries need to be made, approved and properly communicated to all affected parties. Denuded mangrove areas should be replanted with emphasis on river embankments and overexploited production areas.

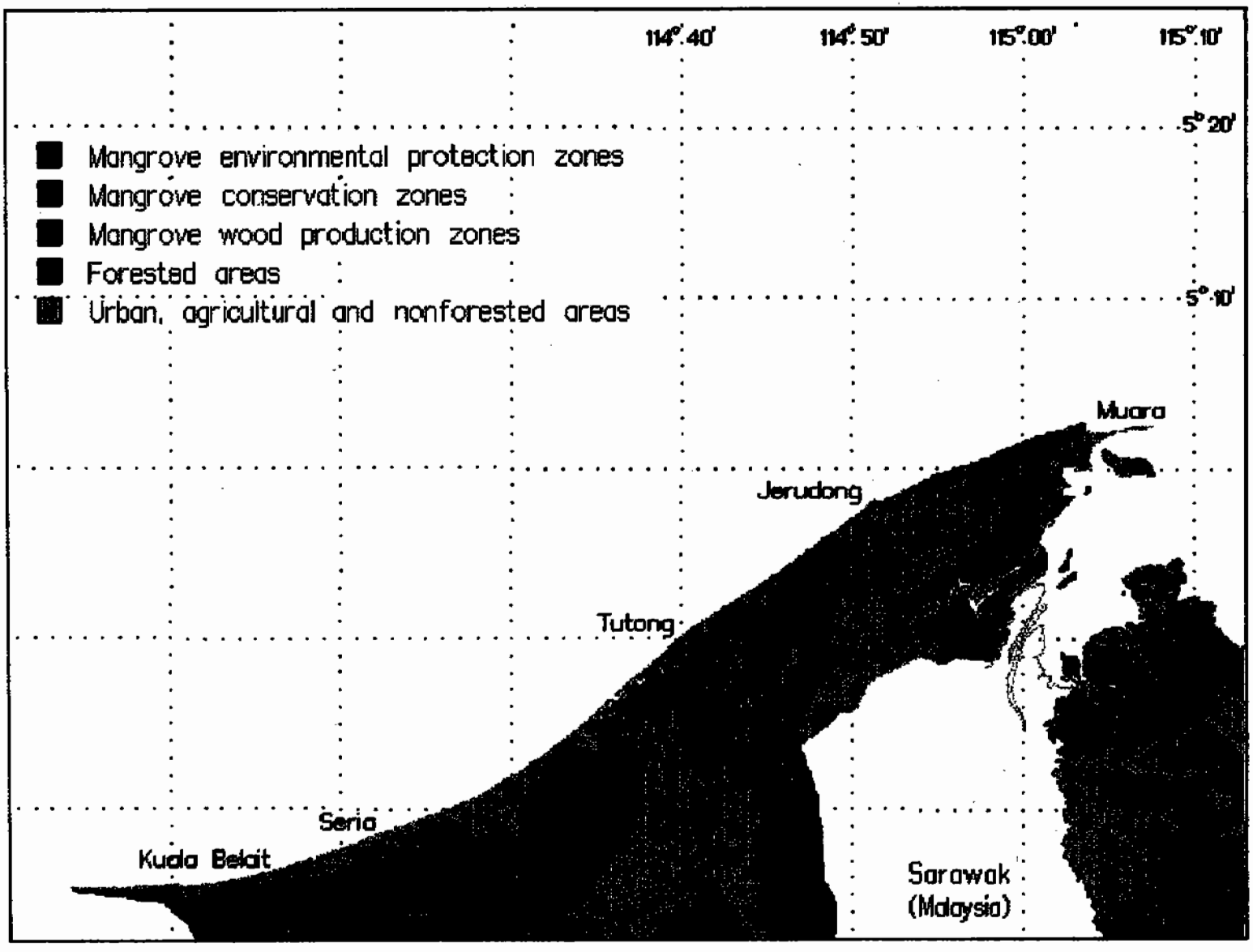


Fig. 4.3. Distribution of mangrove zones as defined in the mangrove zonation scheme for Brunei Darussalam.

PROJECT A6.2: Appropriate monitoring scheme for mangrove areas.

Immediate threats that need to be monitored and checked are: (1) conversion of mangroves into residential and industrial sites and (2) illegal cutting of mangroves near the embankments of Sg. Brunei and other major rivers. These can cause significant undesirable effects on the mangroves and nearby systems, and depletion of mangrove resources. Systematic, periodic monitoring surveys by land (vehicle), water (boat) and air (helicopter) with ground verification are recommended. These will ensure observance of the zonation scheme and activities consistent with it, as well as compliance with specifications stated in the timber licenses in production zones.

PROJECT A6.3: Increased public awareness on mangrove ecosystem.

Information should be disseminated on the ecologic and economic importance of mangroves; objectives and regulations on resource utilization, development and management; and mangrove ecosystem conservation. Increased public awareness enhances sustained use of mangrove resources for the benefit of a greater number of users. A three-pronged scheme should be employed to deepen knowledge and appreciation of the mangrove ecosystem, namely:

- multimedia audiovisuals;
- in-depth education via lectures and *in situ* dialogues/workshops; and
- mangrove-based facilities (e.g., trails, park/picnic grounds, mangrove preserve models).

Priority targets should be communities in or around mangrove areas, mangrove resource users, resource planners and implementors, and enforcement personnel.

PROJECT A6.4: Development of appropriate local manpower.

Technical and scientific manpower to undertake program activities is inadequate. Research work requires advanced degrees in biology of important mangrove flora and fauna, mangrove ecology, and resource economics and sociology with emphasis on mangrove ecosystems. A background in EIA and mangrove ecology is necessary for those charged with monitoring work. While expatriate manpower may be utilized, it is in the best interest of the country to develop local capabilities on mangrove management and the above disciplines.

PROJECT A6.5: Sustained research on mangrove ecosystem.

There has been very little research on the biology of mangrove flora and fauna and the ecology of mangrove forests in Brunei Darussalam. Some studies are planned by the Brunei Museum (BM) and UBD. However, much remains to be done and sustained efforts are needed. Areas of concentration are:

- basic systematic surveys on the full range of mangrove flora and fauna to provide a thorough understanding of the whole ecosystem;
- structure and dynamics of the mangrove ecosystem to characterize internal energy cycle; contribution of mangrove plants, algae, runoff and others to the detrital cycle; and types and residence times of nutrients in the system;
- qualitative and quantitative studies of mangrove links to inshore fisheries; and
- appropriate silvicultural practices and management of mangroves in the local context.

Agencies and administration

The lead/coordinating agency must be FD. The program needs priority in the medium term and EIA should be carried out for any conversion use. Cooperating agencies proposed, among others, are DOF, AD, DOTCP, LD, BM, UBD, RBAF and DBI. Activities pertaining to public awareness/participation, manpower development, legal basis and research should be properly coordinated with the lead agencies designated for these programs under the plan.

A7: Coastal Land Forest Management

Background

The coastal land forests of Brunei Darussalam are not exploited commercially but serve important ecological functions in controlling siltation/sedimentation of coastal waters and as wildlife habitats. Recreational facilities are also situated there. Frequent forest fires, conversion uses, localized household use and littering are specific issues affecting the coastal land forests.

Objectives

The main objective is to preserve and conserve the coastal land forests of Brunei Darussalam to maximize their ecological role in the coastal zone. In support of this, the program aims to mitigate conversion uses of coastal land forests. Other specific objectives are embodied in the projects under this program.

Description

Program activities are envisioned for implementation parallel to other programs in this plan. Integrated zonation, islands management, mangrove management and EIA system (together with monitoring and enforcement schemes under these programs) are essential in restricting conversion uses of coastal land forests.

PROJECT A7.1: Rehabilitation of coastal land forests.

A rehabilitation scheme for fire-razed coastal land forests is essential. The concept of adoption of specific strips of forests by government agencies and private groups for this purpose should be applied. Provision of planting materials and technical supervision of replanting activities, however, are best handled by the lead agency for the program. Shifting cultivators should be actively discouraged.

PROJECT A7.2: Improvement of reporting system on forest fires.

A viable and responsive system for reporting forest fires has to be established. Telephone facilities along the coastal road should be installed, and specific call numbers of the agencies with firefighting capabilities (e.g., FSD, BSP) given to the public and concerned government agencies. The assistance of the latter, such as RBAF, RBPF and Flotilla that conduct regular reconnaissance activities would be beneficial.

PROJECT A7.3: Public awareness and participation in management of coastal land forests.

A multimedia campaign on the significance of coastal land forests and threats to them would help attain project objectives. Public awareness and participation in minimizing littering, garbage dumping, forest fires, indiscriminate felling and other adverse impacts should be emphasized. Publicized call numbers for reporting forest fires would facilitate prompt relay of information and response.

PROJECT A7.4: Regular monitoring of coastal land forest condition.

The government agencies concerned have creditably maintained the aesthetic quality and functional integrity of a large part of the country's land forests. A suitable system, however, of calling their attention to localized instances of deterioration would help considerably. Adoption and periodic monitoring of specific strips of coastal land forest by government agencies and private groups should be explored as a cost-effective alternative to regular surveys by the lead agency for the program.

Agencies and administration

The lead agency should be FD. Recommended cooperating agencies are LD, AD, RBAF, RBPF, FSD, BM, UBD, DBI and BSP. Public education activities should be limited to technical inputs for incorporation by the lead agency designated by the plan for such a program.

A8: Coral/Artificial Reef Management

Background

Brunei Darussalam has limited coral reefs of about 45 km^2. The reefs are mostly in near-pristine state and have not been used for commercial purposes such as fisheries, coral extraction, tourism or the aquarium fish trade. Coral reefs are noted for their high biodiversity; contribution to coastal fisheries due to their high productivity; role as nursery and breeding grounds for many valuable species; and as sources of medicinal materials. For their part, artificial reefs enhance the productivity of coastal fisheries. The DOF has embarked on the deployment of artificial reefs to discourage incursion by commercial vessels into exclusive artisanal grounds. It is actively investigating the potential for ecotourism and sportfishing in selected coral and artificial reef areas.

Objectives

Similar to the thrust of DOF activities, the main objective of the program is to maintain and/or enhance the aesthetic quality and functional integrity of the country's coral reefs. In this effort, the program aims to achieve these specific objectives over the medium term:

1. preserve and conserve natural coral reefs within the coastal zone;
2. promote activities consistent with (1) above; and
3. enhance coastal productivity through a rational artificial reef development scheme.

Description

Activities in this program are targeted to be implemented concurrent with the other ones in the plan. Of particular significance are those for integrated zonation, EIA, oil spills, water quality and fisheries management.

PROJECT A8.1: Zonation scheme for coral/artificial reefs.

The 1-nautical mile buffer zone around coral reefs banning commercial fishing effectively protects them from fishing impacts. Artisanal fishing activities in reef areas should also be prohibited. As the deployment of artificial reefs is programmed around patch reefs, these will also be well protected. Classification of the country's coral reefs into areas for preservation/conservation, protection and limited use is proposed, with appropriate guidelines for permissible activities under each category. Marine parks should be designated

and pertinent regulations formulated and enforced accordingly. Ecotourism could be encouraged in marine parks, and sportfishing using solely hook-and-line gear allowed only in specified limited-use coral/artificial reefs. The use of FADs and fish traps in assigned areas (limited to the periphery of the 1-nautical mile radius around reefs) should discourage commercial fishing incursions into the buffer zones. The legal basis of the zonation scheme and related regulations need proper attention.

PROJECT A8.2: Sustained artificial reef development scheme.

The establishment of artificial reefs/habitats employing used tires and discarded oil rigs is commendable and should be sustained. These structures have been proven to be effective means of enhancing the fisheries productivity of coastal waters. Priority areas for deployment of tire structures are patch reefs such as Pelong Rocks, Scout Patches and Victoria Patches. A long-term artificial reef development scheme should be detailed to indicate areas for putting up structures, their use status and related guidelines. Discarded oil rigs can continue to be located in depths of 18-22 m with the broader side resting on the sea floor, away from existing patch reefs. All artificial reefs should be placed in areas where they do not pose hazards to navigation and consistent with allotted uses of water space in the coastal zone.

PROJECT A8.3: Promotion of sportfishing and ecotourism.

The potential of designated limited-use coral/artificial reefs for recreation and sportfishing (restricted to hook-and-line) should be tapped. The presence of large, highly valued game fishes around reefs would boost this thrust. Ecotourism in appointed preservation/conservation areas is also a good idea, but best limited to diving activities. Research and educational activities in reefs could be encouraged to promote public awareness and appreciation, with appropriate guidelines.

PROJECT A8.4: Coral/artificial reef monitoring scheme.

A systematic and regular monitoring scheme for coral/artificial reefs using standard transects and methodologies is proposed. Chou et al. (1992) give detailed recommendations. Data generated would provide a more comprehensive knowledge of reef structure, dynamics and role in coastal productivity. From this, the zonation scheme and related guidelines should evolve. Adjustments in the artificial reef development scheme could also be made accordingly.

PROJECT A8.5: Public awareness on coral/artificial reefs.

Three sets of activities are envisioned under the project, namely: (1) multimedia campaign on the importance of, and impacts on, reefs; (2) lectures and other presentations to give a deeper understanding of the nature and significance of reefs; and (3) organized *in situ* activities to enhance public awareness and appreciation. The aquarium of DOF could also be fully utilized in this context. Heightened public awareness should minimize potential undesirable impacts on the country's limited reef areas. Priority target groups should be fishermen, mariners, watersports enthusiasts, enforcement personnel, and decisionmakers in government and private entities.

Agencies and administration

The lead agency for this program should be DOF. Cooperating agencies proposed include MD, RBPF, RBAF, BM, UBD and BSP.

A9: Island Management

Background

Of the 33 islands in Brunei Darussalam, 2 are found offshore (Pelong Rocks and P. Punyit) and the rest are in Inner Brunei Bay or the major rivers. Only 3 of the islands are inhabited and majority of the remaining ones are in near-pristine state. Most of the inshore islands are fringed with mangroves, mudflats and swamps, and some are covered by undisturbed primary forest. The fauna and flora of most of the islands are significantly different from those of the mainland. Some harbor endangered wildlife and provide undisturbed breeding sites for them. Most of the islands may come under increased human interference and better management is clearly in order.

Objectives

The main objective of the program is to promote sustainable development of the islands in the coastal zone of Brunei Darussalam for the optimum benefit of present and future generations. This is supplemented by specific objectives over the medium term as reflected in the projects to be undertaken.

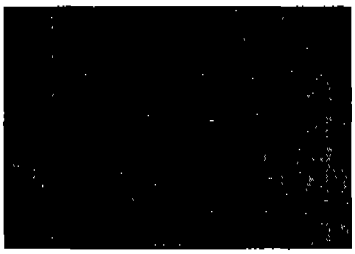
Description

This program's activities should be effected simultaneous with those of other programs in this plan. Integrated zonation, EIA system and mangrove management are essential for the successful attainment of program objectives. Specifics are discussed at length in Agbayani et al. (1992).

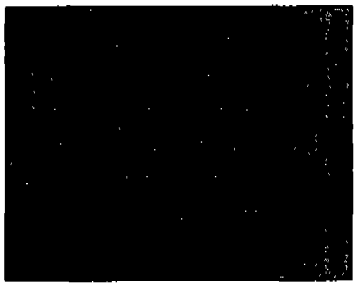
PROJECT A9.1: Adoption of use classification for coastal islands.

Only three coastal islands (Berambang, Berbunut and Baru-Baru) have permanent human settlements. Although uninhabited, many of the remaining

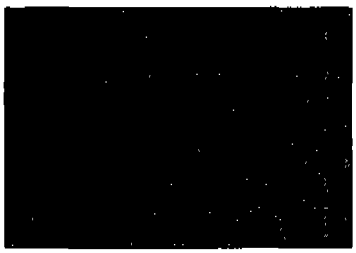
islands are subjected to human interference of varying degrees. Disturbed islands and those earmarked for specific development require environmental protection in keeping with existing or planned activities. Undisturbed islands which harbor rare/endangered species and known for their biodiversity and genepool contribution need maximum protection.



Based on these considerations, a preliminary classification of the islands is proposed for adoption. The major categories are: (1) general use, (2) conservation and (3) protection. With the lowest protection status, islands for general use should be designated for multiple purposes such as recreation and education. Two islands (Muara Besar and Baru-Baru) fall under this category. They should be zoned according to compatible activities and their natural attributes used optimally. Guidelines pertaining to pollution and overexploitation would be helpful.



Islands for conservation could be used for ecotourism, education and research with emphasis on rationally managed exploitation of resources. Ten islands (Pelompong, Berbunut, Chermin, Berambang, Luba, Pelong Rocks, Selirong, Batu Mas, Langsat and Amo) are proposed under this category. Careful planning and zoning are necessary to ensure that natural resources, particularly flora and fauna, are managed sustainably. Inhabited and partly private islands should possess buffer zones of adequate size to prevent disturbance of endangered wildlife (e.g., proboscis monkey) and their habitats.



Islands for protection should be preserved by virtue of their biodiversity, near-pristine state and the presence of endangered species. The rest of the 21 islands in the coastal zone are recommended for this category. Only minimal disturbance for restricted scientific research and monitoring purposes should be allowed with appropriate guidelines.

Adoption of use classification for the islands; guidelines consistent with their designated functions/uses; and the legal basis for these, are top priority. Alterations in use status should be entertained only when covered by appropriate EIAs indicating negligible impacts.

PROJECT A9.2: Research and monitoring scheme for coastal islands.

Very little research has been done on the coastal islands and the fauna, flora and status of many islands are unknown. Research efforts should be encouraged with emphasis on fauna and flora, endangered wildlife, and structure and dynamics of the islands. Priority must be given to existing or planned activities and impacts on the protection status of the islands. Data are necessary for planning, zoning and adoption of guidelines for islands designated for general use and conservation.

A regular monitoring and enforcement scheme is required to ensure compliance with the designated status of coastal islands and related guidelines. The monitoring activities should be designed systematically to complement those of research. The concept of adoption of individual islands by government agencies and concerned private groups could be considered to facilitate monitoring and enforcement activities.

PROJECT A9.3: Public awareness on coastal islands.

The level of public awareness and appreciation of the nature and importance of coastal islands could be raised through a multimedia campaign. More in-depth education activities are ideal (e.g., lectures, *in situ* trips) for target communities on or adjoining coastal islands, enforcement personnel and agencies/groups interested in adopting individual islands. Government efforts in classifying, zoning, researching on and monitoring the islands should be communicated to the public.

Agencies and administration

The lead/coordinating agency should be the Museums Department (MuD). Cooperating agencies recommended are FD, BM, UBD, LD, MD, RBPF and DOTCP. Activities of the program covering legal basis, research and public education must be properly coordinated with lead agencies designated in the plan for these programs.

B1: Integrated Zonation Scheme

Background

Spatial integration via zoning of activities will address development needs, environmental/ ecological integrity, optimal resource use and allocation, and marine to upland compatibility.

There are multiple uses of land and water areas in the coastal zone which compete for space and may be incompatible with each other. Moreover, activities in the coastal zone impacting area (covering the catchments of the major rivers) can have adverse effects on land and water uses in the coastal zone. This program promotes spatial integration via zoning of activities to address development needs, environmental/ecological integrity, optimal resource use and allocation, and marine to upland compatibility. Zonation is a valuable integration tool as it forces planners, the government machinery and the public to catalogue available resources. Furthermore, it clarifies priorities, allowing for orderly and planned utilization of resources to prevent or minimize conflicts.

Objectives

The main objective of the program is to promote sustainable development of the coastal zone and resources in a manner that optimizes benefits for present and future generations and minimizes/prevents incompatibilities and conflicts. In this effort, the program's specific objectives are fleshed out in its three projects.

Description

Activities under this program are intended for implementation at the same time as the other ones in this plan. Programs of particular relevance include EIA, CZMA, and the various sectoral programs (e.g., fisheries, mangroves, coastal land forests) and special concerns (water quality management, island management, coral/artificial reefs).

PROJECT B1.1: Adoption of zonation scheme for the coastal zone.

The various special concerns and sectoral management programs presented above incorporate specific zonation components for adoption and implementation. Fig. 4.4 summarizes some of the elements of the zonation scheme covering land and water uses in the coastal zone, such as those related to mangrove zones, industrial sites based on pollutive capacity, aquaculture areas, fishery and coral reef buffer zones, and navigation cautionary areas. These elements need refinement; in particular, overlaps and incompatibilities require resolution. Other elements for consideration are given in the contributions in Chua et al. (1987) and Silvestre et al. (1992). Appropriate guidelines and enforcement mechanisms for the zonation scheme should be in place, their legal basis and related regulations reviewed and streamlined. Extensive consultations with stakeholders and the public are indispensable to the process. Appropriate public education and participation need sustained support for facility in adoption and success of the zonation scheme.

PROJECT B1.2: Adoption of zonation scheme for the coastal zone impacting area.

Zonation of activities in the coastal zone impacting area (covering the catchments of major rivers) is important to minimize adverse downstream effects on the coastal zone. The forest, agriculture, development, protection, reserve, river navigation, human settlement and urban-industrial zones need attention. Found in the structure/master plan for the country, the elements of the zonation scheme should be reviewed and refined with regard to their consequences on activities in the catchment basins and coastal zone. The structure/master plan itself must be adjusted when necessary. Mitigating and preventive measures to counteract negative impacts have to be detailed in cases where modifications in siting are not plausible. Appropriate guidelines for the various zones need review and streamlining. Democratic consultations and public education are key activities in arriving at a consensus and the success of the zonation scheme.

PROJECT B1.3: Integrated zonation scheme for the coastal zone and its impacting area.

The land and water uses in the coastal zone and its impacting area should be combined. Adjustments and refinements are expected to be minimal at this

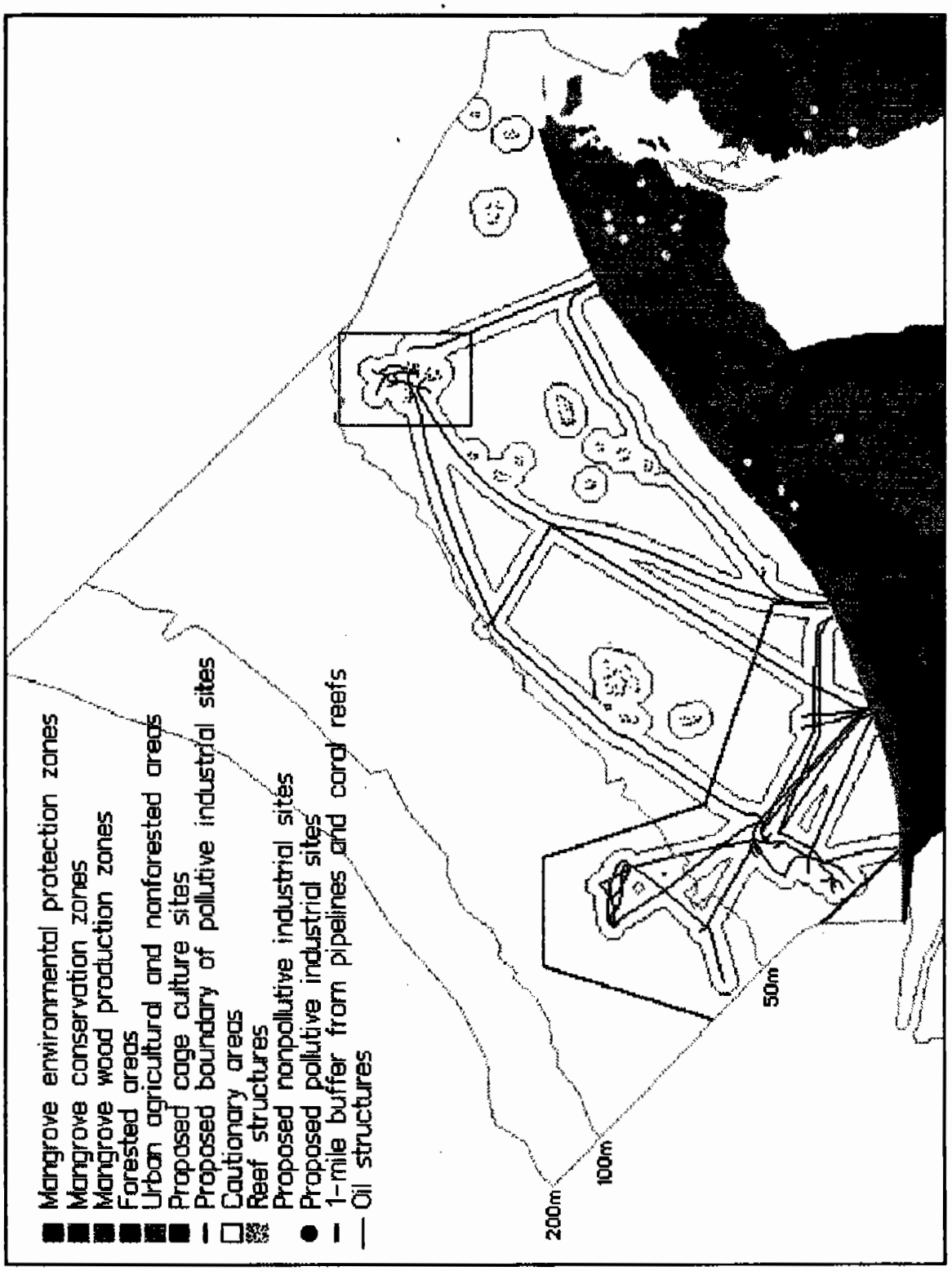


Fig. 4.4. Elements of the zonation scheme covering land and water uses in the coastal zone of Brunei Darussalam.

stage as most of the interlinkage issues should have been sorted out above. Mitigating measures could be explored for activities that may be incompatible and not possible to relocate. The legal basis and regulations should be reviewed and streamlined for the integrated zonation scheme and integrated into CZMA. A system of periodic review of the scheme must be explored and steps necessary for incorporation of revisions clarified. Monitoring and enforcement measures need to be addressed. Thorough consultations and public education are vital to the whole process.

Agencies and administration

The lead/coordinating agency should be the proposed Interagency Committee (IAC) described in the next chapter. Cooperating parties should include representatives from the various ministries and agencies with lead/coordinating roles in the other plan programs. Activities related to legal basis, public education and research should be properly coordinated with lead/coordinating agencies designated for these programs in the plan.

B2: Environmental Impact Assessment System

Background

The EIA, effective planning and regulatory control are the most effective tools for environmental management. Essentially preventive processes, EIAs seek to avoid or minimize harmful environmental effects of a proposed activity or development. The use of EIAs is widespread and many countries find that both its economic and environmental benefits far exceed the associated costs. In view of Brunei Darussalam's economic diversification drive, it is timely to institute an EIA system to safeguard the environment in the process of development.

Objectives

The main objective of the program is to prevent or mitigate adverse environmental impacts from development activities and the resulting incompatibilities/conflicts that such a development may spawn. Towards this end, the projects under this program are designed to achieve its specific objectives.

Description

The EIA system envisioned in this program should be applicable country-wide, particularly in the coastal zone and its impacting area. The EIA system must examine alternatives and select the best for a proposed development; predict the potential significant environmental impacts; recommend appropriate mitigation measures; and identify the long-term environmental costs and benefits of the proposed development.

The environmental impact assessment system must select the best alternative for a proposed development; recommend mitigation measures for potential significant environmental impacts; and identify the long-term environmental costs and benefits.

PROJECT B2.1: Adoption of a list of projects/activities covered by EIA.

All major government and private sector development projects or activities with impacts on the environment should be listed and undergo the EIA system. Criteria to help guide the selection of activities for inclusion in the list are provided in Appendix A.

PROJECT B2.2: Adoption of EIA procedures.

The EIA procedures must be prepared and ratified by appropriate authorities. In contrast to EIA procedures of other countries which may be tedious and complex, Brunei Darussalam requires an effective but simplified version of those enforced by other ASEAN members to suit the country's needs. The EIA system should detail requirements for submission, as well as the process for review and recommendations by the member institutions of the Evaluating Group. Operational procedures and monitoring schemes for compliance with recommendations need to be clearly defined. Appendix A furnishes details on the proposed elements for an EIA system.

PROJECT B2.3: Legalization of the EIA system for Brunei Darussalam.

The legal basis and related rules and regulations for the EIA system should be spelled out, and its legal mandate and implementation by the appropriate agency or agencies pursued.

Agencies and administration

The lead/coordinating agency should be IAC until such time as a more appropriate institution is designated by the interministerial Council on Environment (CE). Representation from the various ministries must be sought as cooperating agencies in the adoption of an EIA system. Extensive consultations with all stakeholders in the government and private sector are crucial to the success of the program. It is recommended that legal aspects of activities in the program be limited to technical inputs for consideration by the lead agency tasked by the plan for this purpose.

B3: Public Awareness/ Participation

Background

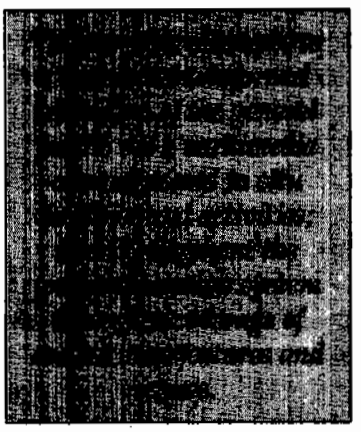
The cooperation and participation of the public are essential in the success of plan programs. Generally, public awareness on environmental issues is fairly high. There are gains to be made, however, in public education and awareness regarding coastal zone features, resources and issues, and the role the

public can play relative to these. The general public is the user and beneficiary of coastal resources, and understanding the coastal zone is critical in maintaining their support and cooperation.

Objectives

The main objective of the program is to increase the level of public awareness of the coastal zone to ensure continued support and cooperation in its sustainable development. In efforts toward this, the program outlines activities over the medium term to realize its specific objectives.

Description



The program adopts a two-pronged strategy to raise the level of public awareness and appreciation of the coastal zone. One strategy attempts to maximize informal education of the general public via a multimedia campaign and *in situ* facilities and activities. The other tries to augment the formal education system through a coverage of coastal zone features and issues, which is a long-term investment on the country's future leaders.

PROJECT B3.1: Multimedia campaign on the coastal zone.

A sustained, informal public education campaign using various media (e.g., posters, billboards, radio, television and newspapers) should highlight the nature and dynamics of the coastal zone, as well as the significance of its quality and functional integrity to the country. A series on the various coastal zone resources, features and economic sectors could be explored, integrating into it the public education aspects of the other programs in this plan for cost-effectiveness. Particular areas to be covered include: the red tide contingency system; proper sewage and solid waste disposal; prevention/mitigation of chronic discharges of pollutants; and the public's role in management or enhancement of economic coastal activities, habitats and wildlife.

PROJECT B3.2: Coastal zone nature facilities and activities.

A coordinated development of parks, picnic grounds and related facilities in the coastal zone is proposed to heighten public appreciation of its interesting flora, fauna and habitats. The latter comprises coastal land forests, mangroves, coastal islands, coral/artificial reefs, marine parks, mudflats and beaches. *In situ* activities such as lectures, trips and guided tours could also be conducted.

PROJECT B3.3: Incorporation of coastal zone education in school curricula.

A coastal zone component should be incorporated in the school curricula. As the development of syllabi usually involves a considerable period, it is urgent that the Curriculum Development Department of the Ministry of Education (MOE) initiate activities at the earliest possible time, starting at the primary level where technical inputs are minimal. Secondary and tertiary science courses should receive attention as information on the country's coastal zone increases. Field activities in the coastal zone must be encouraged.

Agencies and administration

The MOE must be designated as the lead/coordinating agency. Cooperating institutions should include DBI and all the lead/coordinating agencies of the other coastal zone programs in this plan.

B4: Transnational Collaboration

Background

Scientific and technical developments in other countries can facilitate improved CZM in Brunei Darussalam. In addition, a number of transnational issues (e.g., endangered wildlife, oil spills, red tides, pollution mitigation, shared stocks) require enhanced regional and global collaboration. Increased bilateral cooperation with Malaysia is particularly important and mutually beneficial, given interlinkages spawned by a common border. Activities in the country's coastal zone and catchment areas can impact those in the Malaysian states of Sarawak and Sabah, and vice versa.

Objectives

The main objective of the program is to enhance transnational collaboration towards better management of the country's coastal zone. Over the medium term, the program aims specifically to:

1. enhance the country's global and regional cooperation in transnational issues;
2. refine and adopt global and regional scientific, technical and management techniques/experiences to the local setting; and
3. increase bilateral collaboration with Malaysia in coastal environmental and natural resource research and management.

Description

Program activities demonstrate how Brunei Darussalam can greatly benefit from the lessons learned by other countries in CZM.

PROJECT B4.1: Increased regional and global collaboration.

Increased international cooperation by the lead/coordinating agencies of the different coastal zone programs will allow them to benefit from international experience and technology in their respective fields of expertise. These efforts, however, should be coordinated for optimal gain to the country. Particular areas of interest are transnational issues. Existing and planned oil spill response capability in the region can help define the country's needs in this respect. Cooperation in research will strengthen the country's capabilities and partly overcome manpower constraints. A system for exploring and adopting international scientific, technical and management experiences and techniques should be pursued.

PROJECT B4.2: Increased bilateral cooperation with Malaysia.

Increased bilateral collaboration with Malaysia on research, environmental and natural resource management is particularly important and mutually beneficial, given interlinkages spawned by a common border.

A government-to-government protocol on bilateral collaboration in research, environmental and natural resource management should be sought. Technical, political, legal and foreign affairs expertise would be required for the protocol and evaluation of an effective operational mechanism for bilateral dialogue and cooperation. Issues affecting the coastal zones of both Malaysia and Brunei Darussalam must be emphasized, namely:

- control of effluents/pollutants;
- oil spill and red tide monitoring/contingency; and
- mangrove, fisheries and wildlife research and management.

Another case in point is Brunei Bay and adjacent waters, which are significant to both countries. Incompatibilities in planned or existing land and water uses should also be resolved.

Agencies and administration

The lead/coordinating agency for this program should be the proposed IAC. Suggested cooperating institutions include the Ministry of Foreign Affairs, Ministry of Law (MOL), Ministry of Home Affairs and the lead agencies for the various programs in this plan.

B5: Enactment of a Coastal Zone Management Act

Background

The existing legal structure in the country, with its general and broad grants of authority, needs to be translated into relevant rules and regulations to back up the various plan programs. It is imperative to compile appropriate provisions into a Coastal Zone Management Act (CZMA) congruent with the legal requirements for an institutionalized, comprehensive, multisectoral and integrated CZM as envisioned in this plan.

Objectives

The main objective of the program is to provide a clear-cut and sound legal framework for effective CZM. To this end, the specific objectives over the medium term are:

1. clarify statutory mandates and responsibilities of agencies involved in CZM;
2. review and revise laws, rules and regulations pertaining to the coastal zone and programs in this plan; and
3. systematically compile appropriate provisions into a CZMA for ratification.

Description

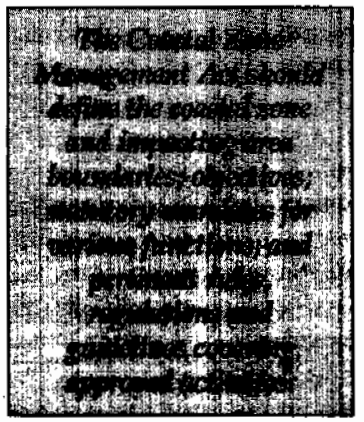
This program's components are geared towards streamlining, updating and compiling suitable legal provisions in support of the programs/activities in this plan. The process is essential for a fully operational CZM.

PROJECT B5.1: Legal provisions in support of coastal zone management programs.

Critical elements under the different plan programs which require proper legal basis to be effectively functional include:

- water quality/effluent standards;
- EIA system;
- various sectoral zonation schemes;
- integrated zonation scheme;
- IAC; and
- pesticide and toxic waste regulation.

Appropriate royalties and penalties covering the true costs of coastal resource utilization need further study. An adequate land and water use tenure to spur various economic coastal activities should be explored. Statutory mandates and responsibilities of agencies necessary for judicious CZM have to be clarified to avoid duplication of functions. Extensive consultations are extremely helpful, together with public information concerning new and/or revised laws, rules and regulations.



PROJECT B5.2: Enactment of a Coastal Zone Management Act.

It is strongly recommended that legal provisions in the preceding project be compiled systematically into a CZMA. This should be a continuing activity until a reasonable draft is obtained. After considerable consultations with various stakeholders and the public, the act must be finalized and ratified by the appropriate authorities, followed by a public information campaign on

its provisions. The act should define the coastal zone and impacting area boundaries; objectives; statutory mandates for various functions; and pertinent rules, regulations and guidelines covering approved activities.

Agencies and administration

The MOL should be the lead agency. Adequate legal, technical and political expertise is required for program implementation. Cooperating parties suggested include all lead agencies for the programs in the plan and representatives from the various ministries.

B6: Coastal Zone Research

Background

A research program in support of the management and development of the coastal zone has to be planned, developed and implemented. Research prioritization, coordination and management (i.e., monitoring and evaluation [M & E]) need adequate attention. Research activities should primarily fill in information gaps, as well as focus on CZM techniques, methods and/or mitigation measures.

Objectives

The main objective of the program is to promote and enhance the generation and application of sound scientific information, techniques and methodologies in the management and development of the country's coastal zone. Over the medium term, program components are intended to fulfill specific objectives.

Description

The activities that follow set the foundation for coordinated research efforts by agencies delegated to various programs. These may eventually lead to the implementation of a detailed research plan for the coastal zone.

PROJECT B6.1: Central data and research repository for the coastal zone.

Despite claims of very little coastal zone research work in the country, considerable amounts of research data and reports are available in the files of various government and private agencies. Often, personnel from different agencies are unaware of the existence of other works, primarily due to some reports needlessly classified restricted or confidential, in the process limiting their distribution. A central clearinghouse or repository for all data and studies is in order, with a system of access classification that can improve retrieval of information and avoid duplication of efforts.

PROJECT B6.2: Review of status of available information on the coastal zone.

A systematic compilation and review of available information on Brunei Darussalam's coastal zone are imperative. A bibliography of completed works and directory of extant information in suitable formats should be accomplished and circulated. Review of research/information gaps can logically proceed from these efforts. Identification of research priorities and systematic development of detailed research plans can follow.

PROJECT B6.3: Research coordination and monitoring.

A number of researches are recommended under the different plan programs. A simple system of research coordination (i.e., proposal, review, funding and approval) and monitoring could facilitate the entire process. A systematic review of proposals against priorities and a scheme of referrals for technical and financial evaluation should be followed.

PROJECT B6.4: Strategic research initiatives.

Strategic areas of inquiry pertaining to CZM include:

- coastal zone ecosystems and predictive modeling;
- pollution-carrying capacities and mitigation measures;
- appropriate valuation and cost-benefit techniques;
- remote sensing and geographic information systems;
- coastal zone issues and interlinkages index; and
- institutional arrangements and reforms in CZM.

It would be a good idea to sustain data collection and explore international cooperation for cost-effectiveness.

Agencies and administration

The lead/coordinating agency should be UBD, supported by all lead/coordinating institutions for the various programs in this plan.

B7: Manpower Development

Background

Brunei Darussalam relies on a mix of local and expatriate scientific/technical manpower to implement its development thrusts. Many institutions involved in the management of the coastal zone and its sectoral activities confront limitations in local expertise. The need to upgrade and develop local

manpower capabilities through appropriate education and training is critical in supporting plan implementation. While reliance on their foreign counterpart may be unavoidable in the immediate future (and thus carefully balanced against socioeconomic, cultural and related implications), it is in the best interest of the country to develop its own capabilities in key areas relevant to coastal zone management and development.

Objectives

The main objective is to develop appropriate local manpower capabilities in coastal zone management and development, supported by specific objectives to be carried out through the program's projects.

Description

It is in the best interest of the country to develop its own manpower capabilities in key areas relevant to coastal zone management and development.

Activities under the program are intended primarily to develop domestic expertise in key scientific/technical areas essential to plan implementation. Moreover, the foundation for retention of such personnel in posts where their specializations are critical should be given due consideration.

PROJECT B7.1: Incorporation of scientific/technical grades into the civil service.

Definition and delineation of a career path for scientific/technical personnel in the civil service deserve proper notice. In many instances, one finds highly qualified specialists moving rapidly into administrative posts. While they perform creditably, such may not often represent the best possible use of the country's limited manpower expertise. Apparently, the key issue is that the only way to progress in the bureaucracy is to assume administrative positions. Scientific/technical grades in the civil service with appropriate remunerations recognizing seniority and degree of specialization should help correct the problem.

PROJECT B7.2: Advanced academic training scheme.

Academic training at the masteral degree level will be offered to develop local manpower capability in key areas of research, planning, management and monitoring. Manpower development activities are outlined for a number of programs in this plan. Monitoring, coordination and support of these activities shall be handled by the lead agency of this program. Selection of appropriate candidates for scholarships, however, should be left to individual agencies where scholars are to be assigned after their studies. The number of scholars under this scheme shall be over and above those already in the government service.

For the proposed IAC, 10 scholars should be sent for education abroad to specialize in: environmental planning, environmental law, environmental management/policy, marine affairs, coastal area management, resource economics, mass communications, public administration, rural/urban development and computer information science. For the other agencies involved in the implementation of plan programs, 26 scholars are needed in the following fields: 1 each for forest flora, forest fauna, forest ecology, fisheries economics, fisheries biology, coral biology, physical oceanography, chemistry, chemical engineering, microbiology, oil spill engineering, oil chemistry, fish/food processing, biochemistry, toxicology, fishing technology, aquatic ecology and socioeconomics; 2 each for forest resource management/economics and fisheries assessment; and 4 for aquaculture. Overall, 36 scholars for a 2-year masteral degree are envisioned in the medium term.

PROJECT B7.3: Short-term training scheme.

Personnel with baccalaureate degrees in science and technical fields receive ample training from local academic institutions. Their specialization in areas relevant to plan programs can be facilitated via short-term trainings in advanced scientific institutions in the region, the U.S. or Western Europe. Monitoring, coordination and proper support for this scheme shall be the responsibility of the proposed IAC, although selection of candidates should be left to the agencies requiring the specific skills.

A year's training may be granted to 25 scholars in the following areas: 2 each in water quality assessment, water quality equipment/instrumentation, solid waste management, soil erosion management, oil spill equipment/instrumentation, oil spill trajectory simulation, island management, syllabi/curriculum development, EIA and mass communications; and 5 in oil spill disposal/cleanup. A total of 15 scholars, on the other hand, may be considered for a 6-month training in the following areas: 2 each in forest resource monitoring, fisheries assessment techniques, oceanographic instrumentation, fish/shrimp hatchery operations, coral/artificial reef monitoring, open water aquaculture and red tide instrumentation/monitoring; and 1 in marine parks. In sum, 40 scholars may be sent overseas for short-term training in the medium term.

Agencies and administration

The proposed IAC is designated as lead agency, assisted by the lead institutions for the other CZM programs.

B8: Facilities Upgrading

Background

Facilities need immediate upgrading for effective implementation of the coastal zone management and development activities in this plan. A wide-ranging inventory of in-country facilities is necessary. Detailed programming after identification of deficiencies is in order to ensure sufficient local capabilities in key areas. Plausible access to existing and planned regional facilities could be sought through institutional sharing and collaboration.

Objectives

The main objective of the program is to develop sufficient local facilities in key areas for effective and sustained coastal zone management and development efforts. Activities over the medium term are meant to pursue specific objectives.

Description

A commendable effort in facilities upgrading/development is programmed in the country's Sixth NDP. Below is a list of short-term needs for consideration and action to complement efforts in the next five years. Moreover, a plan for long-term facilities requirements relevant to coastal zone management and development is suggested.

PROJECT B8.1: Inventory of in-country and regional facilities for coastal zone management and development.

This inventory is intended to identify key areas lacking in facilities. Some facilities could be shared by government agencies in the country and appropriate schemes developed. Reliable access to, and support of, common regional facilities under various auspices, e.g., ASEAN, that are not cost-effective to pursue at the local level should be worked out.

PROJECT B8.2: Prioritization and programming of long-term facilities upgrading.

After the inventory, the next logical step is to set priorities of needs in key areas and draw up detailed operational plans for facilities upgrading. These shall be incorporated into the annual and five-year NDPs.

PROJECT B8.3: Short-term facilities upgrading.

Admittedly, most of the needs in the immediate future are already incorporated in government plans. Some equipment and related facilities to complement those already programmed are the following: high-performance liquid chromatograph; atomic absorption spectrophotometer; oil spill response vessel/s, equipment and dispersants; and deep seagoing oceanographic/fisheries research vessel. Other requirements are small items which can effectively be provided by either existing departmental budgets or institutional coordination/sharing of facilities.

Agencies and administration

The proposed IAC is designated as the lead/coordinating institution. The programs in this plan require facilities upgrading in various degrees and these should be properly coordinated by the committee, particularly in the area of supplemental budgets. Cooperating agencies are those assigned lead/coordinating roles in the other programs.

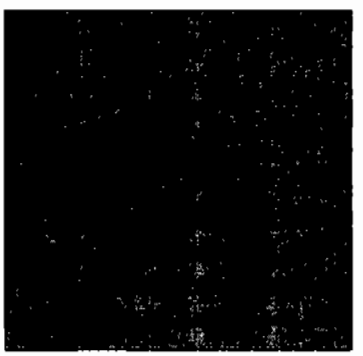
CHAPTER 5

IMPLEMENTATION ARRANGEMENTS

This chapter provides an overview of the institutional and operational arrangements essential for successful implementation of the plan. It covers the following aspects: organization and management; M & E; implementation period and schedule; and indicative costs.

ORGANIZATION AND MANAGEMENT

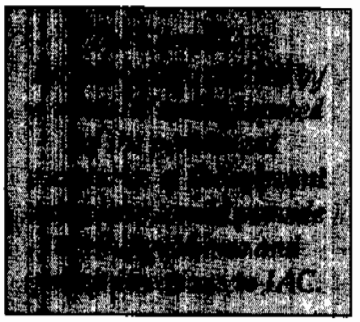
Essentially, there is no standard answer to the type of institutional arrangement that best promotes effective implementation of ICZM plans. Existing arrangements vary globally from highly centralized, single executive modes to extremely decentralized and representative configurations. Various arrangements, thus, are available to effectively manage and allocate the coastal zone and resources among competing and conflicting interests. Evidently, institutional and management arrangements must be adapted to the situational context, considering such factors as the issues involved, political and institutional traditions, and technical capabilities.



The small geographic size of Brunei Darussalam and its legal/institutional setting have resulted in a highly responsive and adaptive government machinery. The plan organization and management structure adopted, therefore, capitalizes on this strength. This framework is a key strategy to achieve multisectoral integration essential to successful ICZM. Intended to provide sufficient balance between comprehensive and sectoral focuses, it allows access to the highest national authorities but respects existing institutional setups and flows of authority.

Three elements of choice characterize the formulation of institutional arrangements: (1) scope of participation; (2) sharing of decisionmaking responsibility; and (3) degree of permanence. Programs in this plan recognize the importance of public awareness, education and participation to attain objectives. Activities over the medium term emphasize the enhancement of these elements. Extensive consultations and consensus-building are recognized as key factors in the decisionmaking process, and are deeply rooted in the country's traditions and formal governance. The M & E scheme (see next section) and the administration/coordination flows proposed are intended to assure responsiveness and amenity to revision over time.

Although quite attractive, the single agency concept to coordinate and integrate CZM in the country could take time to implement. Thus, at least in the interim, an ICZM plan Interagency Committee (IAC) needs to be created with a strong Technical Secretariat to take charge of overall coordination and M & E of plan implementation.



A schematic representation of the organizational structure and relevant coordination/administration flows for implementation of the plan is given in Fig. 5.1. Preferably chaired by a minister and composed of the permanent secretaries of the relevant ministries, CE could provide overall guidance and policy directions to IAC and facilitate the latter's coordination efforts with cooperating ministries.

The IAC could be tasked with the lead/coordinating role for integrated zonation, EIA system, transnational collaboration, manpower development and facilities upgrading. Implementation of the rest of the programs could be delegated to agencies with appropriate line functions and/or capabilities, under the direct supervision of their respective ministries (see Table 4.1). The IAC would need to collaborate with these lead/coordinating agencies. Wide-ranging consultations with beneficiaries, stakeholders and the general public during implementation will ease participation at various levels and ensure that plan activities are achieving desired results.

Programs and activities should be revised whenever necessary and an annual review process for this purpose needs to be instituted and coordinated by IAC. Incorporation of plan programs and activities into the government's annual and five-year plans (as appropriate) should be the responsibility of each implementing agency in charge thereof and accordingly cross-checked by IAC, CE and cooperating ministries.

MONITORING AND EVALUATION

Implementation is described as three sequential but overlapping processes: (1) programming, (2) monitoring and (3) evaluation. Programming lays out exactly what needs to be done, in what order, by whom, and using what materials and methods. It is emphasized that the programs, projects and activities in this plan, in their present form, need translation into operational details. The project proposals have to be laid out for implementation.

Monitoring is a "formative" function to see how a project is going on and what changes are needed for better performance. Evaluation is a "summative" function to know what effects the project has and what lessons can be learned. The rationale for an M & E system is to determine the following:

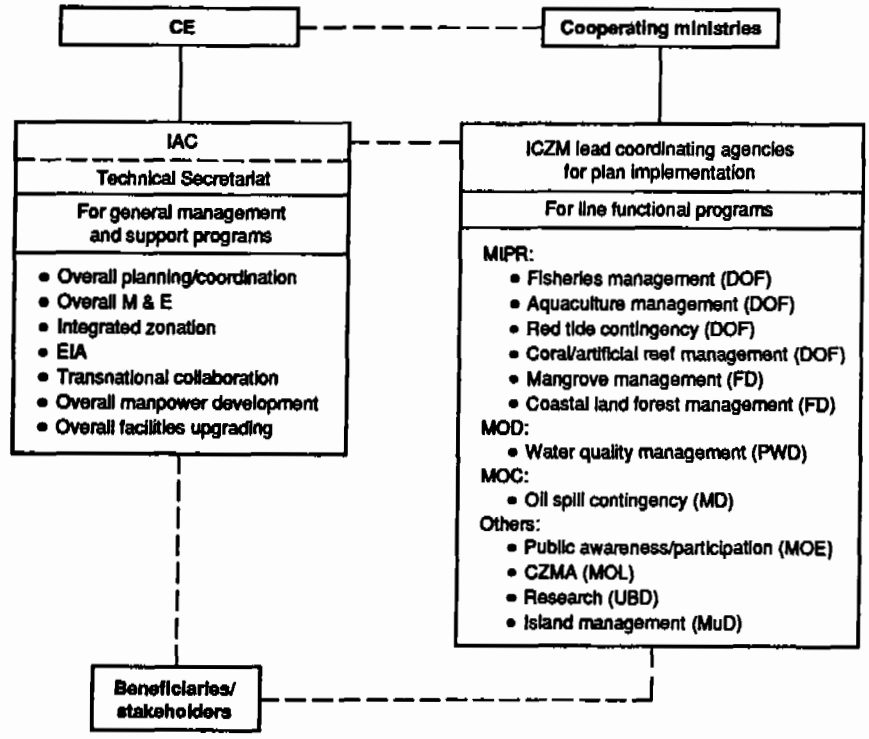


Fig. 5.1. Schematic representation of the proposed organizational structure and coordination/ administration flows for implementation of the ICZM plan.

1. whether the means adopted to realize program objectives are appropriate and executed at minimum cost;
2. the feasibility of the program objectives at both planning and implementation stages; and
3. the extent that intended beneficiaries of a program have actually profited from it.

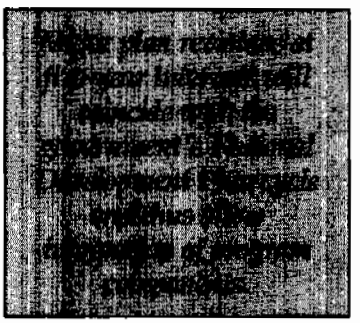
Although M & E overlap, they also have distinctions. Monitoring is the collection of information about a project. In essence, it is an information system that provides data to management regarding the operations of projects. Monitoring can be implemented in four stages: (1) identify and measure expected/desirable performance; (2) identify and measure actual performance; (3) establish performance variances (shortfall, excesses); and (4) communicate variances beyond pre-established tolerance limits.

Evaluation is the periodic assessment of the relevance, performance, efficiency and impact of the project in the context of its stated objectives. The types of evaluation are: (1) *ex-ante* (similar to project appraisal), (2) ongoing (during implementation), (3) terminal (once the project has been completed) and (4) *ex-post* (a number of years after project completion). Two mutually

reinforcing levels of M & E are envisioned for the ICZM plan. The first is at the plan level, the second is at the project/program level. The entire M & E process is depicted in Fig. 5.2.

Each project has to be defined by its implementing agency in terms of: (1) inputs, (2) outputs, (3) purpose and (4) goal. This is best undertaken through the logical framework (logframe) analysis or LFA (see USAID 1980). Briefly, LFA is an aid to logical thinking and a means by which a project may be structured and described for analytical purposes. The logframe structure (Table 5.1) consists of a 4 x 4 matrix in which the rows represent the levels of project objectives (using a bottom-up approach), including the means required to achieve them, while the columns indicate how the achievement of these objectives can be verified. Each program logframe, summarizing project LFAs, will subsequently be prepared at the level of the lead/coordinating agency for the respective programs. An initial and a modified medium-term logframe for the plan should be accomplished by IAC. The first logframe will serve as a basis for guiding individual implementing agencies in their LFA at project/program levels. The modified version shall be a product of revisions using detailed, technical project/program logframes from implementing agencies.

Unlike the existing M & E system for most line agencies which relies more on internal and informal reporting, the one proposed here is formalized and highly related to the organizational structure of the plan. Being a staff function, M & E should be lodged within IAC. The line agencies, however, should maintain responsibility for internal M & E activities; hence, the flow of information for the plan as shown in Fig. 5.2.



All plans are dynamic documents and revisions resulting from M & E activities should be made when necessary. An annual review for this purpose is recommended. Major plan revisions to suit the changing coastal zone situation and socioeconomic realities should be encouraged at five-year intervals. This will coincide with the government's five-year NDP cycle and thus allow integration of program components into the former's sectoral elements.

IMPLEMENTATION PERIOD AND SCHEDULE

The ICZM plan was envisioned for implementation over the medium term. This spans 5-10 years to allow room for flexibility and considerations that may surface in the course of detailed operational programming. A five-year fast-track implementation of functional components, nevertheless, is feasible (see Appendix B). Details on schedules for tasks under each project are available at the ASEAN/US CRMP Secretariat based at DOF.

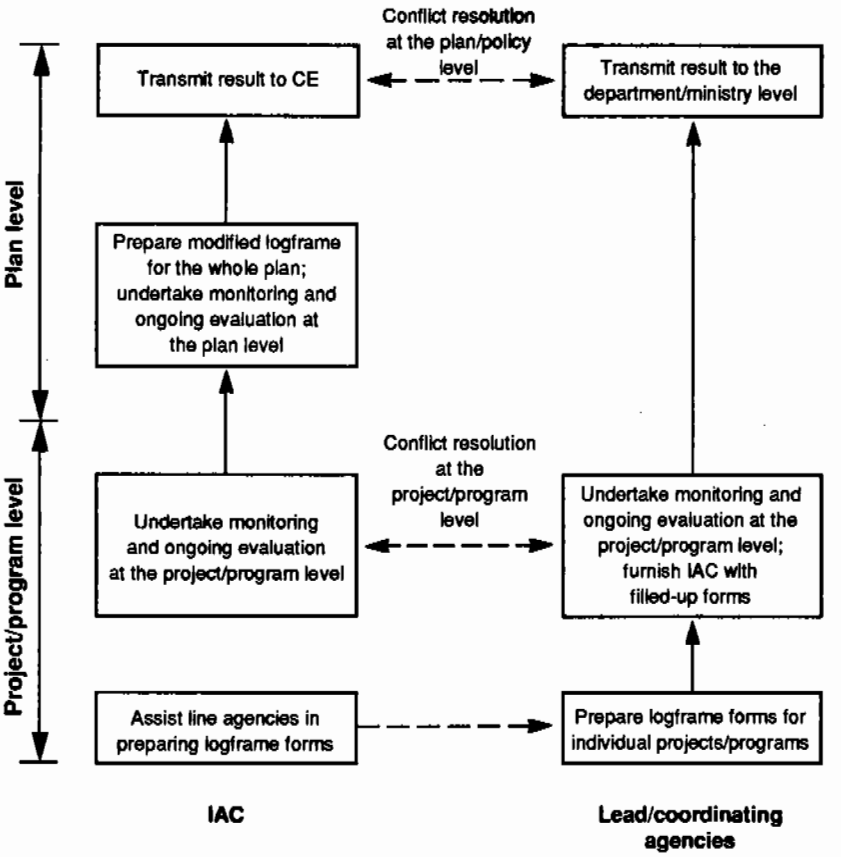


Fig. 5.2. Simplified chart of the M & E system framework for the ICZM plan.

Table 5.1. The logical framework (logframe).

Narrative summary	Objectively verifiable indicators (and targets) (OVI)	Means of verification (MOV)	Assumptions
Goal			
Purpose			
Outputs			
Inputs			

Source: USAID (1980).

Table 5.2. Summary of indicative costs for plan implementation using a fast-track (5-year) schedule of activities. (See Appendix B for details.)

A. Special concerns and sectoral management	(8,035)
1. Water Quality Management	2,500
2. NRTCS	350
3. NOSCS	860
4. Capture Fisheries Management	1,150
5. Aquaculture Management	110
6. Mangrove Management	1,420
7. Coastal Land Forest Management	700
8. Coral/Artificial Reef Management	645
9. Island Management	300
B. General management	(22,913)
1. Integrated Zonation Scheme	850
2. EIA System	250
3. Public Awareness/Participation	5,650
4. Transnational Collaboration	700
5. Enactment of CZMA	1,450
6. Coastal Zone Research	6,500
7. Manpower Development	4,778
8. Facilities Upgrading	2,735
C. Plan coordination, M & E	15,000

INDICATIVE COSTS FOR PLAN IMPLEMENTATION

Detailed operational programming of activities and financial requirements for the plan should be undertaken by the various implementing agencies and coordinated by the proposed IAC. Most of the personnel, operating and capital expenditure requirements are either already incorporated in the government's five-year plan or can be covered effectively by departmental budgets with supplemental allocations in certain cases. A summary of indicative costs for each program is given in Table 5.2. Total cost for plan implementation using the fast-track approach is about B$46 million. This includes additional costs only and excludes expenditures already incorporated in the Sixth NDP or annual departmental budgets. Details of indicative costs by project under the various programs are given in Appendix B.

Implementation of the ICZM plan should go a long way towards enhancing the quality and functional integrity of the coastal zone for sustained benefit of the country's present and future generations.

REFERENCES

Agbayani, C.V., M.W.R.N. De Silva and H.S.H. Mohd. Jaya. 1992. Island management strategy for Brunei Darussalam, p. 143-154. *In* G. Silvestre, H.J.H. Matdanan, P.H.Y. Sharifuddin, M.W.R.N. De Silva and T.-E. Chua (eds.) The coastal resources of Brunei Darussalam: status, utilization and management. ICLARM Conf. Proc. 34, 214 p.

Alcances, R.P., A.D.D. Supetran and M.B. Anderson. 1983. Environmental impact assessment handbook. Environmental Impact Assessment Group, National Environmental Protection Council, Ministry of Human Settlements, Philippines.

Cabahug, D.M., Jr. and L.R. Garces. 1992. Assessment of mangrove forest resources in Brunei Darussalam, p. 59-74. *In* G. Silvestre, H.J.H. Matdanan, P.H.Y. Sharifuddin, M.W.R.N. De Silva and T.-E. Chua (eds.) The coastal resources of Brunei Darussalam: status, utilization and management. ICLARM Conf. Proc. 34, 214 p.

CAMPNET (Coastal Area Management and Planning Network). 1989. The status of integrated coastal zone management: a global assessment. Coastal Area Management and Planning Network, University of Miami, Miami, U.S.A.

Chou, L.M., G.S.Y. Lim and C.B. Leng. 1992. Fish communities in natural reef and artificial habitats in the coastal waters of Brunei Darussalam, p. 75-90. *In* G. Silvestre, H.J.H. Matdanan, P.H.Y. Sharifuddin, M.W.R.N. De Silva and T.-E. Chua (eds.) The coastal resources of Brunei Darussalam: status, utilization and management. ICLARM Conf. Proc. 34, 214 p.

Chua, T.-E., L.M. Chou and M.S.M. Sadorra, editors. 1987. The coastal environmental profile of Brunei Darussalam: resource assessment and management issues. ICLARM Tech. Rep. 18, 193 p.

De Silva, M.W.R.N., H.J.H. Matdanan and H.M.T. Sabri. 1992. Zonation of industrial activities to minimize environmental and coastal water quality degradation in Brunei Darussalam, p. 155-163. *In* G. Silvestre, H.J.H. Matdanan, P.H.Y. Sharifuddin, M.W.R.N. De Silva and T.-E. Chua (eds.) The coastal resources of Brunei Darussalam: status, utilization and management. ICLARM Conf. Proc. 34, 214 p.

FAO (Food and Agriculture Organization). 1991. Reducing environmental impacts of coastal aquaculture. Report of the First Session of the GESAMP Working Group on Environmental Impacts of Coastal Aquaculture, 7-11 January 1991. Kiel, Germany. GESAMP/XXI/8. 27 p. Food and Agriculture Organization, United Nations, Rome.

Lim, P.E. 1992. Water quality in the coastal areas of Brunei Darussalam: status, management issues and recommendations, p. 91-108. *In* G. Silvestre, H.J.H. Matdanan, P.H.Y. Sharifuddin, M.W.R.N. De Silva and T.-E. Chua (eds.) The coastal resources of Brunei Darussalam: status, utilization and management. ICLARM Conf. Proc. 34, 214 p.

MOD-DOTCP (Ministry of Development-Department of Town and Country Planning). 1987. Negara Brunei Darussalam Master Plan. Ministry of Development, Brunei Darussalam.

Silvestre, G., H.J.H. Matdanan, P.H.Y. Sharifuddin, M.W.R.N. De Silva and T.-E. Chua, editors. 1992. The coastal resources of Brunei Darussalam: status, utilization and management. ICLARM Conf. Proc. 34, 214 p.

USAID (United States Agency for International Development). 1980. Design and evaluation of aid-assisted projects. Training and Development Division, Office of Personnel Management, United States Agency for International Development, Washington, D.C., USA.

Zamora, P.M. 1992. Mangrove resources of Brunei Darussalam: status and management, p. 39-58. *In* G. Silvestre, H.J.H. Matdanan, P.H.Y. Sharifuddin, M.W.R.N. De Silva and T.-E. Chua (eds.) The coastal resources of Brunei Darussalam: status, utilization and management. ICLARM Conf. Proc. 34, 214 p.

APPENDIX A

RECOMMENDED ENVIRONMENTAL IMPACT ASSESSMENT SYSTEM FOR BRUNEI DARUSSALAM

DEFINITION OF TERMS

Environmental impacts - man-induced changes in the physical, biological, chemical, social and economic aspects of the environment as a result of certain types of activities.

Environmental impact assessment - the process of identifying and predicting impacts of proposed projects on the environment and on man's well-being and health, and the interpretation and communication of such impacts that are comprehensible to planners and policymakers.

Environmental impact statement - the documentation of the studies and environmental impacts of a project and a discussion of the direct and indirect effects upon human welfare and environmental integrity.

ENVIRONMENTAL IMPACT ASSESSMENT PROCEDURE

All government and private projects/activities that fall under the criteria below (Alcances et al. 1983), or the classification of pollutive/hazardous industries, would be required to carry out an EIA.

Criteria for Requiring an Environmental Impact Assessment

1. Changes in land use pattern.
2. Changes in energy supply/demand.
3. Increased development in floodplains.
4. Discharge of substantial toxic materials or chemicals.
5. Significant changes in ambient air/water quality.
6. Destruction of natural, ecologically significant, historical or cultural resources.
7. Destruction of fish/wildlife habitats, especially of threatened, rare and/or endangered species.
8. Substantial displacement of people/community structure.
9. Significant changes in surface/groundwater quantity and quality.

10. Potential threats to health, safety or property.
11. Exceeding the natural, physical, biological or spatial carrying capacity of an area (e.g., community, ecosystem, town or city).

Environmental Impact Assessment Checklists

Two EIA checklists will be required of major projects with environmental impacts, especially if they possibly fit in the criteria which need EIA preparation. The first checklist will describe the project; the second one its environmental setting. Details are unnecessary; a brief but substantial description will suffice, with emphasis on the wastes and effluents that will be discharged.

Only the first checklist may be required of projects that will be located in an environmentally known area, such as developed industrial or commercial sites.

Checklist for describing the project

I. Planning activities
   A. Project planning
      1. Site design
         a. Size
            total hectares
            land parcels (total project, average size, per hectare)
         b. Buildings
            total number
            type of occupancy (residential, commercial, etc.)
            for demolition (type and number)
            distance between structures (average)
         c. Circulation
            streets (type, width, total length, capacity)
            walkways (type, width, total length)
            bikeways (type, width, total length)
            trails (type, width, total length)
         d. Parking
            parking spaces/structures as required by building code and as provided
            total parking spaces (on-site, off-site)
            guest parking spaces (total)
            total of all parking spaces
         e. Amenities
            landscaping (native and non-native species, number, size)
            recreational facilities (number, type, size)
         f. Orientation to surrounding area
            compatibility with surrounding land uses
            proximity to transportation (streets, etc.)
            inclusion of buffer zones (trees, earth, berms, etc.)

g. Design of climatic conditions
building orientation to sun (natural heating/cooling effect)
use of trees, shrubs, grass for natural cooling of buildings
building orientation to direction of any high winds, blowing sand, etc.

B. Economics
1. Basic data
type of unit (residential, commercial, etc.)
market format (sale, rent, lease, etc.)
total project value
market feasibility
2. Cost-benefit analysis
public costs
public revenues
revenues and costs (dollar difference)
payroll generated (construction, permanent employees)
consumer purchasing power increase (total families x average family income)

II. Construction activities
A. Site preparation
1. Removal action
buildings (number and type)
paving (square meters)
footing (number)
utilities (removal or abandonment in place)
trees (number and type)
unstable land area abatement (square meters/hectares)
hazardous brush removal (square meters/hectares)
rocks and boulders (cubic meters)
2. Grading
cut (total in cubic meters, depth by range in meters)
fill (total in cubic meters, depth by range in meters)
compaction of fill (degree of natural rate)
total soil removal from site (cubic meters)
soil relocation area (on-site, off-site)
landslide/mudslide stabilization actions
3. Site improvements
streets and curbs (total amount)
canals (length, depth, etc.)
street trees (number and species)
utilization (type, above or below ground, etc.)
bridges

4. Temporary facilities
   roads
   bridges
   concrete batching
5. Time
   total construction time
   number of days of nighttime activities
   number of construction phases (time per phase)

B. Construction
1. Structures
   foundations and walls
   shoring and bracing
   basement (depth)
2. Systems installation
   a. Drainage systems
      subsurface, storm and surface slope drains (number, size, capacity)
   b. Supply/discharge systems
      water, electric and gas supply lines (number, size, capacity)
      sewer discharge lines (number, size, capacity)
      solid waste collection bins (number, size, capacity)
      wells (capacity, depth)
      septic tanks (number, size, capacity)
   c. Circulation systems
      roads, streets, sidewalks, etc. (length, width, type of material)
   d. Mechanical systems
      heating/cooling
      lighting
      laundry
      fire control (sprinklers)
   e. Special systems
      fuel handling
      toxic material handling
      communications
      refrigeration

III. Operational activities
A. Consumption
1. Water (liters/month)
2. Electricity (kilowatt hours/month)
3. Gas (cubic meters/year)

B. Discharge
1. Solid wastes (kilograms/month)
2. Liquid wastes (liters/month)
3. Surface water runoff (cubic meters/year)

C. Pollution generated
   1. Air (tons/year)
   2. Water (parts per million/year)
   3. Noise (maximum decibels at peak hours)

D. Other generators
   1. Traffic (vehicles/structure, total vehicles)
   2. Persons (residents or employees/structure, residents or employees/total projects
   3. School age children (total number from elementary, junior and senior high)
   4. If a commercial or industrial project, include:
      operating or working hours
      employees (total/business or shop, by shift or business)

Checklist for describing the environmental setting[1]

I. Physical characteristics

A. Basic land conditions
   1. Geologic
      major land transformation (valleys, rivers)
      structures (substrate)
      resources (minerals, oil, etc.)
      slope stability and landslide potential
   2. Soil
      classification
      hazard potential (erosion, subsidence or expansiveness)
      natural drainage rate
      subsoil permeability
      runoff rate
      effective depth (centimeters)
      inherent fertility
      suitability for method of sewage disposal

B. Biotic community conditions
   1. Plant
      general types and dominant species
      density and distribution
      animal habitat value
      man-introduced species
      endangered species (location, distribution and condition)
      fire potential (pine forest, cogon, etc.)
      timber value
      species of scientific or aesthetic interest
   2. Animal
      general types and dominant species (mammal, fish, fowl, etc.)
      density and distribution
      habitat (general)
      migratory species

[1]To be accomplished only for projects proposed to be sited outside government-planned or earmarked zones.

game species
man-introduced species
endangered species
species of commercial value

C. Watershed conditions
water quality (surface and groundwater)
sources of public or private water supply on-site
watershed importance (on-site and surrounding area)
floodplain importance (on-site and surrounding area)
water runoff rate
aquifer recharge rate
streamside conditions (habitat, streamflow rate)
location of wells, springs
marshland, lake, ocean frontage importance

D. Airshed conditions
general climatic type
air quality
airshed importance
wind hazard area (minimum/maximum speeds)
odor levels
rainfall (average)
temperature (average highs and lows)
prevailing winds (direction and intensity)

II. Socioeconomic characteristics

A. Land use
on-site and surrounding conditions
present use (housing, cultivation, natural area, industrial, etc.)
present zoning classification
surrounding land uses
parcel size (hectares)
existing structures (number, age, type, condition, present use)
present occupants (number, income level, age)
historic value (officially designated landmarks)

Subject to revision and simplification, these checklists are only guides on areas that should be covered in considering EIAs.

Evaluation of Submitted Checklists

A. For projects required to submit both checklists:

The Evaluating Group shall transform the information in the checklists into a matrix. Project activities will be plotted along the horizontal axis and the existing environmental characteristics along the vertical axis. The interaction matrix will more or less identify possible environmental impacts of the proposed project. A preliminary evaluation of the impacts will be made and site evaluation can be referred to any capable member(s) of the Evaluating

Group. The assigned member-institution(s) may ask for more detailed information on significant impacts from the proponents or an environmental impact study on a particular aspect of the proposed project.

B. For projects required to submit the first checklist only:

The project description will be submitted to the designated Evaluating Group. Based on its potential adverse environmental impacts, the project will be referred to the appropriate member-institution for study. The latter may ask the proponents for more information needed to evaluate the proposal properly or an environmental impact study on particular aspects of the project harmful to the environment.

After evaluation, recommendations, comments and requirements must be presented to the Evaluating Group. The group will then discuss the recommendations for proper action, disapproval or approval. Approval of the proposed project may be subject to certain conditions such as strict adherence to imposed mitigating measures. If the project causes pollution, conformity of effluents with environmental quality standards shall be determined. There should be strict enforcement of water, air and noise pollution regulation and control.

APPENDIX B

Summary of CZM programs and projects, fast-track (5-year) implementation schedule and indicative costs.

A. Special concerns and sectoral management								
Water Quality Management	A1						(2,500)	
Reduction of environmental impacts from domestic wastes	A1.1	x	x	x			300	Supplemental
Zonation of industrial activities and waste treatment	A1.2	x	x	x	x	x	300	Supplemental
Reduction of environmental impacts from soil erosion	A1.3	x	x	x	x		600	Supplemental
Mitigation of environmental impacts from livestock wastes and nonpoint pollution sources	A1.4	x	x	x			450	Supplemental
Adoption of water quality and effluent standards	A1.5	x	x				100	Actual
Adoption and implementation of appropriate water quality monitoring system	A1.6	x	x	x	x	x	750	Supplemental
NRTCS	A2						(350)	
Mitigation of economic dislocation from the outbreak of red tides	A2.1	x	x				100	System design
Mitigation of impacts on seafood supply	A2.2		x	x			50	Supplemental
Development of local technical manpower capabilities	A2.3	x	x	x			-	See manpower program
Expansion of red tide monitoring activities	A2.4	x	x	x	x	x	200	Supplemental
NOSCS	A3						(860)	
Inventory of in-country and regional response capabilities	A3.1	x	x				150	Actual
Oil spill trajectory field experiments and refinement	A3.2		x	x			300	Actual
Design and implementation of detailed action/response guidelines	A3.3		x	x			60	Supplemental
Oil spill identification and reporting scheme	A3.4		x	x			50	Supplemental
Inventory of environmentally and economically sensitive areas	A3.5			x	x		200	Supplemental
Mitigation of economic and social dislocation resulting from oil spills	A3.6				x	x	100	System design

Continued

Appendix B (continued)

Capture Fisheries Management	A4						(1,150)	
Shrimp fisheries management	A4.1	x	x	x	x	x	150	Supplemental
Demersal fisheries management	A4.2	x	x	x	x	x	200	Supplemental
Pelagic fisheries management	A4.3	x	x	x	x	x	300	Supplemental
Zonation scheme to minimize sectoral and gear conflicts	A4.4		x	x			180	Supplemental
Streamlining of extension and information services	A4.5		x	x			50	Supplemental
Improvement of inputs to management decision-making process	A4.6		x	x	x	x	160	Supplemental
Increased efficiency in utilization of resources	A4.7			x	x		60	System design
Development of specialized manpower skills	A4.8	x	x	x			-	See manpower program
Mitigation of the effects of rising labor costs	A4.9			x	x		50	Supplemental
Aquaculture Management	A5						(110)	
Mitigation of environmental impacts from aquaculture	A5.1	x	x				60	Supplemental
Development of local manpower skills	**A5.2**	x	x	x			-	See manpower program
Development of support activities	A5.3				x	x	50	Supplemental
Mangrove Management	A6						(1,420)	
Zonation scheme for mangrove areas	A6.1	x	x	x			540	Supplemental
Appropriate monitoring scheme for mangrove areas	A6.2	x	x				30	System design
Increased public awareness on mangrove ecosystem	A6.3		x	x			50	Supplemental
Development of appropriate local manpower	A6.4		x	x	x		-	See manpower program
Sustained research on mangrove ecosystem	A6.5		x	x	x	x	800	Research grants
Coastal Land Forest Management	A7						(700)	
Rehabilitation of coastal land forests	A7.1		x	x	x	x	400	Supplemental
Improvement of reporting system on forest fires	A7.2	x	x				50	System design
Public awareness and participation in management of coastal land forests	A7.3		x	x	x		150	Supplemental
Regular monitoring of coastal land forest condition	A7.4	x	x				100	Supplemental

Continued

Coral/Artificial Reef Management	A8						(645)	
Zonation scheme for coral/artificial reefs	A8.1	x	x				50	Supplemental
Sustained artificial reef development scheme	A8.2	x	x	x	x	x	250	Supplemental
Promotion of sportfishing and ecotourism	A8.3		x	x	x		150	Supplemental
Coral/artificial reef monitoring scheme	A8.4		x	x	x	x	120	Supplemental
Public awareness on coral/artificial reefs	A8.5	x	x	x			75	Supplemental
Island Management	A9						(300)	
Adoption of use classification for coastal islands	A9.1	x	x				50	Supplemental
Research and monitoring scheme for coastal islands	A9.2		x	x	x	x	200	Supplemental
Public awareness on coastal islands	A9.3		x	x	x		50	Supplemental
B. General management								
Integrated Zonation Scheme	B1						(850)	
Adoption of zonation scheme for the coastal zone	B1.1	x	x				100	Supplemental
Adoption of zonation scheme for the coastal zone impacting area	B1.2		x	x	x		600	Supplemental
Integrated zonation scheme for the coastal zone and its impacting area	B1.3				x	x	150	Supplemental
EIA System	B2						(250)	
Adoption of a list of projects/activities covered by EIA	B2.1	x					50	Supplemental
Adoption of EIA procedures	B2.2		x	x	x		100	Supplemental
Legalization of the EIA system for Brunei Darussalam	B2.3				x	x	100	Supplemental
Public Awareness/Participation	B3						(5,650)	
Multimedia campaign on the coastal zone	B3.1	x	x	x	x	x	4,000	Actual
Coastal zone nature facilities and activities	B3.2		x	x	x		1,250	Supplemental
Incorporation of coastal zone education in school curricula	B3.3		x	x	x	x	400	Supplemental
Transnational Collaboration	B4						(700)	
Increased regional and global collaboration	B4.1		x	x	x	x	400	Supplemental
Increased bilateral cooperation with Malaysia	B4.2	x	x				300	Supplemental

Continued

Appendix B (continued)

Enactment of CZMA	B5						(1,450)	
Legal provisions in support of CZM programs	B5.1	x	x	x	x		1,200	Supplemental
Enactment of CZMA	B5.2					x	250	Supplemental
Coastal Zone Research	B6						(6,500)	
Central data and research repository for the coastal zone	B6.1	x	x	x	x	x	4,000	Capital outlay, operating cost
Review of status of available information on the coastal zone	B6.2		x	x			200	Supplemental
Research coordination and monitoring	B6.3			x	x		300	System design
Strategic research initiatives	B6.4		x	x	x	x	2,000	Grants
Manpower Development	B7						(4,778)	
Incorporation of scientific/technical grades into the civil service	B7.1	x	x				40	Supplemental
Advanced academic training scheme	B7.2		x	x	x	x	3,600	72.0 man-years
Short-term training scheme	B7.3	x	x	x			1,138	22.5 man-years
Facilities Upgrading	B8						(2,735)	
Inventory of in-country and regional facilities for coastal zone management and development	B8.1	x	x	x			45	Supplemental
Prioritization and programming of long-term facilities upgrading	B8.2		x	x	x		60	Supplemental
Short-term facilities upgrading	B8.3	x	x				2,630	Actual
C. Plan coordination, M & E							15,000	
Total							45,948	

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The coastal environmental profile of Brunei Darussalam: resource assessment and management issues. T.-E. Chua, L.M. Chou and M.S.M. Sadorra, editors. 1987. No. 18, 193 p. Out of print - available in photocopied form at $29, including airmail cost; ₱270.

The coastal environmental profile of Ban Don Bay and Phangnga Bay, Thailand. J.N. Paw, S. Bunpapong, A.T. White and M.S.M. Sadorra, editors. 1988. No. 20, 79 p. Out of print - available in photocopied form at $12, including airmail cost; ₱110.

The coastal environmental profile of Singapore. L.S. Chia, H. Khan and L.M. Chou. 1988. No. 21, 92 p. Out of print - available in photocopied form at $14, including airmail cost; ₱128.

The coastal environmental profile of Lingayen Gulf, Philippines. L.T. McManus and T.-E. Chua, editors. 1990. No. 22, 69 p. $2 surface; $7 airmail; ₱25.

The coastal environmental profile of South Johore, Malaysia. ASEAN/US Coastal Resources Management Project. 1991. No. 24, 65 p. $2 surface; $7 airmail; ₱25.

The coastal environmental profile of Segara Anakan-Cilacap, South Java, Indonesia. A.T. White, P. Martosubroto and M.S.M. Sadorra, editors. 1989. No. 25, 82 p. $2 surface; $7 airmail; ₱25.

The integrated management plan for the coastal zone of Brunei Darussalam. Department of Fisheries, Ministry of Industry and Primary Resources, Brunei Darussalam. 1992. No. 29, 122 p. $2 surface; $10 airmail; ₱50.

The integrated management plan for Ban Don Bay and Phangnga Bay, Thailand. Office of the National Environment Board, Ministry of Science, Technology and Environment, Thailand. 1992. No. 30, 161 p. $2 surface; $10 airmail; ₱50.

Singapore's urban coastal area: strategies for management. L.S. Chia. 1992. No. 31, 99 p. $2 surface; $7 airmail; ₱25.

The Lingayen Gulf coastal area management plan. National Economic Development Authority, Region I, Philippines. 1992. No. 32, 87 p. $2 surface; $7 airmail; ₱25.

The coastal resources management plan for South Johore, Malaysia. Malaysian Coastal Resources Study Team, Ministry of Science, Technology and the Environment, Malaysia. 1992. No. 33. $2 surface; $10 airmail; ₱50.

The integrated management plan for Segara Anakan-Cilacap, Central Java, Indonesia. ASEAN/US Coastal Resources Management Project, Directorate General of Fisheries, Indonesia. 1992. No. 34, 100 p. $2 surface; $7 airmail; ₱25.

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