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**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



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**THE INTEGRATED MANAGEMENT PLAN  
FOR BAN DON BAY AND PHANGNGA BAY,  
THAILAND**

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FOR BAN DON BAY AND PHANGNGA BAY,  
THAILAND**

*Thailand*

Office of the National Environment Board.  
Ministry of Science, Technology and Environment  
Bangkok, Thailand

1992



**ICLARM**



Association of Southeast Asian Nations/United States  
Coastal Resources Management Project  
Technical Publications Series 8

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SH  
204  
TR4  
#30  
C.2  
JAN 3 1 1994

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**The Integrated Management Plan  
for Ban Don Bay and Phangnga Bay, Thailand**

OFFICE OF THE NATIONAL ENVIRONMENT BOARD  
MINISTRY OF SCIENCE, TECHNOLOGY AND ENVIRONMENT  
BANGKOK, THAILAND

1992

Published by the International Center for Living Aquatic Resources  
Management on behalf of the Association of Southeast Asian Nations/  
United States Coastal Resources Management Project.

Printed in Manila, Philippines.

ONEB-MSTE (Office of the National Environment Board-Ministry of Science,  
Technology and Environment). 1992. The integrated management plan for  
Ban Don Bay and Phangnga Bay, Thailand. ICLARM Tech. Rep. 30, 161 p.

Cover design by Aque.

ISSN 0115-5547  
ISBN 971-8709-16-9

ICLARM Contribution No. 779

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## LIST OF ACRONYMS AND ABBREVIATIONS

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A.	<i>amphoe</i> , meaning "second-order administrative district "
ADB	Asian Development Bank
AGR	annual growth rate
AMFDC	Andaman Marine Fisheries Development Center
ARs	artificial reefs
ASEAN/US CRMP	Association of Southeast Asian Nations/United States Coastal Resources Management Project
BCCA	Building Construction Control Act
BOD	biological oxygen demand
BOI	Board of Investments
CBO	community-based organization
COD	chemical oxygen demand
COPCG	Chronic Oil Pollution Control Group
CPUE	catch per unit effort
CRM	coastal resources management
CZM	coastal zone management
DIW	Department of Industrial Works
DLD	Department of Land Development
DMR	Department of Mineral Resources
DO	dissolved oxygen
DOF	Department of Fisheries
DOTCP	Department of Town and Country Planning
DPW	Department of Public Works
EIA	environmental impact assessment
EIS	environmental impact statement
GDP	gross domestic product
GPP	gross provincial product
GRDP	gross regional domestic product
GRP	gross regional product
HaD	Harbour Department
HD	Health Department
ICLARM	International Center for Living Aquatic Resources Management
ITF	island task force
JICA	Japan International Cooperation Agency
K.	<i>khlong</i> , meaning "river"
KU	Kasetsart University
LG	local government
M&E	monitoring and evaluation
MFD	Marine Fisheries Division
MOAC	Ministry of Agriculture and Cooperatives
MOE	Ministry of Education
MOI	Ministry of Interior
MOInd	Ministry of Industry

## List of Acronyms and Abbreviations

---

MOPH	Ministry of Public Health
MPN	most probable number
MSTE	Ministry of Science, Technology and Environment
MSY	maximum sustainable yield
NEQA	National Environmental Quality Act
NESDB	National Economic and Social Development Board
NESDP	National Economic and Social Development Plan
NGOs	nongovernmental organizations
NH	nonhunting area
NMP	national marine park
NOSCP	National Oil Spill Contingency Plan
NP	national park
NPA	National Park Act
NPD	National Park Department
ONEB	Office of the National Environment Board
PA	protected area
PCDA	Population and Community Development Association
PFO	provincial fisheries office
PG	provincial government
PMCU	Pollution Management and Control Unit
PWWA	Provincial Water Works Authority
RBE	River Basin Entity
RFD	Royal Forestry Department
RTG	Royal Thai Government
SD	Sanitary District
SS	suspended solids
TAT	Tourism Authority of Thailand
TBA	Tourism Business Association
TCPA	Town and Country Planning Act
TURF	territorial use rights in fisheries
URI	University of Rhode Island
USAID	United States Agency for International Development
WB	World Bank
WPB	Water Purification Board
WS	wildlife sanctuary

## CONVERSION RATES, 1972-1992

Baht = US\$1.00	Year
20.00	1972
20.00	1980
23.00	1981
23.00	1982
23.00	1983
26.33	1984
26.14	1985
25.40	1986
25.52	1987
25.65	1988
25.70	1989
25.65	1990
25.35	1991
25.35	1992 (31 July)



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## ACKNOWLEDGMENTS

---

It is impossible to name all of the people who have contributed in some way to the task of formulating this plan, which is the combined effort of numerous planners and scientists. We appreciate the valuable help of Dr. Pakit Kiravanich, Mr. Chalernsak Wanichsombat and Dr. Sirikul Bunpapong. Special mention must be made for all those who wrote the reports on which this plan is based, particularly, Dr. Sanit Aksornkoe, Dr. Suraphol Sudara, Dr. Chumpool Ngampongsai, Mr. Robert Dobias, Dr. Subarn Panvisavas, Ms. Nisakorn Kositratana, Dr. Sittiporn Kajornatiyudh, Mr. Prawin Limpsaichol, Dr. Manuwadi Hungspreugs, Dr. Eddie Hum, Dr. Pisoot Vijarnsorn, Mr. Yodchai Karnasuta, Dr. Ruangrai Tokrisna, Dr. Sukhoom Rowchai, Mr. Somporn Lohsawatkul, Mr. Anucha Laksakundilok, Mr. Panat Tasneeyanond, Dr. Chandhana Indhapanya and Dr. Teerayut Poopetch.

Thanks are also due to the following ministries and departments of the Royal Thai Government:

- National Economic and Social Development Board
- Ministry of Agriculture and Cooperatives
  - Department of Fisheries
    - Brackishwater Fisheries Division
    - Marine Fisheries Division
    - Phuket Marine Biological Center
    - Phuket Marine Fisheries Station
  - Department of Land Development
  - Royal Forestry Department
- Ministry of Interior
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- Ministry of University Affairs
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  - Kasetsart University, Faculty of Fisheries
  - Mahidol University, Faculty of Environment and Resource Studies and Faculty of Social Sciences and Humanities
  - Prince of Songkla University, Faculty of Science
  - Srinakharinwirot University, Department of Aquatic Science

The following ASEAN/US CRMP staff in Manila are also acknowledged: Marie Sol M. Sadorra and Pamela P. del Rosario for editorial work; Rachel C. Josue and Eloisa E. Ben Belaid for typesetting the manuscript; Rachel C. Atanacio and Reynaldo C. Silvestre for drawing the figures and doing the layout; and Noel A. Robles for preparing the thematic maps.

## 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. Blessed 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 low-land 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, coastal erosion and land accretion.

The coastal zones of most nations in the Association of Southeast Asian Nations (ASEAN) are subjected to increasing population and economic pressures manifested by a variety of coastal activities, notably, fishing, coastal aquaculture, waste disposal, tin mining, oil drilling, tanker traffic, 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 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.

## Foreword

---

The ASEAN/United States (US) Coastal Resources Management Project (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 the US Agency for International Development (USAID) and executed by the International Center for Living Aquatic Resources Management (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 also developed site-specific CRM plans containing integrated strategies that are appropriate to the prevailing conditions in each nation.

In Thailand, the Upper South is the pilot study area. This region provides a sizable contribution to the country's economic growth, particularly from tourism and aquaculture. Over the next ten years, the government will have to develop more physical infrastructure to support growth in the manufacturing and industrial sectors in the coastal zone. Such accelerated economic development, however, has accompanying environmental costs and social conflicts.

Several agencies participated in the planning and implementation of the project. The Office of the National Environment Board (ONEB) of the Ministry of Science, Technology and Environment (MSTE) served as the coordinating agency with ICLARM providing technical assistance.

*The integrated management plan for Ban Don Bay and Phangnga Bay, Thailand* illustrates how the bays can be managed on a more sustainable basis. It outlines the key problems and presents action plans and individual projects to mitigate them. This is a dynamic plan that shall respond and adapt to the changing conditions in the coastal zone.

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Management Program, ICLARM

## EXECUTIVE SUMMARY

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### NEED FOR AN INTEGRATED MANAGEMENT PLAN

Thailand has 2,614 km of coastline: the west coast borders Andaman Sea while the east coast faces the Gulf of Thailand (South China Sea). Almost one-third of its 73 provinces border the sea. About 70% of the population lives within a few kilometers from the coast. Coastal lands are richly endowed with natural resources such as fertile soil, minerals, beautiful scenery, mangrove and hardwood forests. Coastal seas support coral reefs, seagrass beds and diverse fish stocks. Hence, the coastal zone is of utmost significance from socioeconomic standpoints.

The annual growth of the gross domestic product (GDP) has been in the region of 10% over the past five years, making it one of the fastest growing economies in the world. A sizable contribution is being made by the Upper South, a region comprised of four provinces: Surat Thani, Phangnga, Krabi and Phuket. The coastal resources of the Upper South are heavily utilized for economic development, particularly tourism and aquaculture. Over the next decade, the government will have to develop more physical infrastructure to support growth in the manufacturing and heavy industrial sectors in the coastal zone.

*Holistic planning and management considers the interrelationships of land and water, coastal resources and habitats, and resource-use conflicts and the environment.*

This accelerated economic expansion is not without costs and conflicts. Damage to coral reefs from water pollution, increased soil erosion and marine sedimentation resulting from logging, is an example of the potential negative impacts of development. Other conflicts are less obvious, such as when an aquaculture company wants to bulldoze a mangrove swamp to create fishponds. The needs of the aquaculture company conflict with those of the fishing industry because the mangrove swamp serves as a nursery for fish and shrimp larvae of value to the coastal and offshore fisheries industries.

The government and the other concerned sectors are undertaking a number of programs and projects to mitigate these problems. The present management strategies and actions, however, are highly sectoral and piecemeal in orientation. Experience has shown that a sectoral approach is inadequate to combat the multifaceted problems in the coastal zone; hence the need for a more holistic planning and management approach which considers the interrelationships of land and water, coastal resources and habitats, and resource-use conflicts and the environment.

The plan focuses on Ban Don Bay and Phangnga Bay because these are economic focal points of the region.

## Executive Summary

---

### FRAMEWORK AND PHILOSOPHY OF THE PLAN

Sustainability is the guiding philosophy of this plan.

The overall goal of the plan is to promote the sustainable development of the Upper South. Sustainable development as defined by the Brundtland Commission is development that does not compromise the future. It should be equitable not only among people alive today but for future generations as well. It also should be environmentally sound and economically feasible.

The objectives of the plan are:

1. Describe the region's natural resource base.
2. Point out current and potential resource-use issues and conflicts.
3. Suggest solutions to these issues.
4. Propose action plans and specific projects that will translate the desired management strategies into concrete actions.

### ACTION PLANS AND PROJECTS

These action plans and projects address three key coastal zone management (CZM) problems: environmental quality, resource exploitation, and institutional and organizational issues (Table A.1). These categories, however, overlap because individual issues often involve aspects of all three, e.g., public health is threatened by pollution, an environmental quality issue, while tin mining can cause pollution, a resource exploitation issue. Problems with the structure of the Health Department (HD) are organizational issues that will determine how the public health threat is dealt with.

Environmental quality issues deal with changes in the natural state of ecosystems and those that may cause health problems. Threats to rare and endangered species, loss of critical habitats, and air and water pollution are all issues included in this category. Resource exploitation issues involve utilization of natural resources, e.g., minerals, forests and fish. Institutional and organizational issues involve government setup and implementation of government policies.

The basic elements of the integrated management plan are its action plans and projects (Table A.2). The four action plans are: land use with three projects; water quality, four projects; fisheries, five projects, and tourism (islands and coral reefs), three projects. Considered high-impact projects, all 15 are expected to be implemented within five years. The implementation schedule is represented by the Gantt chart in Table A.2.

The implementation arrangements involve the lead agency, which is directly responsible for project implementation and monitoring and evaluation (M&E) as well as support agencies, which undertake or coordinate certain components of the project.

*The integrated management plan has 4 action plans and 15 high-impact projects which address environmental quality, resource exploitation, and institutional and organizational issues.*



Table A.1. A summary of management problems and projects that address them.

General	Problem		Project*														
	Specific		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Environmental quality	Water pollution						✓	✓	✓								
	Solid waste pollution						✓	✓	✓								
	Loss of wildlife habitats															✓	
	Loss of scenic value															✓	
	Tourism-related problems							✓	✓								✓
Resource exploitation	Mangrove forest conversion		✓	✓													
	Upland forest conversion				✓												
	Improper agricultural practices				✓												
	Over- and destructive fishing									✓			✓		✓		
	Shoreline erosion																✓
	Coral reef damage																✓
	Illegal hunting															✓	✓
Institutional and organizational issues	Adoption of integrated management plan					✓					✓	✓					
	Insufficient or overlapping regulations					✓											
	Lack of government agency interaction		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Inadequate extension and low public awareness										✓	✓					✓
	Ineffective law enforcement										✓	✓		✓	✓	✓	✓
	Socioeconomic inequities													✓	✓	✓	✓

\*The numbers correspond to the following projects:

Land Use Action Plan

1. Mangrove rehabilitation in Ban Don Bay
2. Pilot multiple-use management system in Ban Don Bay
3. Pilot site for soil conservation in the upland areas surrounding Phangnga Bay

Water Quality Management Action Plan

4. Institutional arrangements, Ban Don Bay
5. Coastal water quality monitoring, Ban Don Bay
6. Coastal water quality monitoring, Phangnga Bay
7. Tin mining pollution abatement, Phangnga Bay

Fisheries Action Plan

8. A study of the optimum fishing effort in Ban Don Bay

9. Educational program on fisheries management and conservation for the fishing communities in Ban Don Bay

10. Educational and public awareness program on fisheries management for the fishing communities in Phangnga Bay

11. Controlling and reducing fishing effort in Phangnga Bay through community cooperation

12. Educational and training programs on alternative occupations

Tourism Action Plan (islands and coral reefs)

13. Ko Phangan community-based resource management

14. Ko Taen community marine reserve

15. Ko Samui shoreline management, education and overall plan coordination

Executive Summary

Table A.2. A summary of action plans and projects in the integrated management plan for Ban Don Bay and Phangnga Bay.

Action plan/project	Organization and management	Duration (year)	Cost (US\$)	Schedule				
				1992	1993	1994	1995	1996
Land use								
1. Mangrove rehabilitation in Ban Don Bay	RFD	ONEB, donor agencies, public	9,280					
2. Pilot multiple-use management system in Ban Don Bay	ONEB	DOF, RFD, DLD	275,000					
3. Pilot site for soil conservation in the upland areas surrounding Phangnga Bay	DLD	RFD, ONEB, public	186,000					
Water quality management								
1. Institutional arrangements, Ban Don Bay	ONEB	NESDB, PC, NGOs, donor agencies	151,000					
2. Coastal water quality monitoring, Ban Don Bay	ONEB	MOInd, donor agencies	86,000					
3. Coastal water quality monitoring, Phangnga Bay	ONEB	MOInd, donor agencies	86,000					
4. Tin mining pollution abatement, Phangnga Bay	ONEB/DMR	Private sector, PC	20,000					
Fisheries								
1. A study of the optimum fishing effort in Ban Don Bay	DOF	ONEB, PC, KU	172,000					
2. Educational program on fisheries management and conservation for the fishing communities in Ban Don Bay	ONEB	DOF, MOE, PC	248,000					
3. Educational and public awareness program on fisheries management for the fishing communities in Phangnga Bay	ONEB	DOF, MOE, PC	166,000					
4. Controlling and reducing fishing effort in Phangnga Bay through community cooperation	DOF	PC	164,000					
5. Educational and training programs on alternative occupations	ONEB	MOI, DOF, PC, private sector	166,000					
Tourism (islands and coral reefs)								
1. Ko Phangan community-based resource management	ONEB	TAT, PCDA, DOF, PC	120,000					
2. Ko Taen community marine reserve	ONEB	TAT, PCDA, DOF, PC	80,000					
3. Ko Samui shoreline management, education and overall plan coordination	ONEB	TAT, PCDA, DOF, PC, private sector	524,000					
Subtotal			916,000					
Grand Total			2,453,280					

Unless otherwise specified.

- DLD - Department of Land Development
- DMR - Department of Mineral Resources
- DOF - Department of Fisheries
- KU - Kasetsart University
- MOE - Ministry of Education
- MOI - Ministry of Interior
- MOInd - Ministry of Industry
- ONEB - Office of the National Environment Board
- PCDA - Population and Community Development Association
- PC - Provincial Government
- RFD - Royal Forestry Department
- TAT - Tourism Authority of Thailand

## **Executive Summary**

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The total investment cost is \$2,453,280. Mangrove Rehabilitation in Ban Don Bay costs the least at \$9,280 while Ko Samui Shoreline Management, Education and Overall Plan Coordination costs the most at \$524,000. For action plans, fisheries costs the most at \$916,000 while water quality management costs the least at \$343,000.

The Upper South Region will undoubtedly undergo enormous transformations during the last decade of this century and the first decades of the next. Such transformations, however, need not sacrifice the coastal environment and resources. This plan illustrates concretely how both might be managed on a more sustainable basis.



## CHAPTER 1

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### INTRODUCTION

#### **SIGNIFICANCE OF THE COAST**

Thailand has 2,614 km of coastline: the west coast borders Andaman Sea while the east coast faces the Gulf of Thailand (South China Sea). Almost one-third of Thailand's 73 provinces border the sea. About 70% of the population lives within a few kilometers from the sea. Coastal lands are richly endowed with natural resources such as fertile soil, minerals, beautiful scenery, mangrove and hardwood forests. Coastal seas support coral reefs, sea-grass beds and diverse fish stocks. The coast is thus the focus of much socio-economic activity.

#### **NEED FOR AN INTEGRATED MANAGEMENT PLAN**

The growth of GDP in Thailand was 10% or higher from 1988 through 1990, making it one of the fastest growing economies in the world. Although it slowed somewhat in 1991, this growth continues. A sizable contribution is being made by the Upper South, a region comprised of four provinces: Surat Thani, Phangnga, Krabi and Phuket. Several sectors of the Upper South economy are contributing to the growth, but tourism and aquaculture have shown particularly rapid expansion. Over the next decade, the government will have to develop infrastructure such as roads, ports, water supply facilities and power plants to support growth in the manufacturing and heavy industry sectors. But this economic expansion is not without costs and conflicts.

During periods of rapid growth, there are often conflicts between parties competing for natural resources. Some conflicts are obvious, such as when a farm competes for water needed for irrigation with a nearby company that requires water for a manufacturing plant. Other conflicts are less obvious, such as when an aquaculture company wants to bulldoze a mangrove swamp to create fishponds. The needs of the aquaculture company conflict with those of the fishing industry because the mangrove swamp serves as a nursery for fish and shrimp larvae of value to coastal and offshore fisheries industries.

Several issues that have received considerable media attention involve conflicts between individual or firm interests and the interests of society. Damage to coral reefs, caused by water pollution, increased soil erosion and marine sedimentation resulting from logging, is an example of the potential

## Chapter 1. Introduction

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negative impacts of development. In each case, the activities of individuals or firms conflict with the greater social good.

The planning process provides an opportunity to minimize costs and conflicts. First, available resources and potential resource users are identified. Then, geographical zones are delineated which serve as a guide for land use. Specific development goals are laid out and projects are designed to help meet those goals. Changes in government regulations and operation are recommended. The participation of the general public and nongovernmental organizations (NGOs) is encouraged throughout.

Certain natural resources, e.g., endangered species or rare forest ecosystems, may be unique and therefore irreplaceable. A management plan identifies such resources and suggests ways of protecting them indefinitely.

### CONTEXT AND BACKGROUND OF THE PLAN

#### Subregional Development Study

In 1983-1985, the Japan International Cooperation Agency (JICA), produced *The subregional development study of the Upper Southern part of Thailand* (1985) which outlined the future development of the Upper South within a tripartite framework of internationalization, industrialization and decentralization.

By virtue of its strategic location, the Upper South could play a key role in the expansion of international trade between Thailand and the Middle East, Europe and Japan. It would also play a major role in integrating the South Region with the rest of the country. Thirdly, it could serve as an alternative urban and industrial complex to Bangkok and the Eastern Seaboard and thus, facilitate a more balanced distribution of population in the country.

Spatial development strategies proposed for the Upper South include:

1. Develop Surat Thani/Phun Phin into a major industrial distribution and urban center on the basis of its strategic location which could easily link various parts of the country and its rich resource potential in the hinterland. This would include building a deepsea port at Khanom and establishing industrial zones and estates in Surat Thani.
2. Reinforce the link between Surat Thani/Phun Phin and Phuket to link the economy of the western world and the Andaman Sea coast more closely with Bangkok. This east-west link would obviate the need for Thai ships heading for western markets to take the long way round Malaysia and Singapore (Strait of Malacca). Instead, goods would travel



## Chapter 1. Introduction

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from Bangkok to the Phuket International Port via Surat Thani and then on to the west. The need for improved road links between urban centers was highlighted.

3. Utilize fully the resources available in the hinterland through (a) agricultural expansion and intensification; (b) environmental rehabilitation; and (c) intermediate agro-industrial development in the area.

### Sixth National Economic and Social Development Plan

*The sixth national economic and social development plan (NESDP) 1987-1991 (RTG 1987)* earmarked the Upper South for priority development. Its objectives are to develop the region's economic links with the rest of the country and internationally as well as promote economic and social development while protecting and enhancing natural development.

The strategy highlights three main sectors for future economic development: tourism, agriculture and manufacturing/industry.

### Upper South Region Development Program

A further study of the Upper South was conducted by the National Economic and Social Development Board (NESDB) (1988) with technical assistance from the Asian Development Bank (ADB). *The Upper South Region development program* reviewed the JICA study, identifying project priorities and preparing these for implementation. Changing national socioeconomic conditions led the NESDB team to reject or defer some of JICA's project proposals.

Twenty priority projects were listed, 11 of which are located within the planning area of ASEAN/US CRMP.

Rank	Project
3	East-West Road Link (linking Surat Thani and Phuket)
4	Surat Thani/Phun Phin Industrial Promotion Zone
5	Surat Thani Industrial Estate
6	Surat Thani Water Supply
7	Department of Highways Road Program 1987-1991
10	Tha Thong Port Development
10	Ko (meaning "island") Samui Water Supply System
13	Various projects included in the National Tourism Development Project
14	Ko Samui Water Supply
18	Central Lowland Development
19	Surat Thani Slum Upgrading

## Chapter 1. Introduction

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The NESDB study recognized that although the Royal Thai Government (RTG) was committed to the development of the Upper South, very little action had been taken so far to implement the JICA proposals. It was hoped, however, that the new priorities would provide impetus for feasibility and detailed design studies of priority projects, project preparation studies, and efforts to improve local government (LG) administration capacity to encourage and support development. No specific mention was made of the likely environmental effects of the priority projects; it was implicit that the environmental impact assessment (EIA) process would ensure that environmental values be given appropriate consideration.

### ASEAN/US Coastal Resources Management Project

The implementation of ASEAN/US CRMP, which began in the last quarter of 1986, was funded by USAID and the ASEAN member-countries themselves. The ICLARM acted as project executing agency and provided technical and administrative support.

The project has two major components: information dissemination and manpower development, and the development of site-specific CRM plans.

Designated project sites were Ban Don Bay and Phangnga Bay in the Upper South, a region earmarked by RTG for intense economic development in the next decade. Serious resource-use conflicts and worsening resource degradation in the region's coastal zone make an issue-based CRM plan a high priority.

The planning process was divided into three, nondiscrete stages with ONEB acting as lead agency. Resource assessment and planning work was carried out entirely by local planners and scientists, with ICLARM providing technical assistance as needed.

The three stages were undertaken as follows:

1. *Design* began with a preliminary reconnaissance survey to make a tentative diagnosis of the sites and prepare baseline information and a work-plan. This stage ended with the preparation of an environmental profile of both bays (Paw et al. 1988).
2. *Execution* had two phases. Phase 1 involved a relatively in-depth resource assessment of the sites. Principal needs and problems, resource-use trends, development potentials and constraints were all identified. This phase ended with interim reports which named conflicts and issues and proposed management and development strategies.

Phase 2 concentrated on the formulation and preparation of four issue-based action plans including resource management strategies and policies. These are: "Coral reefs, beaches and shoreline development in Ban

*Designated project sites are Ban Don Bay and Phangnga Bay in the Upper South, a region earmarked for intense economic development in the next decade.*

Don Bay and Phangnga Bay"; "Mangroves, land use, wildlife and aquaculture in Ban Don Bay and Phangnga Bay". Statements of management were also drawn up for Mu Ko Ang Thong National Marine Park (NMP) in Ban Don Bay and Phangnga Bay NMP. An overall tourism action plan highlighting project area priorities for implementation has also been produced (see Chapter 9).

3. The actual *implementation* of the policies and projects is the last stage. Project designs will be refined with the assistance of government agencies, NGOs, local communities, interest groups and the private sector. The ONEB will direct and monitor the implementation process and offer guidance and support where necessary.

The time frame of the plan includes short- (0-5 years), medium- (6-10 years) and long-term considerations.

### PLANNING AREA

The planning area is shown in Fig. 1.1. Although the plan will cover all natural resources and significant socioeconomic activities in the Upper South, the emphasis will be on Surat Thani, Krabi and Phangnga Provinces. Focus will be on Ban Don Bay (Fig. 1.2) and Phangnga Bay (Fig. 1.3), which are economic focal points for the region. Figs. 1.4 and 1.5 show the cross-sectional profiles of the coasts along Ban Don Bay and Phangnga Bay, respectively.

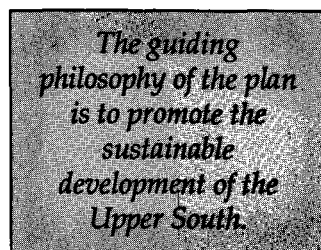
### OBJECTIVES OF THE PLAN

The guiding philosophy of the plan is to promote the sustainable development of the Upper South. Sustainable development as defined by the Brundtland Commission is development that does not compromise the future. For development to be sustainable, it should also be equitable not only among people alive today but for future generations as well.

The specific objectives of the plan are:

1. Describe the region's natural resource base.
2. Point out current and potential resource-use issues and conflicts.
3. Suggest solutions to these issues.
4. Propose action plans and specific projects that will translate the desired management strategies into concrete actions.

This introductory chapter has presented the need for an integrated management plan for Upper South's Ban Don Bay and Phangnga Bay and listed the specific objectives of the plan. Chapter 2 gives an overview of the environmental and socioeconomic setting of the Upper South.



The guiding philosophy of the plan is to promote the sustainable development of the Upper South.

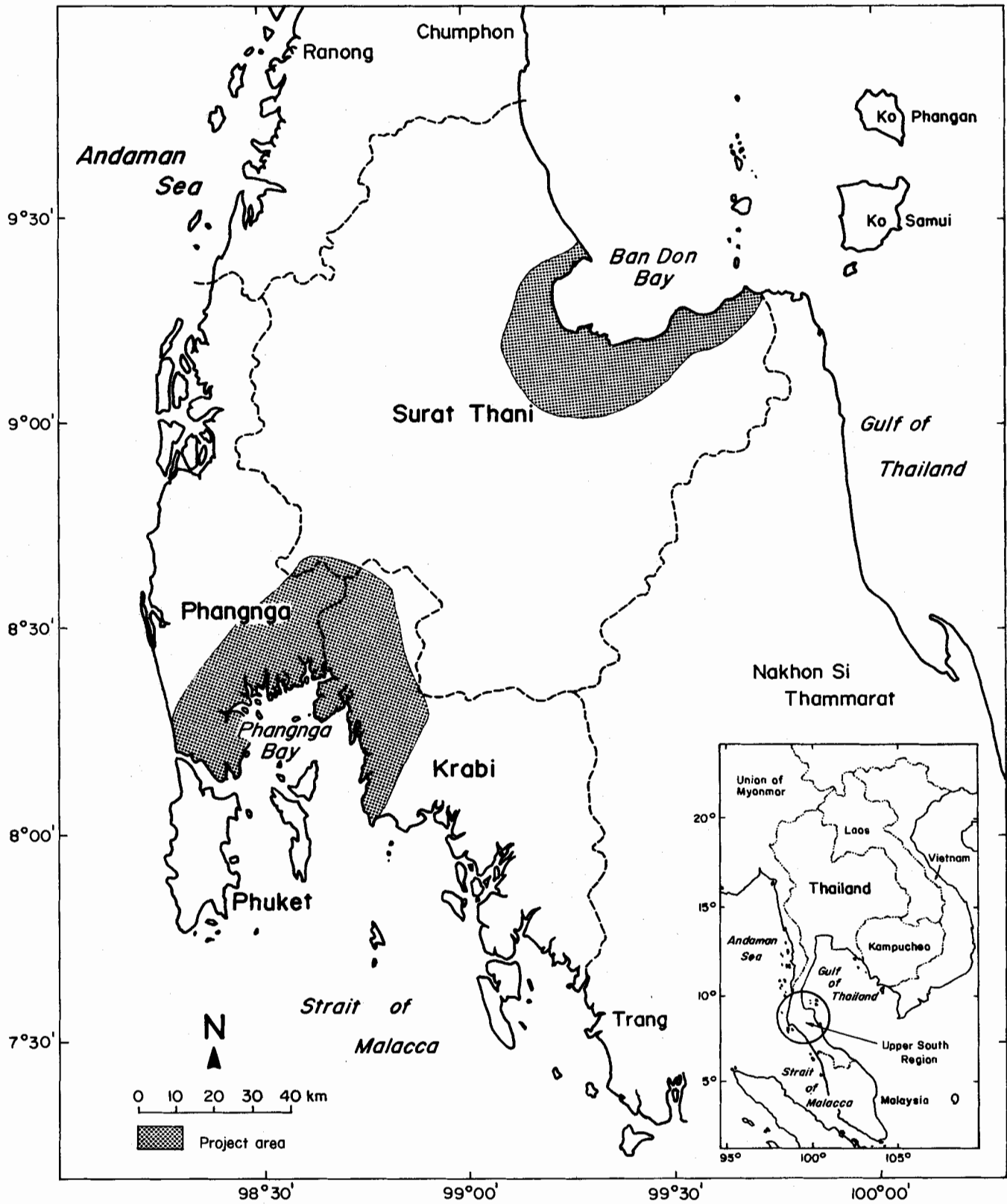


Fig. 1.1. The planning area in the Upper South Region.

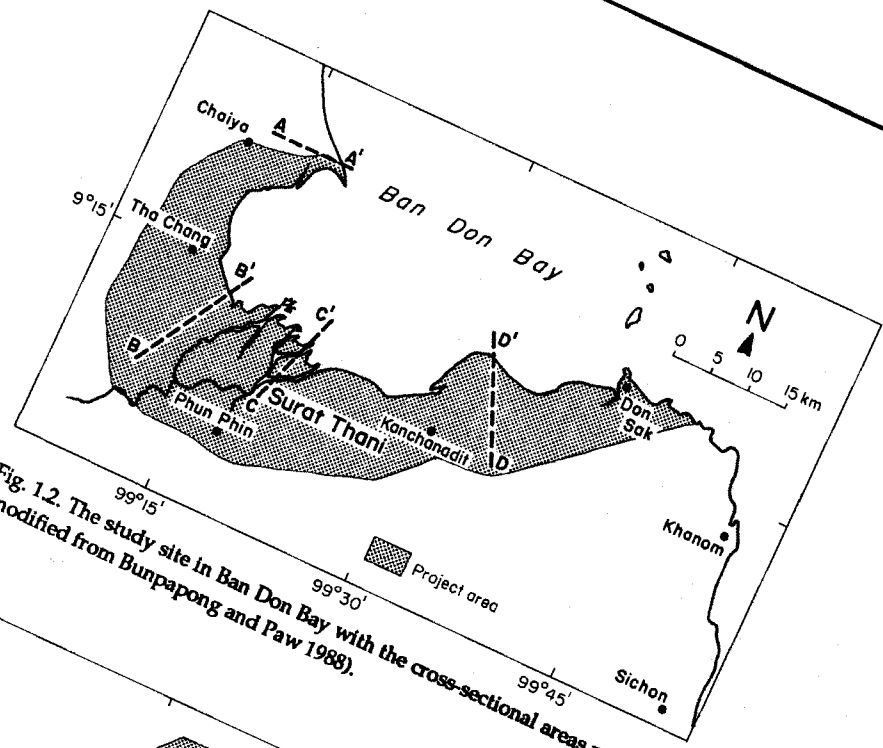


Fig. 1.2. The study site in Ban Don Bay with the cross-sectional areas marked (modified from Bunpaong and Paw 1988).

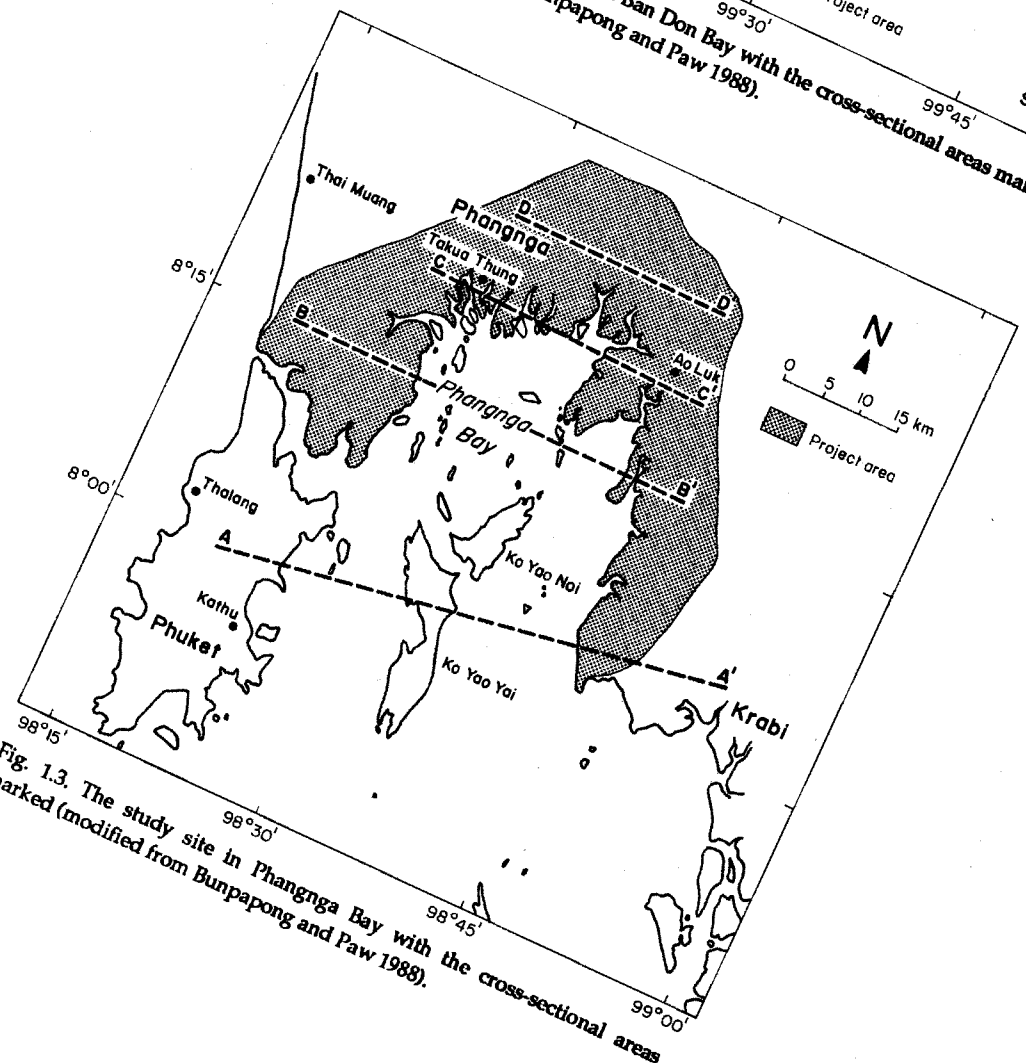


Fig. 1.3. The study site in Phangnga Bay with the cross-sectional areas marked (modified from Bunpaong and Paw 1988).

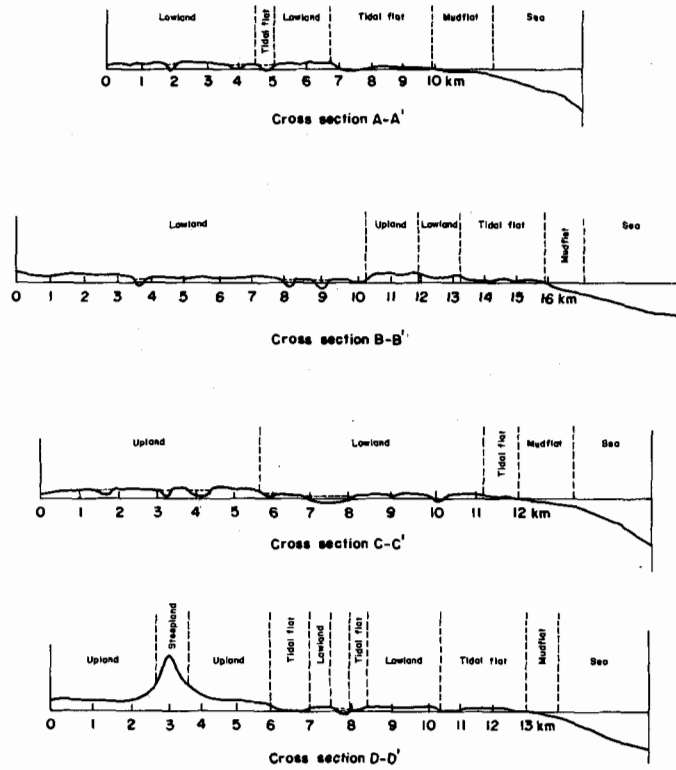


Fig. 1.4. Cross-sectional profiles of the coasts along Ban Don Bay (Bunpamong and Paw 1988).

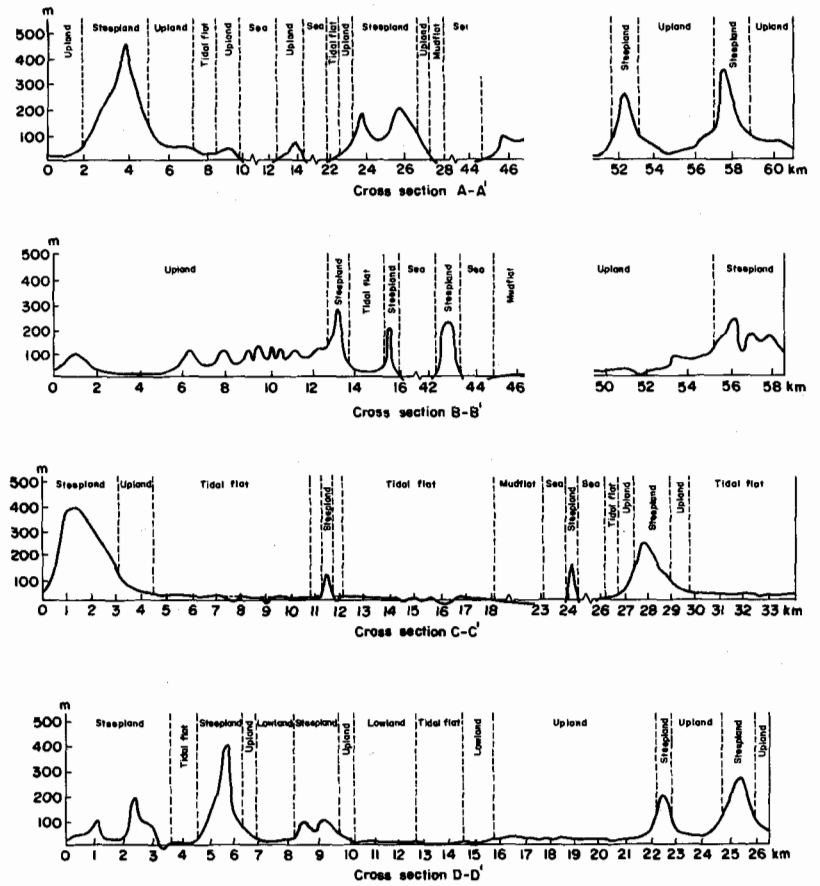


Fig. 1.5. Cross-sectional profiles of the coasts along Phangnga Bay (Bunpamong and Paw 1988).



## CHAPTER 2

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# BIOPHYSICAL AND SOCIOECONOMIC SETTING

### PHYSICAL SETTING

#### Topography and Geology

*The Upper South Region lies in a rich tin-bearing granite belt which intrudes folded sedimentary rocks along the length of the upper Malay Peninsula.*

The Upper South Region has a total area of about 52,600 km<sup>2</sup> and is situated on the upper part of the Malay Peninsula. The region lies between the Gulf of Thailand on the east and Andaman Sea on the west.

Two parallel mountain ranges are situated in the Upper South (Fig. 2.1). The Phuket Range runs southward along the peninsula from Khlong (K., meaning "river") Khura Buri, close to the west coast and south to Ko Phuket descending into Andaman Sea. The range is about 400 km long and 25-75 km wide. The mountains reach heights of 600-900 m.

Located about 100 km from the Phuket Range to the east is the Nakhon Range which stretches northwards from the extreme southwest of Satun to the Gulf of Thailand and marks a few islands such as Samui and Phangan. The Central Lowland, a flat land forming the watershed of the Tapi River System, is situated between the two ranges (Bunpapong and Paw 1988).

The region lies in a rich tin-bearing granite belt which intrudes folded sedimentary rocks along the length of the upper Malay Peninsula. Two major faults occurring in the north-south and northeast-southwest directions strongly influence the topography of the region. Sedimentary rocks, particularly remnants of Permian limestones, form steep-sided hills and ridges which are extensive in the west coast.

Along Phangnga Bay, some of these large limestone ridges display a well-marked karst topography. Lowlands, particularly along the coast and the central basin, are composed generally of alluvial deposits. Detrital materials along beaches contain economically important minerals such as tin, rare-earth minerals and quartz. Most of these minerals are derived from the erosion of coastal mineral-bearing granitic formations. Marine sediments, on the other hand, are mostly composed of mud, sand, silt and gravel which

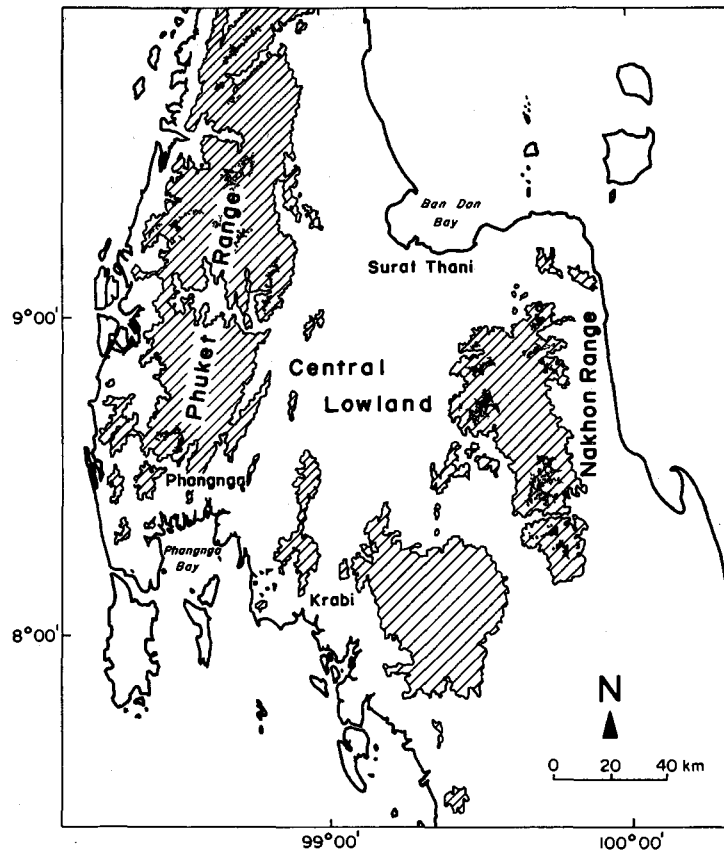


Fig. 2.1. Mountain ranges in the Upper South (Bunpapong and Paw 1988).

probably came from fluvial sediment deposits as well as from weathering and erosion of rock formations along the coast (Bunpapong and Paw 1988).

## Climate

The climate is intermediate between equatorial and tropical monsoon types and is characterized by a constant high temperature without extremes of heat; high rainfall with little risk of monsoon failure; and a dry season of moderate severity. Dry season generally occurs in February and March on the east coast and December to March on the west coast. In April, rainfall intensifies on the west coast due to the southwest monsoon and lasts from June to September. Rainfall on the east coast is moderate at about 100 mm/month until the onset of the northeast monsoon in September. Precipitation intensifies up to 500 mm around November (Fig. 2.2).

In coastal areas, mean monthly temperature ranges from 29°C (sometimes up to 39°C inland), usually in the wettest month, to 33-35°C, usually in April. Mean monthly minimum ranges from 20°C in January to 24°C in May. Inland temperature may fall to 13°C in January. Coastal areas generally have uniform temperatures but it is not uncommon for extremes at some sheltered inland sites to be outside the 12-39°C range.

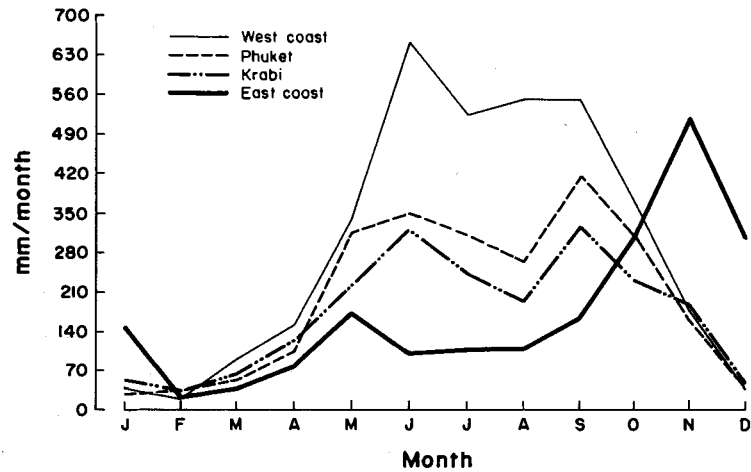


Fig. 2.2. Mean annual rainfall pattern in the Upper South, 1969-1978 (Bunpapong and Paw 1988).

## Soils

Major soil types in the Upper South found in coastal, lowland, upland and steepland areas are shown in Fig. 2.3. Classification is based on the standards set by the US Department of Agriculture soil taxonomy.

## Coastal soils

Coastal soils in mangrove swamps and tidal flats or beach ridges (unit 1.1 in Fig. 2.3), in general, are classified as Sulfaquents or Hydraquents. These soils are permanently saturated with saline water. Sulfaquents have an appreciable amount of sulfides and are generally associated with acid sulfate soils.

In the Ban Don Bay area, two main soil types can be distinguished: the muddy soils developed in the lower part of the tidal range and the acid sulfate or potentially acid sulfate soils (unit 2.1) in the upper part. The less developed muddy soils are mostly found in submerged condition and are alkaline in reaction. They have dark gray color, clayey texture and many decayed roots in the profile. The surface layer is about 20-30 cm thick.

Most soils in Phangnga Bay mangrove areas are derived from clayey and silty sediments. The soils have a clayey texture throughout the profile when undisturbed by mining activities. Yellowish or brownish mottles are observed in the upper soil profile, particularly the oxidized layers. The lower part of the profile, the C-horizon, is always saturated with water which results in a bluish color or strong graying condition. The soils are alkaline (pH 7-8) in reaction and are generally moderately fertile and high in organic matter. Mudballs are generally observed.



Most of the loamy soils (unit 2.2) occupy the lower part of alluvial terraces or transitional sites between terraces and coastal lowlands. These soils are commonly classified into Plinthaquults and Paleaquults. The former have dark red mottles usually in platy, polygonal or reticulate pattern; the latter do not have these. Loamy soils are exclusively used for paddy rice. Average yield under ordinary management is 1,560-2,190 kg/ha.

The clayey soils (unit 2.3) occupy the basin of large rivers or former tidal flats. They are classified as Tropaquepts and Paleaquults and most have been cultivated for paddy rice, with the yield somewhat higher than that of loamy soils.

### **Upland soils**

Upland soils commonly occur on undulating to rolling topography with slope ranges of 3-35%. Their parent materials vary from old alluvium to transported material derived from various rocks. Upland soils are subdivided into these units:

- The deep to moderately deep loamy soils (unit 3.1) comprise Dystropepts, Paleudults, Tropudults and Plinthudults which are moderately to well-drained and have rapid to moderate runoff. The natural fertility is relatively low. Lateritic gravels may occur in the lower subsoils.
- The deep to moderately deep clayey soils (unit 3.2) belong only to Paleudults. Their characteristics are similar to those described in unit 3.1 except that the former have more clay content in subsoils.
- The shallow soils (unit 3.3) comprise those containing lateritic gravels or rock fragments throughout the soil profiles. Those containing lateritic gravels can be classified into Paleudults; otherwise, they can be classified into Tropudults or Troporthents.

### **Steepland soils**

About 32% of the total area of the Upper South has soils which occur on steep-sided hills and mountains. The soil texture and thickness of the solum are variable depending on the nature of the parent rocks. These soils are highly susceptible to erosion even though they are cultivated with tree crops. In general, tropical evergreen forest remains dominant except in areas with commercial timbers.

### **Surface Water Resources**

#### **Catchment area**

There are a number of catchment areas between Phuket and Nakhon Ranges. The Phum Duang River Basin is the largest, covering 6,125 km<sup>2</sup>, or 41% of the total catchment area. This is followed by the Tapi River Basin covering about

## Chapter 2. Biophysical and Socioeconomic Setting

5,460 km<sup>2</sup> or 37% of the total catchment area (Fig. 2.4). The headwater of K. Phum Duang is situated in the west and drains mainly on the eastern slopes of Phuket Range with several substantial tributaries such as K. Saeng, K. Sok and K. Yan. From the south is K. Tapi which drains into an extended part of the Central Lowland and the western slopes of Nakhon Range. The two main rivers join about 10 km west of Surat Thani, forming an extended delta as they discharge into the Gulf of Thailand.

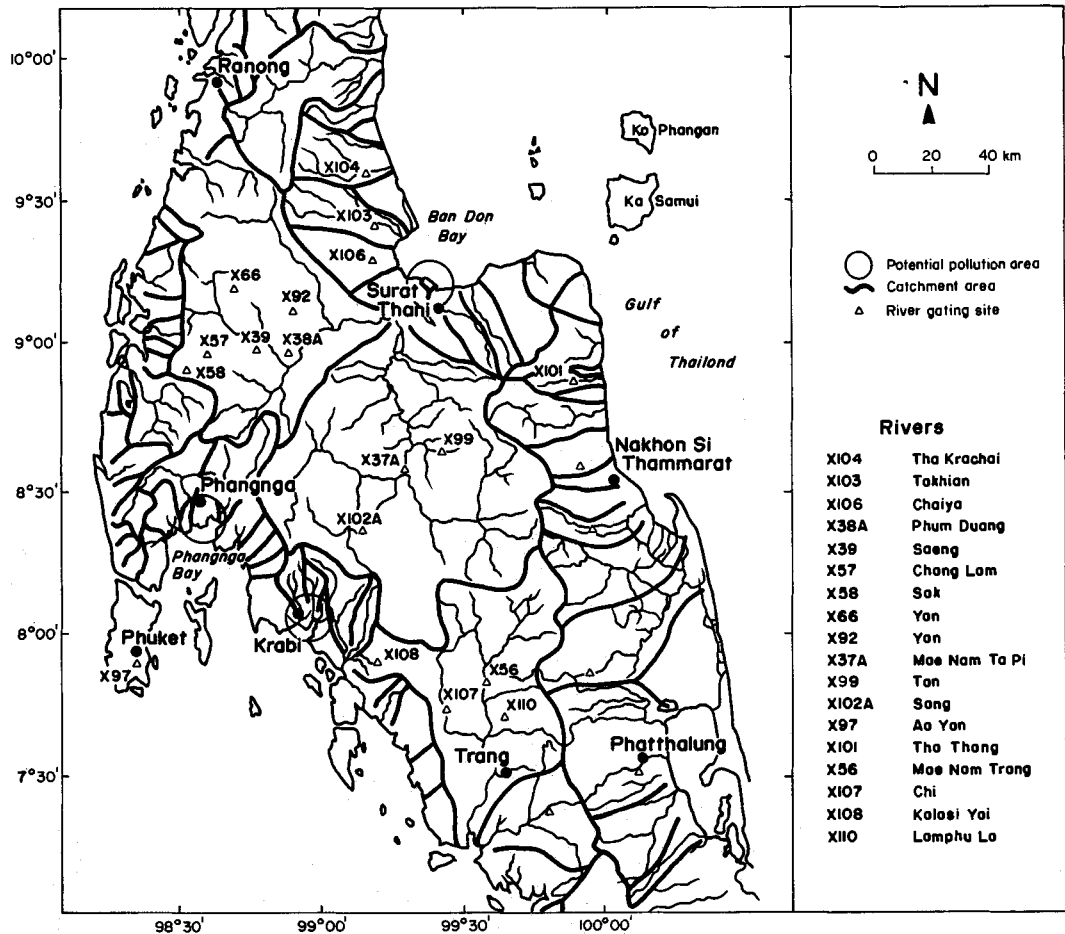


Fig. 2.4. Catchment areas of rivers in the Upper South (Kositratana 1988).

### Drainage system

Most of the surface freshwater discharge into Ban Don Bay is from the Tapi-Phum Duang River Watershed (Fig. 2.4). Several smaller coastal watersheds also contribute to the total freshwater runoff to the bay. The Tapi-Phum Duang River System includes several subwatersheds in the mountains of Surat Thani which form a drainage system flowing to the north and north-east and discharging into the bay in Amphoe (A., meaning "second-order administrative district") Muang, Surat Thani.

## Chapter 2. Biophysical and Socioeconomic Setting

The surface freshwater discharge into Phangnga Bay planning area is from several relatively small coastal watersheds in Phangnga and Krabi Provinces. The most significant flow comes from K. Phangnga, K. Bo San and K. Marui in Phangnga Province, and K. Krabi and K. Thom in Krabi.

Annual runoff in K. Tapi and K. Phum Duang amounts to more than 10 billion t (60% of the runoff in the whole South Region). The small river basins, particularly those facing Andaman Sea, can provide no more than 50,000 m<sup>3</sup>/day.

The hydrological characteristics of the Upper South rivers are summarized in Table 2.1 and Figs. 2.5 and 2.6. The ratio of the maximum and minimum discharges appears to be extremely high in most rivers, which implies that monthly discharges fluctuate according to seasonal precipitations.

Table 2.1. Hydrological characteristics of selected rivers in the Upper South, 1984.

No.	River	Catchment area (km <sup>2</sup> )	Discharge (m <sup>3</sup> /s)			Ratio Maximum/minimum	Annual runoff (million m <sup>3</sup> )
			Mean	Minimum	Maximum		
X104	Tha Krachal	354	10.99	0.30	203.20	677	347.6
X103	Takhian	180	3.91	0.00	140.68	-	123.8
X106	Chaiya	309	5.03	0.00	41.42	-	159.1
X38A	Phum Duang	2,706	179.60	5.70	1,686.60	296	5,679.3
X39	Saeng	1,437	116.60	4.70	1,437.60	306	3,886.2
X57	Chong Lom	8	1.31	0.11	22.66	206	41.3
X58	Sok	312	26.36	2.00	250.05	125	833.7
X66	Yan	661	36.00	1.80	561.00	312	1,138.3
X92	Yan	1,001	44.24	5.00	473.00	95	1,399.0
X37A	Mae Nam Ta Pi	5,200	131.92	16.50	421.60	26	4,171.5
X99	Tan	105	1.78	0.28	14.08	51	56.4
X102A	Sang	152	2.76	0.04	21.88	547	87.4
X97	Ao Yan	2	0.02	0.00	1.64	-	0.5
X101	Tha Thong	95	3.49	0.41	226.90	553	110.4
X56	Mae Nam Trang	1,801	31.34	3.28	214.60	65	990.9
X107	Chi	248	4.68	0.23	48.61	211	147.9
X108	Kalasi Yai	57	0.70	0.13	5.08	39	22.0
X110	Lamphu La	229	3.82	0.13	28.83	222	120.8

Source: Kositratana (1988).

### Water quality

The results of the monitoring of the lower K. Phum Duang show a large conductivity range (Table 2.2). This indicates the influx of freshwater during the rainy season while tidal influence is apparent during the dry season which results in brackishwater condition.

A two-day nearshore water quality survey was carried out in 1984 at K. Boa Dan which discharges into Phangnga Bay. This study provides limited

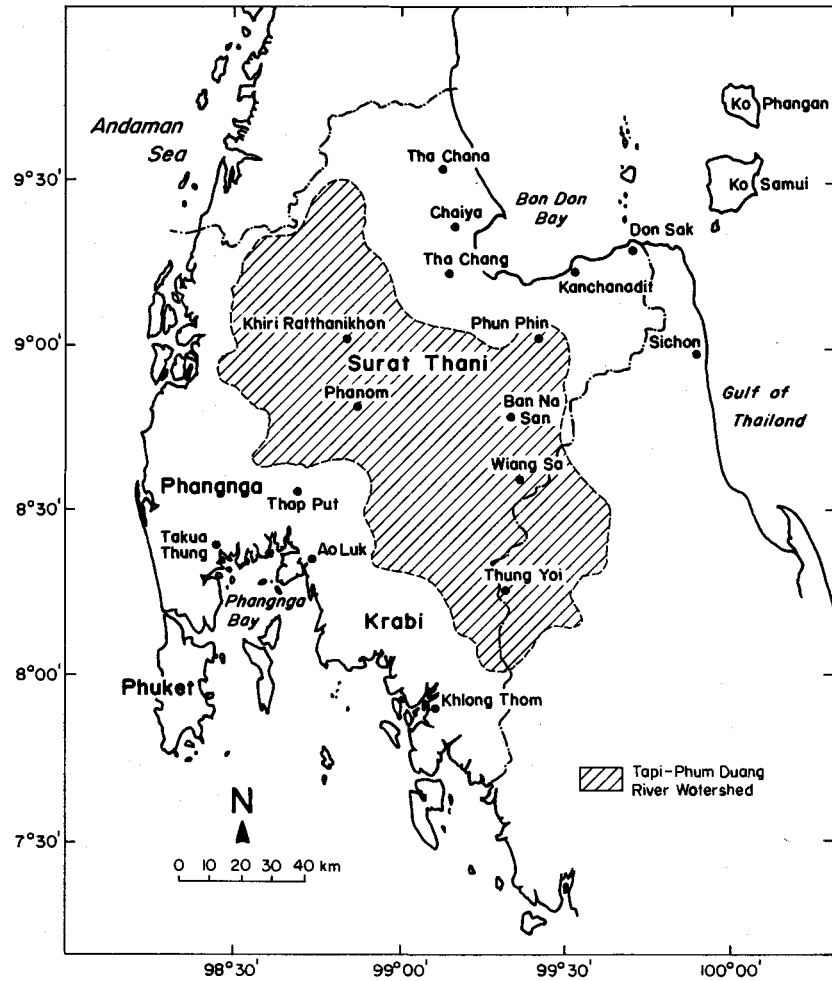


Fig. 2.5. Tapi-Phum Duang River Watershed, Upper South (Bunpapong and Paw 1988).

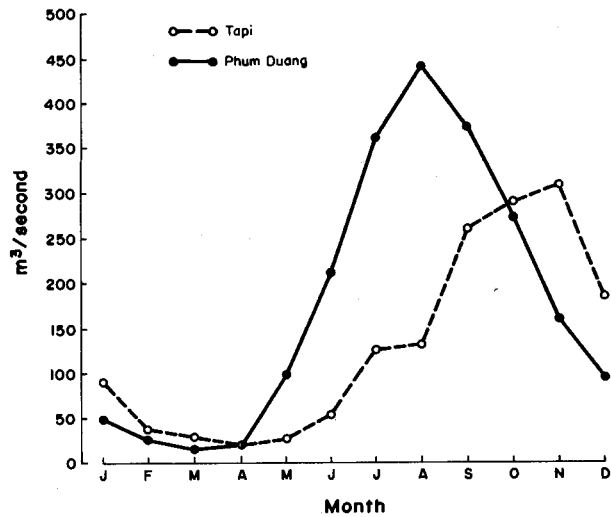


Fig. 2.6. The monthly discharge of K. Tapi and K. Phum Duang into Ban Don Bay (Kositratana 1988).



## Chapter 2. Biophysical and Socioeconomic Setting

information on diurnal fluctuation of water quality at the mouth of the river including some nutrient concentrations.

In general, information on surface water quality is limited, but the most significant influence is that of silt from upland activities. Also, extreme fluctuations in salinity have implications for culture activities in the area.

Table 2.2. Range of water quality parameters from K. Phum Duang, 1986.

Month	pH	Temperature (°C)	Conductivity (µmho/cm)	DO (mg/l)	COD (mg/l)
January	7.4-7.9	28.2-29.7	160.3-177.3	5.2-6.1	-
February	7.1-7.8	27.1-30.4	138.4-245.0	4.9-6.8	-
March	7.4-7.9	26.6-31.5	275.0-181.5	4.7-6.5	-
April	7.3-7.8	29.4-32.9	214.0-285.0	4.2-6.6	15.1-17.6
May	6.9-7.9	26.3-31.0	51.5-284.0	4.3-6.8	0.4-27.3
June	7.0-7.8	26.7-29.5	83.8-143.9	4.5-7.2	0.4-33.1

DO - Dissolved oxygen.

COD - Chemical oxygen demand.

Source: Kositratana (1988).

## BIOLOGICAL SETTING

### Mangrove Forests

Many commercially important marine animals especially fishes, shrimps, crabs and various kinds of mollusks use mangroves as their nursery ground and shelter areas during their juvenile stage. The primary nutrient source for organisms in mangrove-dominated estuaries is detritus, i.e., particulate organic material derived from decomposing forest litter. One study concluded that the annual mangrove litter fall range is 6.9-9.4 t dry weight/ha/year. Such amount of litter, when decomposed, injects considerable nutrients into the mangrove ecosystem. Moreover, mangrove forests contribute to alluvial plain development and protect land against storm-tide surges, cyclones and soil erosion. They also provide habitat for numerous rare or endangered wildlife species such as the masked finfoot, saltwater crocodile and smooth-coated otter.

Strong wave energy inhibits the formation of extensive mangrove forests at Ban Don Bay. Muddy sediments have been deposited along the river mouth and mangroves are well established there. Coverage, however, is along a narrow strip as tidal range is not great. Phangnga Bay provides a better environment for mangroves. It has a larger tidal range and a very gentle sloping or flat land form. This, combined with low wave energy, has resulted in considerable deposition of sediment, clay, silt and organic matter. Limestone and other rock formations also offer good shelter and wind protection.

## Chapter 2. Biophysical and Socioeconomic Setting

The total extent of mangrove in Thailand in 1986 was estimated at 268,694 ha (TDRI 1987). According to Aksornkoae (1987), mangroves in Phangnga Bay and Ban Don Bay covered 19,638 and 4,160 ha, respectively. The figures for the various districts are presented in Table 2.3. The geographical distribution of mangroves in Ban Don Bay and Phangnga Bay is shown in Figs. 2.7 and 2.8, respectively. Dominant species are *Rhizophora* spp., *Avicennia alba*, *Sonneratia alba*, *Xylocarpus* spp. and *Bruguiera* spp.

Table 2.3. Mangrove areas (ha) in Phangnga Bay and Ban Don Bay, 1987.

Phangnga Bay	Area	Ban Don Bay	Area
Phangnga Province		Surat Thani Province	
A. Takua Thung	5,731	A. Chaiya	1,784
A. Muang	7,487	A. Tha Chang	404
A. Thap Put	1,955	A. Phun Phin	411
A. Ko Yao Noi	85	A. Muang	508
		A. Kanchanadit	836
		A. Don Sak	217
Krabi Province			
A. Ao Luk	4,380		
<b>Total</b>	<b>19,638</b>		<b>4,160</b>

Source: Modified from Aksornkoae (1987).

### Species zonation

Different species tend to dominate certain bands or zones which are clearly differentiated. Still, some overlapping occurs. The zonation patterns may result from differences in species adaptation to adverse site conditions, e.g., waterlogged soils, salinity, poor soil aeration and strong prevailing seashore winds. Adaptations include stilt roots, pneumatophores, thick and leathery leaves with thick cuticle, water storage tissues, salt-secreting glands, fruits and seeds capable of floating on water for several days without deterioration, vivipary or human interference. In Phangnga Bay, *Rhizophora* spp. are mainly found along the banks of estuaries and rivers where the soil is waterlogged and very muddy. Occasionally, these are also found associated with *Ceriops* sp. Belts of species of *Bruguiera*, variable in width, occur behind the zone of *Rhizophora*. *Sonneratia* and *Avicennia* species tend to be distributed in a well-defined zone and usually occur along the margin of estuaries and canals where the soils are rather silty or sandy. The *Xylocarpus* community generally occupies the area behind the *Bruguiera* community. The *Xylocarpus* spp. can also be found at the forest margin where the riverbank is rather elevated. The *Excoecaria* community has a wide distribution and is abundant throughout the drier area on inland sites.

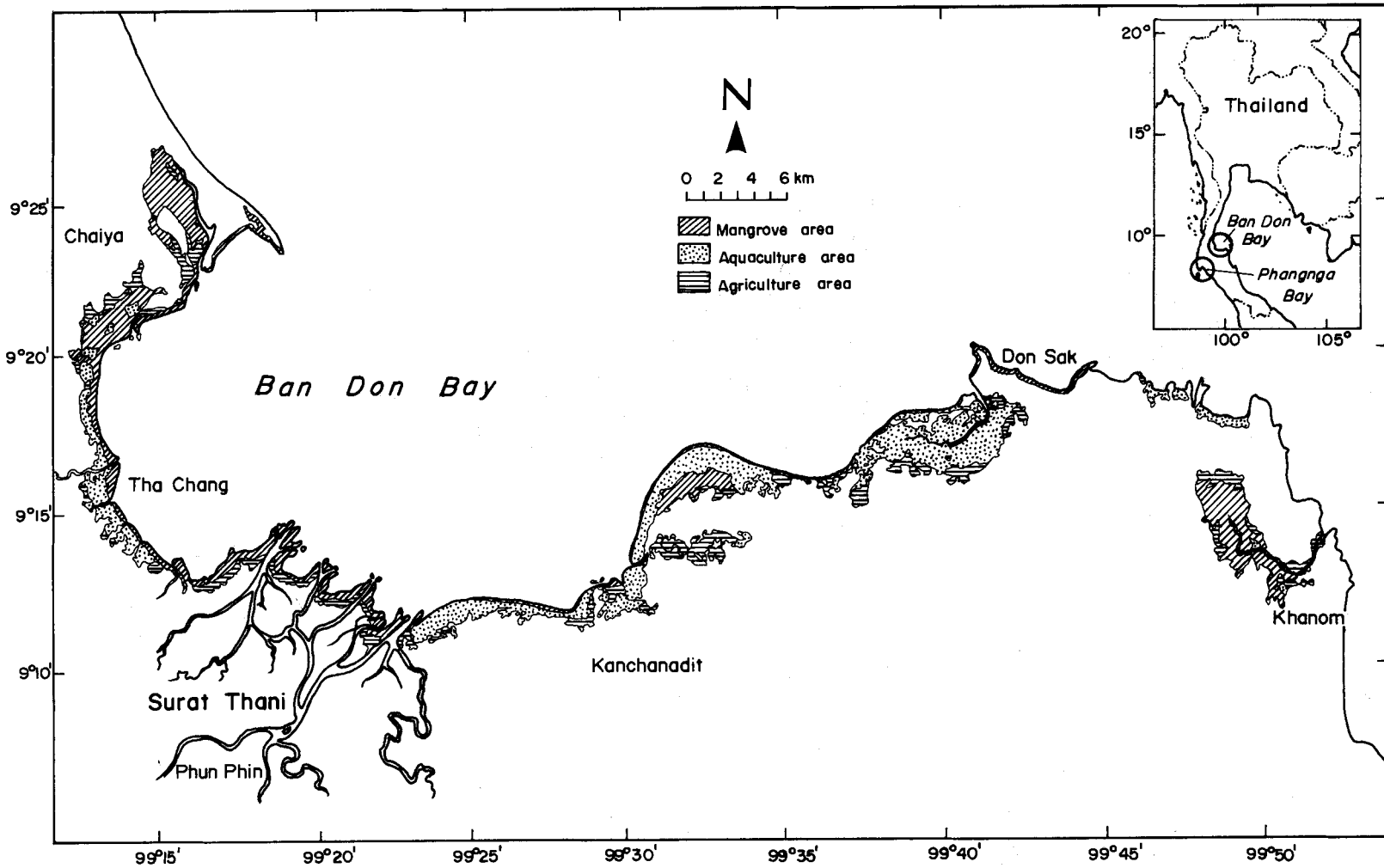


Fig. 2.7. Distribution of mangroves and other land-use types in Ban Don Bay, 1987 (Aksornkoae et al. 1988).

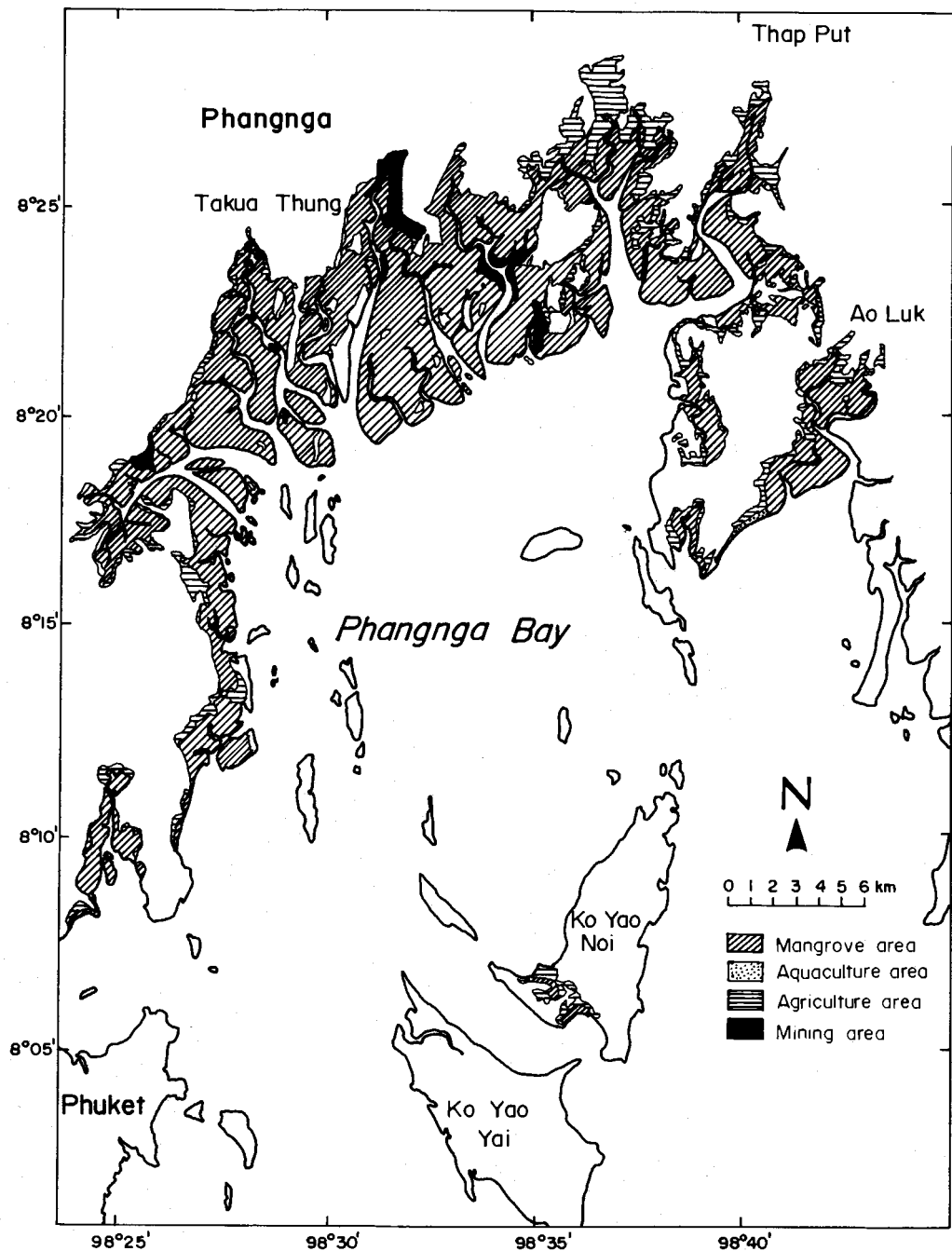


Fig. 2.8. Distribution of mangroves and other land use types in Phangnga Bay, 1987 (Aksornkoae et al. 1988).

In Ban Don Bay, *Rhizophora* spp. generally occupy an area along the margin of estuaries, rivers and canals where the soils are muddy. The *Avicennia* community is mainly found on new mudflat developments especially at Don Sak and Kanchanadit. This community, however, is also found at forest margins along the coastline. The *Sonneratia* spp. also occur on the area along the bank of the estuary but they mainly dominate soils of the sandy loam type.

## **Chapter 2. Biophysical and Socioeconomic Setting**

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The *Xylocarpus* community is usually formed behind the *Rhizophora* zone and *Bruguiera* and *Ceriops* communities are found only associated with *Xylocarpus* community. The *Excoecaria* sp. can be found throughout the mangrove area at Ban Don Bay.

Natural regeneration in both bays is reported to be good with average densities of about 9,500 seedlings/ha around A. Phanom in Ban Don Bay and 2,896 seedlings/ha at A. Muang in Phangnga Bay.

### **Wildlife Habitats**

The wildlife in the region is found throughout four main habitat types: mangrove, *Melaleuca*, evergreen and agricultural.

### **Mangrove**

The mangrove habitat, including beaches, covers approximately 76 km<sup>2</sup> in Ban Don Bay. Seventy-five species of birds were found there by the Upper South Wildlife Study Team, including the very rare and endangered masked finfoot and other water birds such as lesser theeduck, osprey, and Pacific reef egret.

Over 75% are resident birds and just over 15% are migratory birds that spend the winter months (September to February) in the area. Three species of reptiles including the saltwater crocodile, were recorded in this habitat, as was one rare and endangered species of amphibian and five rare species of mammals.

The mangrove habitat covers approximately 276 km<sup>2</sup> in Phangnga Bay and shelters 101 wildlife species: 86 birds, 5 mammals, 3 amphibians and 7 reptiles. Seventy-two species of birds considered rare include numerous bulbul, kingfisher, iora and tailorbird species. Two species of rare and endangered mammals were recorded, i.e., smooth-coated otter and serow. There were also three rare species of amphibians, including the crab-eating frog and six rare species of reptiles.

### **Melaleuca**

The *Melaleuca* habitat covers an area of 215.75 km<sup>2</sup> in Ban Don Bay where 22 species of wildlife were found, i.e., 14 birds, 5 mammals, 2 amphibians and only 1 reptile. Most of the wildlife are common except for one previously unrecorded bird, the vinous-breasted starling.

### **Evergreen**

The evergreen habitat has the highest species diversity. In Ban Don Bay which covers an area of just over 2,000 km<sup>2</sup>, there are 74 wildlife species: 12 birds, 24 mammals, 24 reptiles and 14 amphibians. Among the mammal species considered threatened or endangered are the white-handed gibbon, marbled cat, clouded leopard, tiger, wild elephant, Sumatran rhinoceros, banteng, gaur and serow. The green peafowl and helmeted hornbill are among the threatened bird species.

Lowland evergreen forest covers 973.25 km<sup>2</sup> in Phangnga Bay and is home to 103 wildlife species: 77 birds, 3 mammals including the white-handed gibbon, 3 amphibians and 20 reptiles. Most wildlife species are considered to be rare in Phangnga Bay's lowland forest habitat, which presently is under great pressure from the expansion of palm oil and rubber plantations.

### Agricultural

The agricultural type confined to Ban Don Bay, contained a reported total of 77 wildlife species: 55 birds, 6 mammals, 5 amphibians and 11 reptiles. A number of important migratory birds are found in this habitat because of the resemblance of the open-field condition to their northern breeding territory. These include the Chinese pond heron, little ringed plover, common snipe, oriental cuckoo and black-capped kingfisher.

A number of the mammals in this habitat are considered rare, e.g., the Burmese striped tree squirrel, gray-bellied squirrel and lesser mouse deer. Many wildlife species in the Upper South are under threat due to illegal poaching or habitat conversion, especially for agriculture.

### Marine Fisheries

Fisheries resources are valuable as food and as feed for livestock. Fish feed or low-value fish are referred to as "trash fish," which in other countries are thrown back into the ocean because they are not profitable to process. Based on this definition, there are almost no trash fish in Thailand, as almost all fish that are caught are utilized in one form or another. (See Chapter 3 for a fuller discussion of fisheries resource utilization.)

### Coral Reefs

Coral reefs serve as a food source and habitat for economically important fish. Fringing reefs may also protect shorelines from eroding due to the force of tropical storms and tidal waves. Historically, corals served as a source of rock for building and lime for agriculture.

Coral reefs and other coral formations occur along the shorelines of Surat Thani's offshore islands such as Mu Ko Ang Thong (an archipelago), Ko Samui, Ko Phangan and Ko Taen. Ko Tao is also discussed in this section. Although it is located in Chumphon Province, it is closer to the islands of Surat Thani than the other islands in Chumphon. Coral research in these areas is comparatively recent, almost consisting entirely of observations carried out for TAT's tourism master plan for Ko Samui, Surat Thani (TISTR 1985) and the more technical studies conducted by the Department of Marine Science, Chulalongkorn University (Sudara et al. 1989a) and the Department of Aquatic Science, Srinakharinwirot University for the ASEAN-Australia Cooperative Program on Marine Science. The latter studies are the source of most of the material contained in this section. The distribution and quality of coral in Ban Don Bay are shown in Fig. 2.9.

*Coral reefs and other coral formations occur along the shorelines of Mu Ko Ang Thong, Ko Samui, Ko Phangan and Ko Taen.*

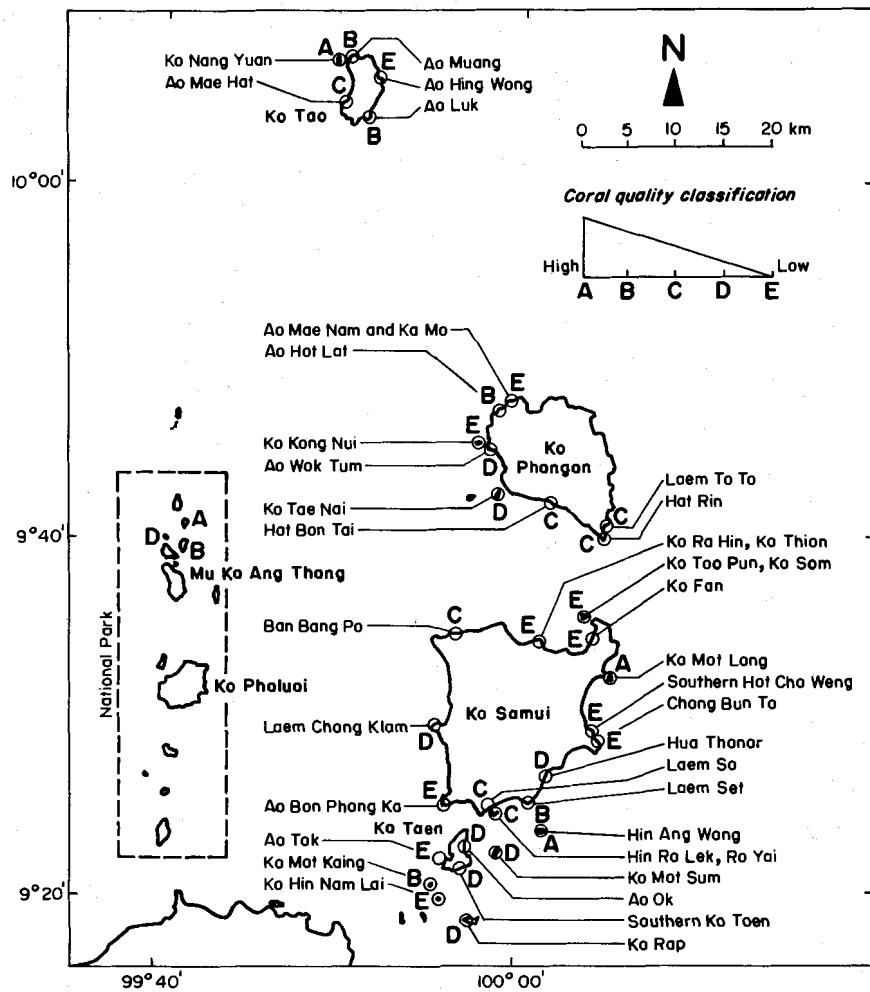


Fig. 2.9. Distribution and quality of coral in Ban Don Bay.

## Ko Tao

Ko Tao (and the much smaller Ko Nang Yuan) is 75 km from the Chumphon Delta, located at about 101°3'N latitude and 99°49'E longitude. Due to its distance from the Chumphon Delta, this area has clear water; some types of coral not found elsewhere in the Gulf of Thailand are found here. Reefs fall into three groups, according to reef structure.

1. In the southern part of Ko Tao where the waters are relatively calm, the *Acropora* sp. (branching type) was dominant.
2. In the southern part of Hat Sai Lee on the west coast of Ko Tao where the waters are also relatively calm, the dominant species were non-*Acropora* in colonies of massive, foliose and encrusting forms while *Acropora* was entirely absent.
3. In the northern part of Sai Lee reef and southwest of Ko Nang Yuan reef, both non-*Acropora* and *Acropora* sp. together were dominant.

Corals in this area had the highest percentage of coral cover among the study sites. But human impacts such as boat anchoring and blastfishing appear to be having deleterious effects.

### **Mu Ko Ang Thong**

The Mu Ko Ang Thong archipelago consists of more than 70 islands located between 9°35' and 9°40'N latitude and about 99°40'E longitude. The islands were gazetted as an NP in 1980. There are three reef groups, according to benthic component.

1. The first group, located in clear water in areas with strong water movement, had a high coral density and diversity especially of the *Acropora* sp. Reefs at the western part of Ko Sam Sao and the northern part of Ko Tai Plao are good examples.
2. The second group is composed of those corals found in calm but turbid waters, usually *Porites lutea* and *Goniopora* spp. This group includes reefs on the east side of Ko Mae Ko and Ko Sam Sao, around Ko Phi, Ko No Raet, Ko Wua Kan Tang and Ko Phaluai.
3. The third group is composed of corals in turbid water with fairly strong water movement. A few *Acropora* colonies are found in this group but the predominant communities consisted of non-*Acropora* massive and submassive forms.

Reefs in Mu Ko Ang Thong were generally in good condition but sedimentation from K. Tapi-Phum Duang damaged corals in the southern and western parts of the archipelago and coral cover was lower here than at other study sites. Reefs are also damaged due to tour boat anchoring and coral souvenir collecting.

### **Ko Phangan**

Ko Phangan is located to the north of Ko Samui between 9°40' and 9°50'N latitude and 99°57' and 100°6'E longitude.

According to benthic component and reef structure, two groups can be defined.

1. The first group is located north of Ko Phangan at Hat Khom and Mae Hat where there are clear, calm waters. Both *Acropora* and non-*Acropora* corals had a high percentage of cover.
2. The second group is found along the western coast. Reefs here could be separated into two zones: a reef-flat zone composed of dead corals, algae and *Acropora* in submassive colony forms and a reef-slope composed predominantly of massive colony forms such as *P. lutea*.



Corals in Ko Phangan have been smothered by bottom sediments being resuspended by passing boats. Damage has also been caused by local fishermen breaking off coral to camouflage their fish traps and by anchovy fishing boats using small-meshed purse seines which catch on branching corals in particular.

### **Ko Samui**

Ko Samui is located between 9°25' and 9°35'N latitude and 99°55' and 100°07'E longitude.

According to the benthic component, reefs in this area have three groups.

1. The first group includes the reefs around Ko Fan where the waters are calm and turbid. *P. lutea* and *Goniopora* spp. are the predominant coral colonies as they are relatively tolerant to sedimentation. It also includes the Tao Pun reef located nearby which has a similar abundance of non-*Acropora* but a greater abundance of *Acropora*. At Laem (meaning "cape") Na Phra Lan, the presence of *Acropora* is even greater but non-*Acropora* sp. predominates. At Ban Bang Po in the northeast of the island, *Acropora* predominates.
2. The second group is located on the west coast of Ko Samui. *P. lutea* predominates while *Acropora* is found mainly in rougher waters. An abundance of seagrass (*Halophila* spp.) was found in this zone and gorgonians were found around the reefs at Hat Yow. Soft corals were also found in this zone.
3. This last group consists of the reefs in the southern and southwestern-most part of Ko Samui. There is a large reef flat area, and limestone and coral rubble are often found in this zone. In some areas, seagrass (*Enhalus acoroides*) is present. The reef slope area, wider than in other parts of the island, had many living corals of *Acropora*. The *Acropora* in this zone had the highest percentage of coral cover around Ko Samui.

### **Southern Islands**

This island group consists of six islands and four small rocky islands between 9°15' and 9°25' N latitude and 99°55' and 100°05' E longitude.

There are two reef groups according to coral component.

1. Found at the eastern side of Ko Taen and Ko Mat Sum, the first group has *Acropora* and non-*Acropora* in equal abundance.
2. The second group is found around the western side of Hin Ang Wong where *Acropora* spp. dominated and non-*Acropora* were almost absent.

Water in this area is very clear and the corals here had the highest percentage of cover in Ban Don Bay, apart from Ko Tao. There was very little evidence of coral damage resulting from human activity.

**SOCIOECONOMIC  
SETTING**

**Population**

In 1989, the Upper South population was estimated at approximately 1.4 million, about 2.6% of the national total. In 1980-1987, the annual growth rate (AGR) in population in the Upper South was 3.4% compared with 2.0% in the whole country. The proportion of rural and urban populations remained relatively stable in 1970-1980.

The region's population is concentrated mainly in the municipalities of Surat Thani and Phuket. Surat Thani's population size has grown steadily over the years, reaching a peak AGR of 3.98% in 1983. The largest age group in both Surat Thani and Phangnga Provinces is 0-9-year olds. The male to female ratio is close to 1:1. In 1980, 19,280 persons above 5 years old migrated to Surat Thani from other provinces. Most of these migrants were men from the south in search of work. Phangnga also received a large number of migrants.

The latest NESDB population forecasts for the Upper South are presented in Table 2.4. Of the total projected population of 481,200 by the year 2000, Surat Thani is expected to absorb the largest share of 193,000 whereas Phangnga will take in about 88,600 additional people. The AGR of population in the Upper South is expected to be higher (2.3%) than in the South Region (2.1%) or the whole country (1.4%).

The change in urban and rural population by province is shown in Table 2.5 Both Surat Thani and Phangnga are expected to remain predominantly rural. In fact, most of the change for the Upper South as a whole can be attributed to the more pronounced increase in urban population in Phuket. It is possible, however, that the various development projects proposed for the region could substantially alter these projections by increasing in-migration.

Table 2.4 Population forecasts (thousand) in the Upper South, by province, 1991-2000.

Province/region	1991	2000	Average AGR (%)
Surat Thani	816.4	926.0	1.8
Phangnga	240.8	303.9	2.7
Krabi	338.1	421.7	2.9
Phuket	179.6	227.6	2.7
Upper South	1,574.9	1,879.2	2.3
South	7,715.0	9,166.0	2.1
Thailand	57,196.0	64,389.0	1.4

Source: NESDB (1988).

Table 2.5. Urban/rural population (thousand) in the Upper South, by province, 1980-2000.

Province	1980	1990	2000
Surat Thani	588.4	816.4	926.0
Urban	60.0	98.0	157.4
Rural	528.4	718.4	768.6
Phangnga	170.3	240.8	303.9
Urban	15.3	26.5	48.6
Rural	155.0	214.3	255.3
Krabi	216.2	338.1	421.7
Urban	15.1	30.4	54.8
Rural	201.1	307.7	366.9
Phuket	131.0	179.6	227.6
Urban	44.5	77.2	122.9
Rural	86.5	102.4	104.7
Upper South	1,105.8	1,574.9	1,879.2
Urban	132.7	252.0	394.6
Rural	973.1	1,322.9	1,484.6

Source: NESDB (1988).

### Culture

Most of the people in the region are Buddhist but there are Muslim minorities in both Phangnga and Surat Thani.

The literacy rate is high: 90% in Surat Thani and 91% in Phangnga. Men have a slightly higher rate than women, and on average, a higher rate is found in municipal areas than in rural areas. Although the Central Thai dialect is spoken in schools and most government offices, the Southern Thai dialect is spoken widely in other contexts.

### Standard of living

According to the National Statistics Office, in 1980 about 7% of houses in Surat Thani were of permanent building materials, i.e., cement and wood. Over 85% of Surat Thani residents owned their living quarters and associated land plots. In Phangnga, 61% of houses were of permanent materials. About 84% of Phangnga residents owned living quarters and associated land plots.

About 13% of households in Surat Thani used piped water, most of them in the municipal area. In Phangnga, just over 7% used piped water, mostly in the municipal area. Wells are the most common source of household water in the Upper South. About 86% of municipal and 19% of nonmunicipal households in Surat Thani used electricity. Still, about 84% in both areas used gas or charcoal for cooking.

In Phangnga, 94% of municipal households utilized electricity whereas only 26% did so in nonmunicipal areas. Large numbers also used gas or charcoal for cooking.

## **Chapter 2. Biophysical and Socioeconomic Setting**

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About 85% of municipal and 28% of nonmunicipal households in Surat Thani used sanitary latrines whereas Phangnga had 86% and 40% usage, respectively.

In Surat Thani, 88% of municipal households owned radios and 52% owned televisions. Large numbers also owned electric fans, bicycles and motorcycles. About 96% of nonmunicipal households owned radios but only 9% had televisions.

In Phangnga, ownership rates for consumer durables in municipal and non-municipal areas, respectively, were: radios, 92% and 96%; motorcycles, 60% and 44%; bicycles, 60% and 44%; and electric fans, 77% and 18%. About 2% of households owned televisions.

### **Employment and productivity**

In 1980, the Upper South labor force was about 512,700 persons, 70% (358,000) of whom worked in agriculture, 22% (112,000) in the service sector and 4% (20,000) in mining. Although more recent figures are not available, the service sector should have grown more rapidly than the other sectors.

More than 50% of the labor force was in Surat Thani and 14% in Phangnga. About 17% of the regional labor force was thought to be underemployed.

According to the Industrial Office in Surat Thani, there were 514 factories employing 5,057 persons in 1984. Most of these were in A. Muang or A. Phun Phin.

In 1985, Phangnga had 192,165 persons in the labor force, 42,624 of whom worked in agriculture and 26,880 in nonagriculture jobs. About 8,330 persons worked in 1,035 factories.

Labor productivity in the Upper South is higher than that of the country. In the former, the gross regional domestic product (GRDP) per worker grew from 12,850 to 17,753 baht between 1970 and 1980. The country figures were 9,000 and 13,000 baht, respectively. In the Upper South, mean annual income per head in 1988 was 27,152 baht (NESDB 1989).

### **Infrastructure**

#### **Roads**

The Upper South has two primary and three secondary national highways. The existing road network in the Upper South is illustrated in Fig. 2.10. There are approximately 1,800 km of well-maintained national and provincial roads in the region. Both local and long-distance bus services are available.

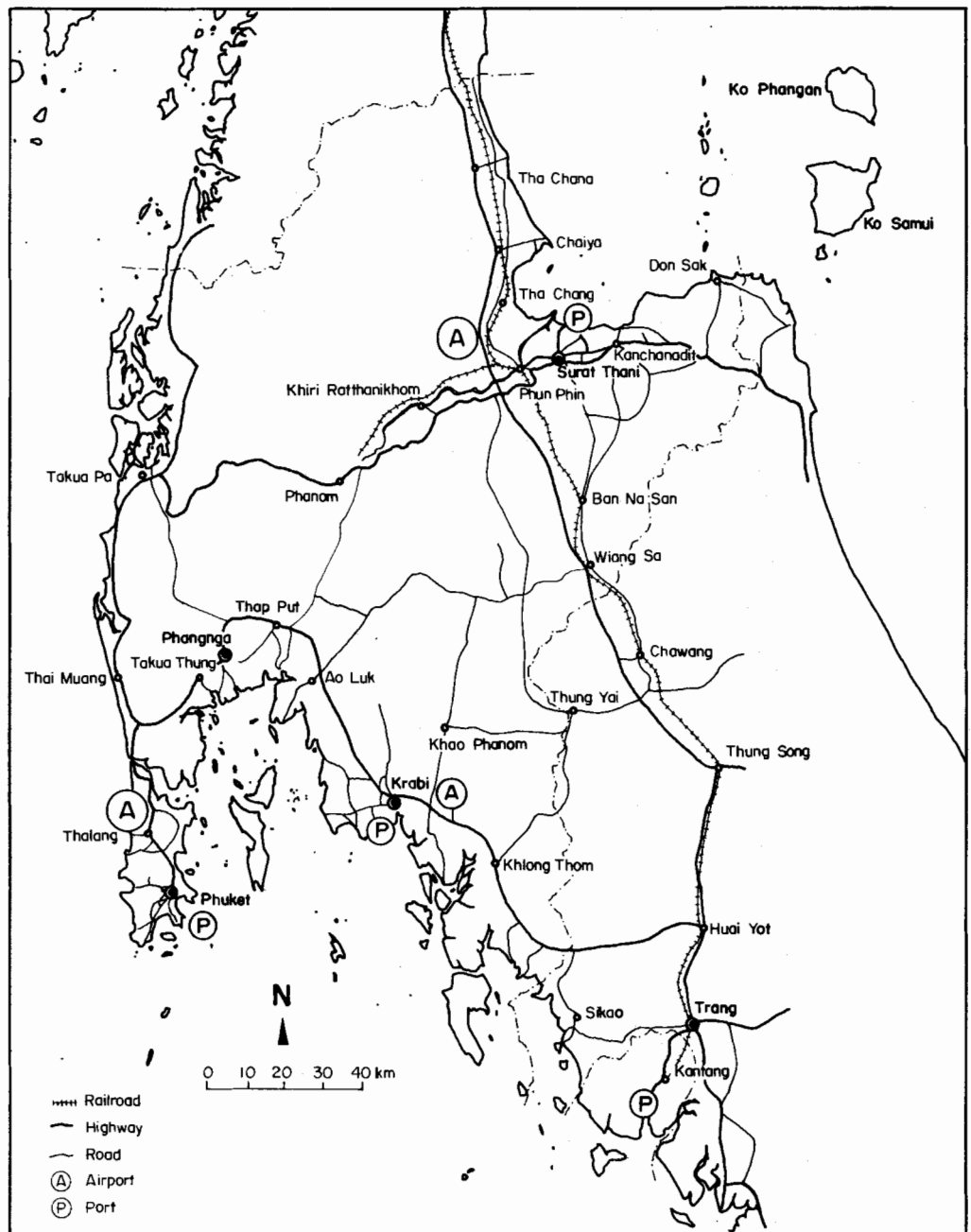


Fig. 2.10. Existing road network in the Upper South, 1982 (NESDB 1988).

The State Railway of Thailand's southern line covers about 170 km and 20 stations and passes through Surat Thani. Eight passenger trains, six freight trains and two trains travel in each direction each day. There are two express passenger trains—one travels to Bangkok in about 12 hours and the other to Hat Yai in 5 hours.

## **Chapter 2. Biophysical and Socioeconomic Setting**

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Surat Thani's major port is the Inner Ban Don. The Tha Thong port handles mainly coastal shipping. In 1981, 408,000 t of which 213,000 t were oil/fuel, were handled at this port. A vehicle and passenger ferry also operates from Don Sak to Ko Samui.

There are no major ports in Phangnga, although neighboring Krabi has two ports. The older City Port, basically a fishery port, handled 247,313 t in 1981, of which 72,901 t were oil/fuel.

### **Air transport**

The three commercial airports in the Upper South are located in Phuket, Surat Thani and Ko Samui. Phuket has regular flights to Bangkok and Surat Thani as well as direct international flights to Singapore, Hong Kong, Penang and Kuala Lumpur. Surat Thani is a domestic airport with direct flights to Bangkok, Phuket and Hat Yai. In 1986, it handled 85,000 passengers and 220,600 kg of freight, corresponding to annual increases of 48% and 67%, respectively, between 1981 and 1986.

### **Telecommunications**

The area accessible to telephone services in 1982 was approximately 3.2% of the Upper South and was confined to a radius of 5 km from the local stations. Applicants outside these areas had to use VHF radio transmission systems installed at their own expense.

The Economic Development Program of the Telephone Organization of Thailand planned to increase line capacity in the Upper South from 6,200 in 1982 to 44,500 in 1988. Existing telephone service areas were to receive an extra 31,000 lines with 13,200 going to new areas, mainly rural communities. The program aimed for 14% of the Upper South being within a telephone service zone.

### **Sewerage, sewage treatment and drainage**

Although there are almost no sewerage and sewage treatment systems in rural areas and only a few in urban areas, it was not a high priority among the municipalities surveyed by NESDB in late 1984 as part of the preparation of the Sixth NESDP. Moreover, although LGs and PGs are empowered to issue by-laws and ordinances to maintain clean water under their jurisdiction, they have not developed municipal waste treatment systems and regulatory standards for management and control due to a shortage of financial resources and technical and management skills.

Drainage, for rainy season flood protection, is the responsibility of the Department of Public Works (DPW) and the municipalities, but is given low priority and is relatively undeveloped, even in the urban areas of the Upper South.

Energy

In 1982, the Upper South's power was composed of petroleum products, traditional fuels (i.e., firewood or charcoal) and electricity (Fig. 2.11).

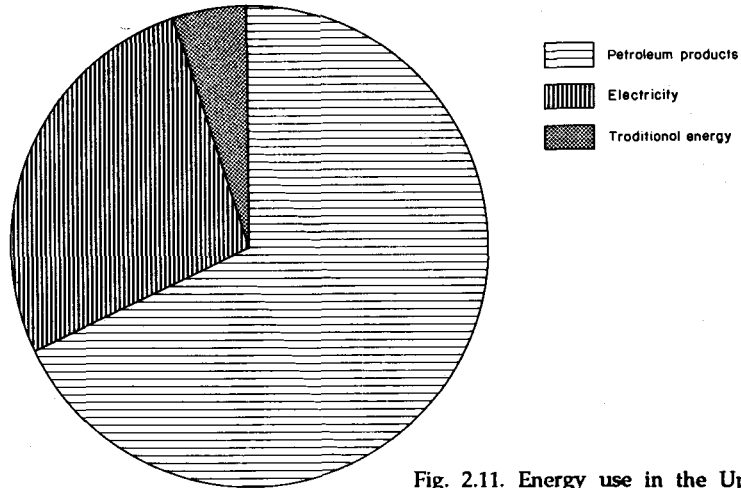


Fig. 2.11. Energy use in the Upper South (NESDB 1988).

In 1976-1980, consumption of petroleum products grew by 13.8% and electricity by 16.9%/year. Both of these rates were higher than the national averages. The amount of traditional sources of energy used was thought to have changed little. But there was a strong shift from firewood to charcoal.

The consumption of petroleum products in 1980 was about 7,000 barrels/day. This was made up of diesel oil, gasoline, fuel oil, liquefied petroleum gas and kerosene. Fig. 2.12 gives a rough idea of the use of petroleum products by sector (NESDB 1988).

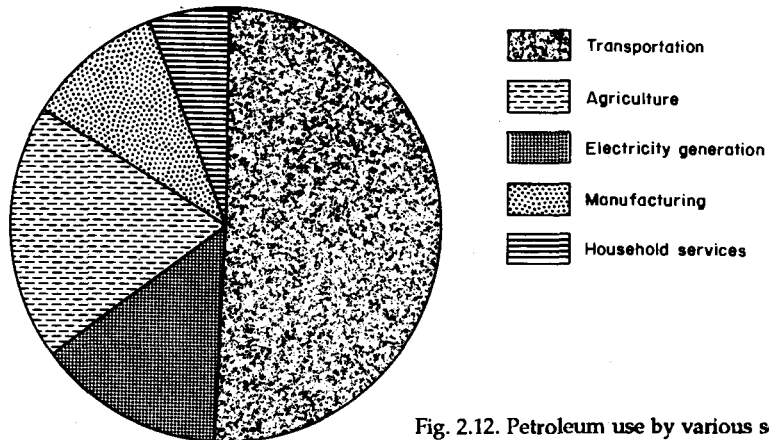


Fig. 2.12. Petroleum use by various sectors in the Upper South, 1980 (NESDB 1988).

## Chapter 2. Biophysical and Socioeconomic Setting

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Between 1973 and 1982, there was a rapid increase in electric consumption in all Upper South provinces except Phangnga. Fig. 2.13 illustrates the consumption by sector in the Upper South. In 1982, the average annual electric consumption per customer was 1,114.8 kwh with the highest consumption in Phuket at 1,419 kwh, and the lowest in Surat Thani at 939.6 kwh (NESDB 1988).

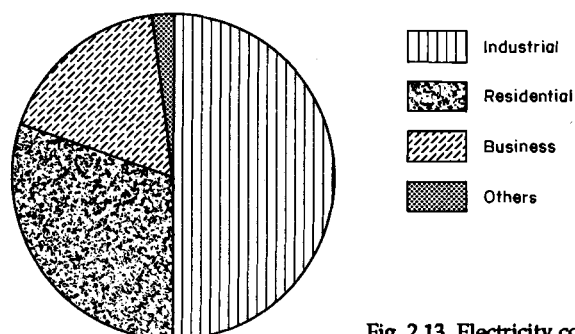


Fig. 2.13. Electricity consumption by sector in the Upper South, 1980 (NESDB 1988).

Over half the households in the Upper South were still using traditional energy in 1983, especially for cooking. An average household burns 70.6 kg and 42.6 kg of firewood and charcoal, respectively, per month (NESDB 1988).

Chapter 2 has described the natural and socioeconomic setting of the Upper South. Chapter 3 shows how the people use and manage their resources.



## CHAPTER 3

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# RESOURCE UTILIZATION AND EXISTING MANAGEMENT

### LAND USE

*The Upper South land can be divided into forest, agriculturally productive and low-intensity areas.*

The Upper South can be divided roughly into:

1. forest area (mainly to the west), covering about 53% of the region and is made up of primary forest, 60%; secondary forest, 33%; and mangrove, 7%;
2. agriculturally productive area, mainly around Phangnga, Krabi and Surat Thani, covering 23% of the region with paddy and tree crops comprising 18% and 82%, respectively; and rubber accounting for 78% of the tree crops area; and
3. low-intensity area, mainly in the eastern half of the Upper South and consisting of secondary forest, secondary forest with crops, idle land and mining areas, and covers about 41% of the Upper South.

Since the early 1970s, the Upper South has experienced major changes in land use. For example, in 1973-1982, about 1,000 km<sup>2</sup> of new tree crops (rubber and oil palm) were planted, mainly in the low-intensity area. As much as 1,600 km<sup>2</sup> should be under oil palm alone by the year 2000 if target production figures are to be met (JICA 1985).

Agricultural land accounts for 5,120 km<sup>2</sup> or 23% of the total area. Fifty percent of the agricultural land in the Upper South is in Surat Thani; Phangnga has 30%, Krabi, 13% and Phuket, 7%.

### Mangrove Forests

Mangrove forests play an important role in the economies of Ban Don Bay and Phangnga Bay, particularly as a source of energy and food protein. Traditionally, the local people have depended on mangrove trees for firewood, charcoal, timber and other minor products. They also depend on mangrove areas for catching fishes, shrimps and crabs.

According to TDRI (1987), between 1980 and 1985, mangrove areas decreased by about 8.5% in the Upper South compared to an overall rate of 6.5% in Thailand. The causes of conversion in Ban Don Bay and Phangnga

### Chapter 3. Resource Utilization and Existing Management

Mangrove forests play an important role in the economies of Ban Don Bay and Phangnga Bay, particularly as a source of energy and food protein.

Bay were clear cutting for firewood, construction materials or charcoal-making, aquaculture, tin mining and agriculture. In some cases, such as in conversion into agricultural land or shrimp ponds, the mangrove forest is completely removed. In other cases, replacement vegetation may take over. Tables 3.1 and 3.2 present the major causes of conversion and identify the affected habitats and the type of substitution vegetation. Table 3.3 gives the extent of former mangrove forest now devoted to other uses in Ban Don Bay and Phangnga Bay.

Table 3.1. Major causes of mangrove conversion in Ban Don Bay, habitats most affected and substitute vegetation which becomes established.

Major cause of conversion	Habitats most affected	Substitute vegetation which becomes established
Severe cutting of trees for firewood, posts, poles and charcoal-making	Muddy area dominated by <i>Rhizophora</i> and <i>Sonneratia</i> species	Regeneration of young seedlings of <i>Rhizophora</i> , <i>Sonneratia</i> , <i>Bruguiera</i> spp.; new common species becoming established include <i>Acanthus</i> spp. and <i>Finlaysonia maritima</i>
	Sandy loam areas dominated by <i>Avicennia</i> species	Regeneration of dense young seedlings of <i>Avicennia</i> spp.; new common species becoming established include <i>Acrostichum</i> spp.
	Drier soils on inland sites with less tidal inundation dominated by <i>Xylocarpus</i> and <i>Excoecaria</i> species	Regeneration of dense young seedlings of <i>Excoecaria</i> spp. and seedlings of <i>Xylocarpus</i> ; new common species becoming established include <i>Acrostichum</i> spp., <i>Flagelaria indica</i> and <i>Phoenix paludosa</i>
Agriculture	Mangrove areas at more inland sites dominated by <i>Excoecaria</i> , <i>Heritiera</i> and <i>Phoenix</i> species	Mangrove forests completely changed into agricultural land and oil palm, rubber and coconut plantations
Aquaculture (shrimp farm)	Most types of mangrove species and habitats	Mangrove forests completely changed into shrimp ponds; in abandoned shrimp ponds, regeneration of common seedlings of mangrove species such as <i>Excoecaria</i> and <i>Lumnitzera</i>

Source: Aksornkoae (1987).

### Agriculture

The Upper South produces more than 10% of the combined national production of oil palm, cashew nut, *sataw*, rubber, rambutan, coffee, *langsats* and coconut (JICA 1985). Forestry production also exceeds 10% of the national total.

As can be seen from Table 3.4, the economy of the Upper South is largely based on natural resources with agriculture, the leading sector, contributing 24% of the gross provincial product (GPP) in 1987. This is also the leading sector in both Phangnga and Surat Thani Provinces.

### Chapter 3. Resource Utilization and Existing Management

Table 3.2. Major causes of mangrove conversion in Phangnga Bay, habitats most affected and substitute vegetation which becomes established.

Major cause of conversion	Habitats most affected	Substitute vegetation which becomes established
Severe cutting of trees	Muddy area dominated by <i>Rhizophora</i> and <i>Bruguiera</i> species	Regeneration of young seedlings of <i>Rhizophora</i> and <i>Sonneratia</i> spp.; new common species becoming established include <i>Acanthus ilicifolius</i> , <i>F. maritima</i> and <i>Thalassina omala</i> Mound
	Sandy loam areas dominated by <i>Avicennia</i> and <i>Sonneratia</i> species	Regeneration of young seedlings of <i>Avicennia</i> , <i>Sonneratia</i> and <i>Ceriops</i> ; new common species becoming established include <i>Acrostichum</i> spp., <i>Premna obtusifolia</i> and <i>Acanthus</i> spp.
	Drier soils on inland sites with less tidal inundation dominated by <i>Xylocarpus</i> and <i>Excoecaria</i> species	Regeneration of young seedlings of <i>Xylocarpus</i> , <i>Excoecaria</i> and <i>Ceriops</i> spp.; new common species becoming established include <i>Acrostichum</i> spp., <i>F. indica</i> , <i>P. paludosa</i> , <i>Caesalpeia crita</i> , <i>Combretum tetralomphum</i> and <i>Atalantia monophyllia</i>
Mining	Most types of mangrove species and habitats	Creation of bare land by tree and mud removal in the areas, 1-2 years after mining; seedlings of some mangrove species becoming established such as <i>Avicennia</i> , <i>Sonneratia</i> , <i>Aegiceras</i> , <i>Acanthus</i> , <i>Finlaysonia</i> , <i>Derris</i> and grasses
Agriculture	Mangrove areas at more inland sites dominated by <i>Heritiera</i> , <i>Lumnitzera</i> and <i>Phoenix</i> spp.	Mangrove forests completely changed into agricultural land and rubber and coconut plantations
Aquaculture (shrimp farm)	Most types of mangrove species and habitats	Mangrove forest completely changed into shrimp ponds

Source: Aksornkoae (1987).

The Upper South economy is largely based on natural resources, with agriculture as the leading sector.

Rubber yield is higher in Surat Thani than in Phangnga (Table 3.5). In Surat Thani, rubber yield for old varieties was 1,000 kg/ha whereas yield for new varieties was 1,594 kg/ha. In Phangnga, yields were 563 and 1,125 kg/ha for old and new varieties, respectively.

Rice is the second most important crop in both Surat Thani and Phangnga although production still does not meet local demand. Rice cultivation downstream of the Tapi-Phum Duang River Basin in Surat Thani has a good potential to increase productivity but rice fields in upland areas in Surat Thani and in Phangnga have limited potential as they are generally unsuitable for rice; they are usually cultivated by rubber planters for their own consumption.

Vast areas suitable for oil palm plantation are available in the Central Lowland of the Upper South. It should be noted that the Trans-Thai Land Bridge Development Project will enable ready access to rapidly increasing oil palm importers of the Middle East and South Asia.

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Table 3.3. Areas (ha) of former mangrove forests now converted into other uses, Phangnga Bay and Ban Don Bay, 1987.

Location	Shrimp pond	Agriculture	Mining
<b>Phangnga Bay</b>			
Phangnga Province			
A. Takua Thung	51	1,087	-
A. Muang	-	619	672
A. Thap Put	-	185	-
Krabi Province			
A. Ao Luk	74	1,180	-
<b>Total</b>	<b>125</b>	<b>3,071</b>	<b>672</b>
<b>Ban Don Bay</b>			
Surat Thani Province			
A. Tha Chang	811	151	-
A. Phun Phin	-	207	-
A. Muang	-	391	-
A. Kanchanadit	2,213	768	-
A. Don Sak	2,204	643	-
<b>Total</b>	<b>5,331</b>	<b>2,277</b>	<b>-</b>

Source: Modified from Aksornkoe (1987).

Table 3.4. Comparison of GPP in 1987 at constant 1972 prices (million baht) of Phuket, Surat Thani, Krabi and Phangnga with GRP of the Upper South.

Production sector	Phuket	Surat Thani	Krabi	Phangnga	Upper South
Agriculture	150,796	1,406,589	764,759	468,889	2,791,033
Fisheries	67,552	211,202	23,713	74,142	376,609
Forestry	49	62,529	268,027	307,695	638,300
Mining	131,894	634,644	25,709	385,939	1,178,186
Manufacturing	314,660	400,664	44,130	62,107	821,566
Construction	51,003	199,419	48,105	34,814	333,341
Electricity and water supply	85,298	97,798	32,875	23,478	239,449
Transportation and communication	303,748	264,920	51,440	79,602	699,710
Trade	289,591	893,514	364,715	414,905	1,962,725
Banking insurance	77,389	117,654	24,286	36,907	256,236
Ownership of dwelling	50,261	212,549	73,272	60,555	396,637
Public administration and defense	83,390	276,554	90,025	91,815	541,784
Services	448,257	532,748	180,466	198,857	1,360,328
<b>GPP</b>	<b>2,063,988</b>	<b>5,310,784</b>	<b>1,991,522</b>	<b>2,238,705</b>	<b>11,585,904</b>

Source: Calculated from NESDB (1989).

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Table 3.5. Major agricultural products from Phangnga and Surat Thani.

Province/ crop	Production (t)	Value (million baht)	Year
Surat Thani			
Coconut	238,589	653	1987
Rubber	137,122	2,984	1988
Rice	105,921	426	1989
Oil palm	219,132	620	1989
Phangnga			
Coconut	12,907	35	1987
Rubber	70,269	1,529	1988
Rice	9,787	40	1989
Oil palm	4,893	14	1989

Source: MOAC (1989).

The Upper South produces 47% of the national total of cashew nut, 38% of *sataw* and 20% of rambutan. Growing urbanization and the rapidly expanding tourism industry will offer substantial markets for these and other fruit tree crops.

#### WATER USE

The uses of water can be categorized as follows:

1. upper watershed - village water supply, artisanal fisheries, and irrigation;
2. flood plains - domestic water supply, artisanal fisheries, and irrigation; and
3. coastal zone - urban, domestic and industrial water supply, commercial and artisanal fisheries, and aquaculture.

#### Marine Fisheries

The Upper South marine fisheries production in 1982 was 175,600 t, accounting for 8.75% of the national total. Surat Thani contributed 98,400 t while the west coast provinces had a combined production of 77,200 t (Lohsawatkul 1988).

Fishers in the Ban Don Bay area generally use small-scale fishing gear including shrimp gill nets, crab gill nets and threadfin gill nets. Income is primarily from catches of shrimp and swimming crab. The maximum crab catch in October 1981 was 24.2 kg/boat/day. That year, 200 fishing days brought in a catch of 1,357 t valued at 30 million baht. But the most valuable

### Chapter 3. Resource Utilization and Existing Management

catch out of about 60 species caught is the white shrimp (*Penaeus merguensis*). The average fishing effort using shrimp gill nets in 1981 was 240 fishing days, and the maximum catch rate was 2.1 kg/boat/day (in May). In 1989, the value of combined shrimp catch from Surat Thani, Phangnga and Krabi was 1.29 billion baht.

A survey of demersal fisheries carried out around Ko Samui-Phangan and Mu Ko Ang Thong in 1981 determined the demersal resources, species composition, distribution of major species and spawning periods. The average catch rate was about 40 kg/hour and the catch included squid, cuttlefish, crab, shrimp, octopus, whiting, sardine, herring, anchovy, gizzard shad and croaker.

Ban Don Bay contains important spawning and rearing grounds for anchovies, some mollusk species and Indo-Pacific mackerel (offshore), and has been declared by DOF as a conservation zone (Figs. 3.1 and 3.2). Trawling and purse seine fishing are prohibited from 15 February to 15 May of

A conservation zone, Ban Don Bay contains important spawning and rearing grounds for anchovies, some mollusk species and the Indo-Pacific mackerel.

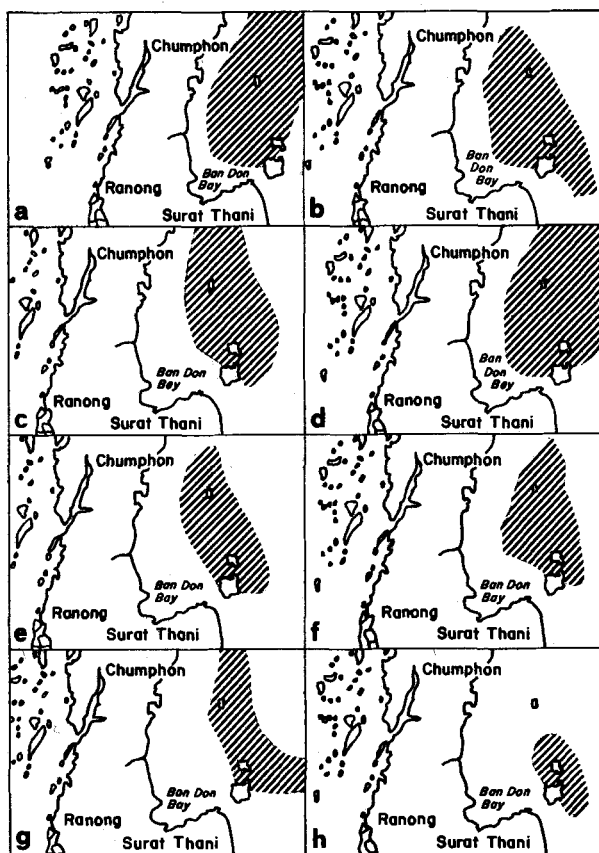


Fig. 3.1. Important spawning areas of some commercially important species in Ban Don Bay: (a) Indo-Pacific mackerel; (b) sardine; (c) anchovy; (d) threadfin bream; (e) red snapper; (f) sea bass; (g) goat fish; and (h) squid.

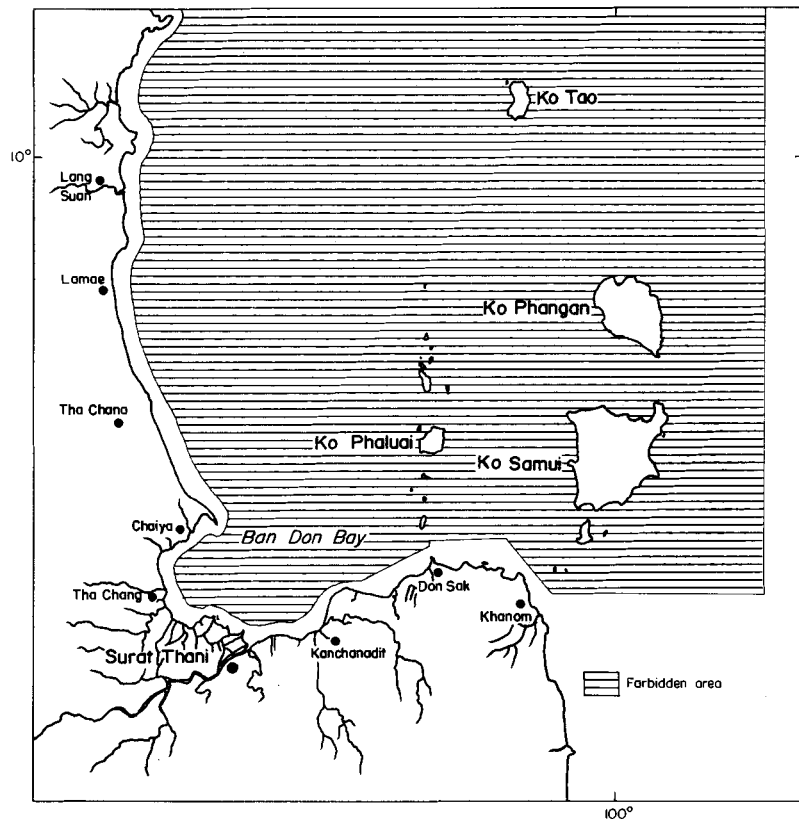


Fig. 3.2. Prohibited fishing grounds in Ban Don Bay, 15 February-15 May of every year.

every year. Still, illegal fishing is common, particularly by trawlers (single and twin types) on the northern side of Mu Ko Ang Thong for Indo-Pacific mackerel and in the area between Mu Ko Ang Thong and Ko Samui-Phangan. Enforcement of the fisheries management regulation is ineffective because of lack of manpower, equipment and budget.

In 1977-1983, the country's total marine fisheries production fluctuated (Table 3.6). Fluctuations have been attributed to changes in fuel prices, increased efficiency of fishing gear and boat capacity, introduction of exclusive economic zones and the development of new fishing zones in the Gulf of Thailand.

The Gulf of Thailand accounts for over 50% of the total marine capture fisheries production. There is general agreement that the marine fisheries of the gulf are overexploited. Table 3.7 indicates that the exploitation level has exceeded the estimated maximum sustainable yield (MSY) for both pelagic and demersal fisheries resources. The situation is similar for the pelagic resources of the Andaman coast. According to the Upper South Marine Fisheries Sector study, the total shrimp landing in the gulf decreased from 156,902 t in 1982 to 91,514 t in 1985.

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Table 3.6. Marine fisheries production (t) in Thailand, 1977-1983.

	Quantity
1977	2,067,533
1978	1,957,785
1979	1,813,158
1980	1,647,953
1981	1,824,444
1982	1,986,571
1983	2,099,986

Source: TDRI (1987).

Table 3.7. Level of exploitation and MSY of marine fisheries resources in the Gulf of Thailand and Andaman coast.

Fishing ground	Resource	Exploitation	MSY	Current catch
Gulf of Thailand	Pelagic	466,480	616,800	400,000
	Demersal	1,170,944	1,136,434	750,000
Andaman coast	Pelagic	101,122	93,954	100,000
	Demersal	211,133	208,037	200,000

Source: TDRI (1987).

A 1984 study in A. Tha Chang, Surat Thani, to evaluate the effect of the use of push-nets on demersal fish revealed that 43% of the catch was small-sized but of commercial value and 57% were low-value fish. Of the low-value fish, 53% were low-quality, low-value species and 47% were juveniles of economically important species (2-6 cm in length).

Total catch per unit effort (CPUE) among fishers in Ban Don Bay has not significantly declined as they increase catch efficiency by modernizing their equipment. The declining value of CPUE, however, reflects the change in catch composition. Also, the increasing number of push-net vessels has a significant effect on economic fish yields. Immediate action is recommended to discourage the entry of new push-net vessels into the area to protect juveniles.

In Phangnga Bay and adjacent areas, fisheries surveys were carried out by Phuket Marine Fisheries Station staff in 1967-1978. Special trawling surveys were conducted in 1967-1971 and 1975-1978.

The average catch rate for all stations surveyed reached a maximum of 219 kg/hour in 1969, with the highest at 536 kg/hour in Phangnga Bay itself. The catch rate decreased to 22 kg/hour in 1976 and increased to 127 kg/hour in 1978. The low-value fish catch in the area reached a maximum of 81% of the total catch in 1969 and dropped to 69% in 1978.



### **Chapter 3. Resource Utilization and Existing Management**

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In 1968, the major commercial fisheries in Phangnga Bay were squid, wolf herring, lizardfish and gizzard shad. The percentage of penaeid shrimp, the most valuable species, decreased from 10% in 1968 to less than 1% in 1978. The juveniles of many high-value fish such as snapper, grouper, goatfish, club mackerel, pomfret, lizardfish and threadfin bream comprised a large proportion of the low-value fish catch. These facts were very important in persuading DOF to close Phangnga Bay to trawl fisheries in 1979.

In 1987-1988, the Andaman Marine Fisheries Development Center (AMFDC) investigated fisheries resources in Phangnga Bay during two monsoon seasons and reported that the average catch of marine species in the bay by otterboard trawl in the northwest monsoon season (39 kg/hour) was almost equal to those caught in the southwest monsoon (36 kg/hour). The average catch was at a maximum in the late northeast monsoon (44 kg/hour) and at a minimum in the late southwest monsoon season (32 kg/hour). The most productive areas of the bay were the shallow waters in the upper region of Ko Yao Noi and Ko Yao Yai whereas the least productive area was on the east coast of Phuket. Fish and trash fish were the major compositions of the total catch in which the ratio between trash fish and valuable economic species was 60:40 in the northeast monsoon and 67:33 in the southwest monsoon.

A survey of fishing gear operated in the vicinity of Phangnga Bay revealed that the average catch of small otterboard trawlers (with boom) was 16 kg/hour in which 4.4 kg (27%) were economically valuable species and the other 11.9 kg (73%) were trash fish. Among the total trash fish caught by small otterboard trawlers, 3.7 kg (31%) were juveniles of economically important species, such as shrimp, swimming crab, gizzard shad and croaker whereas 8.2 kg (69%) were trash fish.

Average catch of push-nets in Phangnga Bay was 60 kg/day which was composed of 10.8 kg (18%) of economically valuable species and 49.3 kg (82%) of trash fish. About 50% of the total trash fish were juveniles of economically important species such as swimming crab, shrimp and mullet.

The average catch rate of shrimp drift gill nets was smaller than that of trawlers and push-nets, at 7.5 kg/day in which 2.2 kg were medium- and large-sized penaeid shrimp. Other species caught by these nets were croaker, mullet and swimming crab.

According to AMFDC, the 39 fishing communities included in the survey employed 18 fishing gear types. The gear that were popularly used in the vicinity of Phangnga Bay were shrimp drift gill net, swimming crab set gill net, fish gill net, push-net and small otterboard trawl (with boom). Each fisher usually possessed more than one gear type so that he could use them in accordance with changes in season and fishing ground.

### **Coral reefs**

*In the outer parts of Ban Don and Phangnga Bays, coral reefs support a high diversity of fishes of economic value. Reef flats are gleaned for mollusks and small crabs.*

Coral reefs in the outer parts of Ban Don and Phangnga Bays support a high diversity of fishes of economic value. Resident reef fish such as grouper, snapper and fusilier use the reef as habitat and as a food source. Some pelagic fish such as mackerel, jacks and tuna are indirectly dependent on the reefs as a source of food for their prey organisms. Although the value of fish has not been reported for Thailand reefs, annual yields from similar reefs in the Philippines are 5 t/fisherman and 5 t/km<sup>2</sup> of reef.

In Ban Don Bay, reef flats are also gleaned by residents for mollusks and small crabs, and artisanal fishers use hand lines in the vicinity of offshore reefs.

### **Aquaculture**

*In the past ten years, aquaculture has expanded rapidly to meet increased national and international demands.*

Aquaculture is a traditional practice in Ban Don Bay. In the past 10 years, it has expanded rapidly on a commercial basis to meet increased national and international demands. About 5,000 t of shrimp was produced in 1989 at a value of approximately 1.2 billion baht. Abundant supply of shrimp, however, has caused prices to drop somewhat since 1989 and may slow the development of more ponds.

Production from coastal aquaculture in Surat Thani Province has grown from 237 kg/ha in 1978 to 669 kg/ha in 1985—an increase of over 180%. The majority of this growth is from the increased production capacity for shrimp which accounted for about 96.5% of the aquaculture production in 1985. The total (officially recorded) area of land devoted to shrimp culture in 1985 was 3,049 ha compared to 170 ha in 1978. The estimated value of shrimp production in 1985 was 186 million baht. Since 1985, the conversion of land into shrimp farms has increased dramatically to 8,171 ha producing 9,829 t in Surat Thani. Phangnga is the major shrimp producer on the Andaman coast with 116 ha of shrimp ponds producing 318,678 t in 1989 valued at 57.6 million baht. Krabi, with 60 ha, produces 68,411 t in 1989, valued at 20.5 million baht.

Shrimp culture is generally extensive or semi-extensive and is based on introducing wild fry into the ponds by means of engine-operated pumps. The DOF has successfully increased production by using hatchery-bred fry, but so far the technology has not been widely disseminated.

Some problems result from improper aquaculture practices, i.e., the excessive use of poisons to kill predators in the ponds, overfeeding, establishing ponds on acid sulfate soils and contamination of water source with pond water effluent which pollute neighboring ponds. Clearly, practices need to be improved through increased training and extension support services.

In 1984, Surat Thani produced 35,363 t of short-necked clams valued at 61.5 million baht. These are harvested from nature and are not cultured. The production of blood cockle amounted to 776 t valued at 1,656 million baht. About 590 t of oyster valued at 11.7 million baht were also produced.

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The disposal of untreated domestic wastewaters has resulted in high coliform counts in oysters from Ban Don Bay. Likewise, bottom turbulence in the bay caused by illegal bottom trawlers has resulted in the smothering of short-necked clams by fine sediments.

Cage culture is very suitable for the Andaman Sea coast as there are many protected bays and coves and wide tidal fluctuations. The main species being cultured are grouper and sea bass. Shrimp culture is not as widespread on the Andaman coast as it is in the Gulf of Thailand. Coastal waters are also relatively unpolluted along the Andaman coast except near mining areas.

More than 75% of the total number of grouper farmers operating along the Andaman coast are located in Phangnga Bay. There are more than 300 families operating 250 fish farms with 1,000 cages. Grouper fingerlings are collected from natural waters and low-value fish are used as fish feed. The groupers reach marketable size of 0.4-0.8 kg after 6-7 months. The live fish are exported to Malaysia and Singapore at 120-150 baht per kilogram.

Sea bass (*Lates calcarifer*) are either cultured in net cages or more commonly, in ponds with grouper. There were about 160 farms and 390 net cages with a total area of 0.9 ha in 1984 in Trang, Phangnga and Ranong Provinces. Fish are grown to a marketable size of more than 500 g and sold for about 65-80 baht per kilogram.

A major problem in grouper culture is the availability of fry, as hatchery production is still experimental. Mortalities from cannibalism and disease result in survival rates of only 20-30% for sea bass. Clearly, rearing techniques need to be improved. The unavailability of high quality but low-priced feeds also constrains the expansion of grouper and sea bass culture.

## **TOURISM INDUSTRY**

Both Ban Don Bay and Phangnga Bay play important but different roles in the region's tourism industry. Ko Samui in Ban Don Bay is an international resort contributing significantly to national and regional tourism receipts. Ko Phangan also in Ban Don Bay, is gaining popularity and in the near future will probably become a significant resort destination. The reefs in Ban Don Bay provide an aesthetic and educational experience to tourists. They can also make an important contribution to the local economy, e.g., by helping to diversify tourist attractions and encouraging tourists to stay longer. Moreover, the reefs provide opportunities for locals to rent out diving equipment and boats and to serve as tour guides.

Phangnga Bay, on the other hand, is important chiefly as a destination for tourists staying in Phuket.

Ban Don Bay

The major attractions of the bay are Ko Samui, Ko Phangan and the Mu Ko Ang Thong archipelago. The major beaches on Samui are Hat Chaweng and Hat Lamai on the eastern side followed by Hat Cheong Mon and Hat Bo Phut on the northeastern side of the island (Fig. 3.3). Apart from Talat Nathon, these areas contain the bulk of the island's tourist facilities. At present, although Ko Phangan is relatively undeveloped, Hat Rin in the south-east and Nai Wok on the west coast attract the largest number of tourists and have the majority of accommodation units (Fig. 3.4).

The beauty of the islands of Ban Don Bay attracts both western and Thai tourists. Thais accounted for 82% of visitors to Ko Samui in 1984. Tourism volumes in Ko Samui have increased 20 times between 1980, when 868 visitors landed on the island, and 1987 when 306,607 visitors were recorded (Fig. 3.5). In 1984, Ko Phangan had 22,910 and Mu Ko Ang Thong had 54,155 visitors. By 1996, the number of visitors projected to visit Ko Samui annually is over 640,000 while 128,000 are expected to visit Ko Phangan.

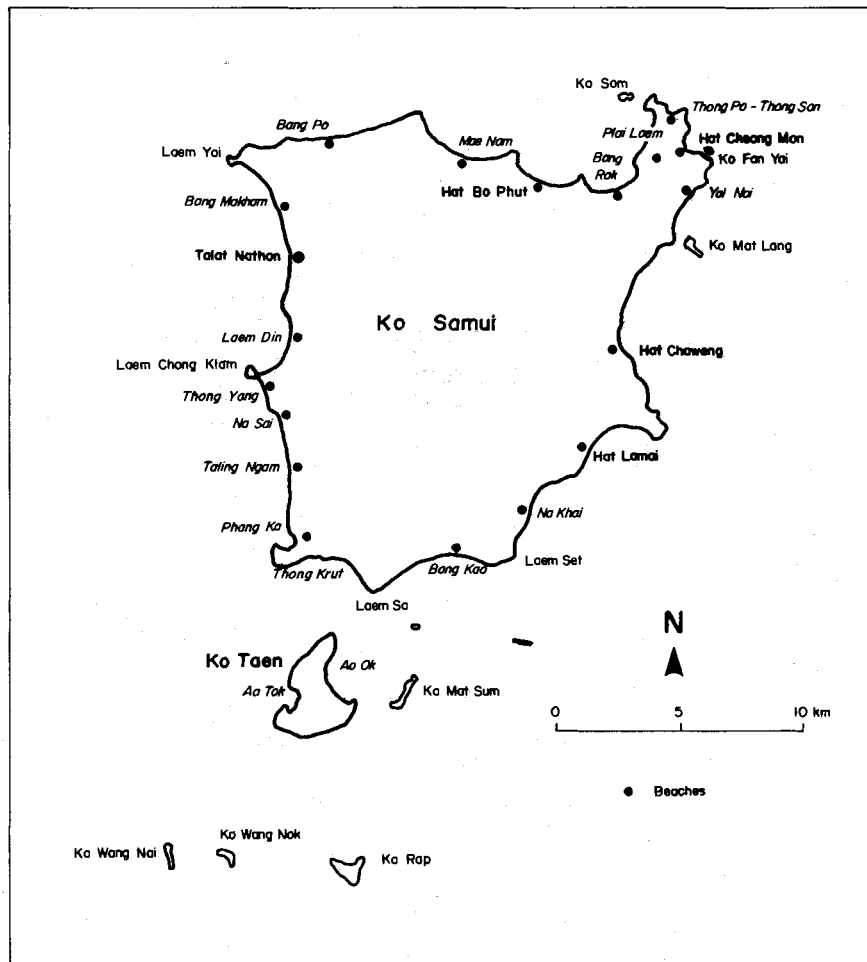


Fig. 3.3. Major tourism beaches on Ko Samui, Ban Don Bay.

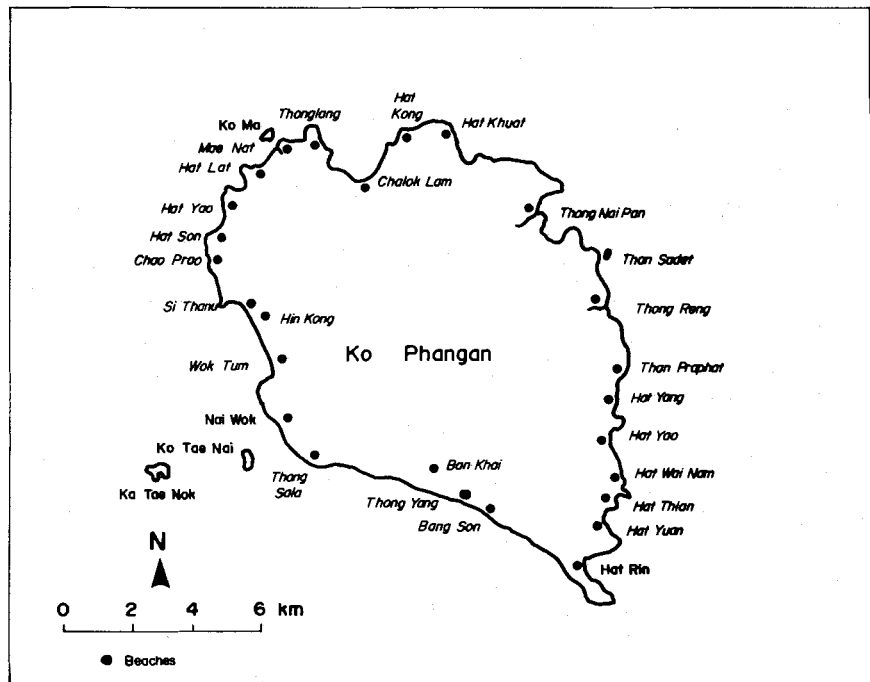


Fig. 3.4. Major tourism beaches on Ko Phangan, Ban Don Bay.

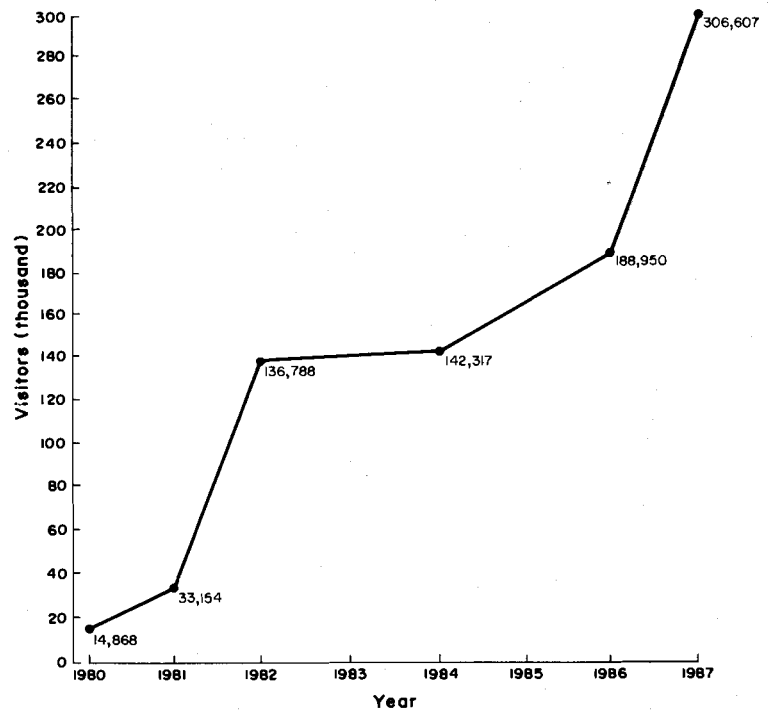


Fig. 3.5. Tourism volume at Ko Samui, 1980-1987 (TISTR 1988).

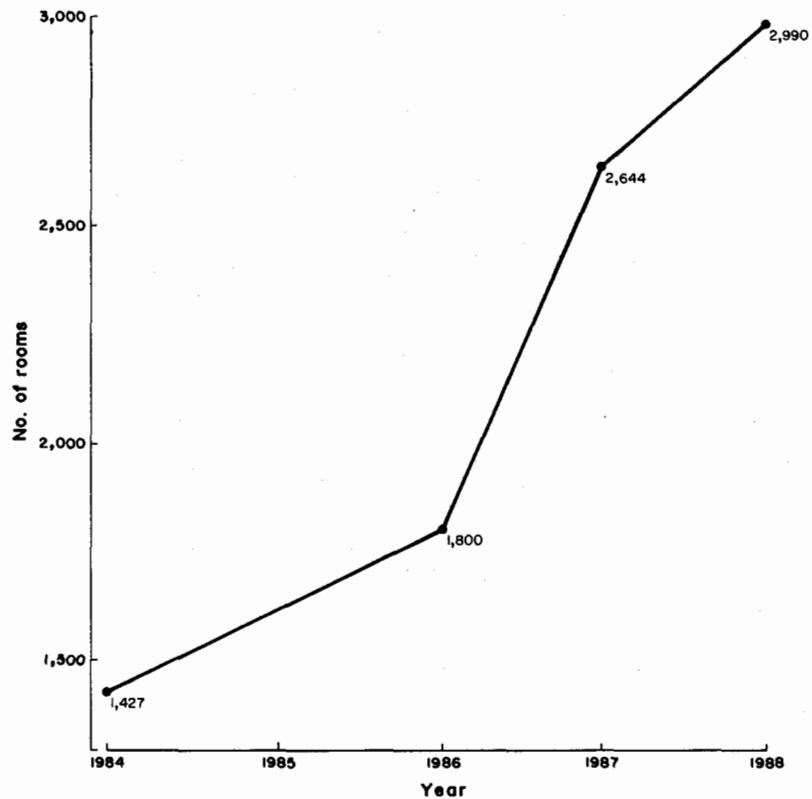


Fig. 3.6. Increase in the number of rooms at Ko Samui, 1984-1988 (TISTR 1988).

*Ko Samui in Ban Don Bay is an international resort contributing significantly to national and regional tourism receipts.*

In 1984, Thai tourists on Samui stayed for about 2.5 days on average and spent about 600 baht/day. Foreign tourists, on the other hand, stayed 14 days on average and spent less than 200 baht/day. The reason for the low-value of foreign tourists' spending is that they were predominantly young people on limited budgets. This is changing as more up-market tourists visit Ko Samui.

In 1989, foreign visitors to Surat Thani spent a mean of over 600 baht/day while Thais spent almost 800 baht/day. Thais stayed for an average of 2.3 days while foreigners stayed 5.8 days. Ko Samui tourism receipts amounted to about 240 million baht in 1984 with foreigners contributing 28% of the total. For 1987, it was estimated that both Thai and foreign tourists spent a total of 33.84 million baht in Ko Phangan.

In 1988, there were about 210 accommodation units with a total of 2,900 rooms on Ko Samui (Fig. 3.6). The large majority (80%) were priced at 50-450 baht/night. Only 12% were priced at 800-3,000 baht/night. Most observers expect the tourism volume on Ko Samui to continue to expand; projections for accommodation suggest that there will be 6,113 rooms in 1991, 16,931 in 1996 and 48,893 in 2001.

Only beach bungalows are available on Ko Phangan; there are 102 accommodation units with a total of 1,325 rooms priced at 50-2,000 baht/day.

## **Phangnga Bay**

*The natural attractions of Phangnga Bay include Ko Panyi and its national park and striking karst formations.*

Phangnga Bay is also noted for its natural attractions, particularly its striking karst formations and national park. Ko Panyi, a Muslim village on stilts, is also a major attraction. A large proportion of Phangnga's visitors are tourists staying in Phuket who take boat trips around the bay with short stopovers at some of the small islands such as Panyi and Phingkan. About 80% of these visitors are reportedly Thai.

While the number of visitors to Phuket is increasing significantly, visits to Phangnga Bay appear to be on the decline. There were over 250,000 visitors in 1983, just over 200,000 in 1984 and less than 200,000 in 1985. In 1985, Phangnga had 23 hotels with 615 rooms. There is only one first class hotel.

According to TAT, projections for the number of hotel guests for Phangnga and Krabi show a steady increase: 85,615 in 1986, 105,783 in 1991 and 125,638 in 1996. The number of tourists staying in hotels in the town of Phangnga in 1987 was 42,894.

Major problems are overcommercialization of places such as Ko Panyi and Ko Phingkan, environmental degradation of caves and other tourist sites, and restricted tourism season due to bad weather during the monsoon period.

## **OTHER ECONOMIC SECTORS**

### **Animal Husbandry**

The Upper South undoubtedly has potential for livestock production: there are few diseases, the region is close to importing countries and has adequate pasture land. In 1988, there were 12,652 buffaloes, 12,513 cattle, 62,058 swine and 588,063 chickens in Surat Thani. Production for all of these, except cattle, is decreasing due to rising feed costs.

In Phangnga, there were 262,580 chickens, 21,198 swine, 871 cattle and 2,024 buffaloes in 1988. Production of swine and cattle in Phangnga is increasing slightly whereas that of buffaloes and chickens is decreasing.

### **Industry**

In 1980, about 50% of industrial establishments in the Upper South were rice mills with the majority located in Surat Thani. Most industries are based on the processing of food, wood, concrete, ceramics, rubber and tin. Other industries are machine repair and shipbuilding. Development of textiles, chemicals, metalworking and electrical appliance manufacturing is very limited in the Upper South although they are fast developing in the country.

### Chapter 3. Resource Utilization and Existing Management

There is a low degree of diversification within the region's industrial sector and the scale of industrial activities is still small. There appears to be a rapid increase, however, in medium-sized industrial establishments in the Upper South. Out of 150 companies surveyed in 1983, 12 establishments had more than 100 employees. Most industries apart from rice mills are located in Phuket, followed by Surat Thani. An estimated 80% of industrial production in the Upper South remains in the South Region whereas 11% finds its way to Bangkok.

#### Trade and Services

As can be seen from Table 3.8, trade and services together accounted for over one-quarter of the GPPs of Surat Thani and Phuket.

With respect to the Upper South gross regional product (GRP), Surat Thani's trade and service sectors contribute a total of 12.3% whereas Phangnga's contributed a total of 5.3% in 1987.

According to NESDB (1989), between 1975 and 1985, the service sector of the Upper South grew almost twice as fast as the agriculture, mining and manufacturing sectors at 7.2% per annum, with tourism undoubtedly playing a leading role. In the same period, Surat Thani's and Phangnga's service sectors grew at 7.7% and 6.2% per annum, respectively.

Table 3.9 shows that in 1985-1987, the service sector of the Upper South grew at an average of 7.5% per annum with Surat Thani's service sector growing at an average rate of 6.9% and Phangnga's at 5.4%.

The service sectors made the third and fourth largest contributions, respectively, to the GPP of both Surat Thani and Phangnga in 1987.

Table 3.8. Contribution of trade and services in 1987 at constant 1972 prices (million baht) to GPP and Upper South GRP.

Sector	Surat Thani		Phangnga		% of Upper South GRP	
	GPP	%	GPP	%	Phangnga	Surat Thani
Trade	893.5	16.85	414.9	18.5	3.6	7.75
Service	532.7	10.0	198.9	8.9	1.7	4.6

Source: NESDB (1989).

Table 3.9. Growth of service sector in the Upper South and constituent provinces at constant 1972 prices (thousand baht).

Province/ region	1985	1986	1987	Average % change per annum
Phuket	371,544	402,529	448,257	9.9
Phangnga	179,220	184,598	198,857	5.4
Surat Thani	466,787	4,888,732	532,748	6.9
Krabi	159,827	167,733	180,466	6.3
Upper South	1,177,378	1,243,592	1,360,328	7.5

Source: Calculated from NESDB (1989).



## **Mining**

*The Upper South is the largest tin mining area in Thailand.*

In 1980, Thailand produced 45,986 t of tin concentrates valued at 1,000 million baht. In 1985, these were 29,979 t and 6,396.9 million baht.

The Upper South is the largest tin mining area in Thailand. In 1983, 59% of the production total came from the Upper South. The region's mining sector, however, declined overall in 1980-1985 at an annual rate of -12.4%. Nevertheless, mining was the third most important sector, in terms of GDP contribution, in Phangnga and Surat Thani in 1987. The mining sector in Surat Thani and Krabi showed a positive trend with 19.1% and 6.7%, respectively, in 1986-1987.

Phangnga's mining sector declined by -2.2% and Phuket's by -4.0% for the same period contributing to an overall growth in mining in the Upper South of 8.2%.

Major problems facing the mining industry have been falling prices, the depletion of high-grade offshore tin grounds and closer scrutiny by environmental organizations due to pollution caused by tin mining.

## **UPPER SOUTH REGIONAL ECONOMIC PERFORMANCE**

### **Relationship with the South Region and the National Economy**

The annual growth in GDP of the Upper South, the South Region and Thailand as a whole over the 1982-1987 period is shown in Fig. 3.7. There have been major fluctuations in the national and Upper South economies over this period due largely to the changing prices of tin, rubber and crude oil and to the growing protectionism of countries to which Thailand exports.

The entire South's GRDP in 1987 was 41,862.4 million baht at 1972 prices, or 3.39% of GDP. In 1987, the Upper South's GRDP was 11,595.9 million baht at 1972 prices, 27.7% of the South's GRDP and less than 1% of GDP.

In terms of contribution to GDP, the South Region occupies an intermediate position—it contributed more than the Central, Eastern and Western Regions but less than the North, Northeastern and Bangkok Regions.

### **Economic Performance of the Upper South**

In 1987, of Upper South's four provinces, Surat Thani had the largest GPP of 5,310.8 million baht at 1972 prices. This was followed by Phangnga with 2,397 million baht, Phuket with 2,053.9 million baht and Krabi with 1,991.5 million baht. The contributions of some of the major sectors to the Upper South's economy in 1981-1987 are presented in Table 3.10.

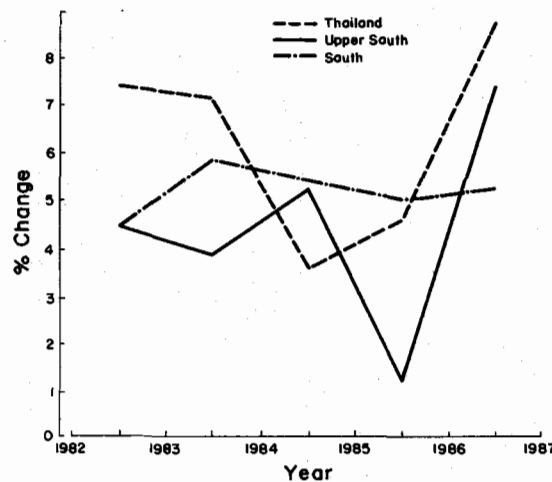


Fig. 3.7. Annual GDP growth rates, 1982-1987 (NESDB 1989).

Table 3.10. The Upper South GRDP at 1972 prices (million baht) by major sector, 1981-1987.

Year	Agriculture <sup>a</sup>	%	Mining	%	Manufacturing	%	Services	%	Trade	%	Total
1981	2,539.9	33.9	1,661.8	22.2	848.1	11.3	881.6	11.8	1,563.7	20.9	7,495.1
1982	2,930.4	36.0	1,447.6	17.8	1,127.4	16.8	941.2	11.6	1,696.2	20.8	8,142.8
1983	3,461.3	42.6	1,181.6	14.6	660.1	8.1	1,008.0	12.4	1,806.0	22.2	8,117.0
1984	3,465.5	41.6	1,339.2	16.1	714.9	8.6	1,022.2	12.3	1,796.0	21.5	8,337.8
1985	3,521.3	40.9	1,139.9	13.2	828.7	9.6	1,177.4	13.7	1,949.8	22.6	8,617.1
1986	3,512.8	40.9	1,089.1	12.7	848.5	9.9	1,243.5	14.5	1,895.2	22.1	8,589.1
1987	3,805.9	41.7	1,178.1	12.9	821.6	9.0	1,360.4	14.9	1,962.7	21.5	9,128.7

<sup>a</sup>Includes fisheries and forestry.  
Source: NESDB (1989).

Agriculture has remained the dominant sector throughout this period and in 1987 accounted for 41.7% of GRDP. Trade is the next largest sector and accounted for 21.5% of GRDP. The service sector has been steadily expanding over the years and accounted for 14.9% of GRDP in 1987. Mining has been on the decline throughout this period although it recovered slightly in 1987 when it accounted for 12.9% of GRDP. The manufacturing sector has been fluctuating somewhat and in 1987 accounted for 9.0% of GRDP. Fig. 3.8 illustrates the contribution to the Upper South economy of the major production sectors in 1987.

**ENVIRONMENTAL LAWS AND ADMINISTRATION**

There are more than 30 statutory laws concerned with the management of land, water, forest, minerals, wildlife and fisheries and most of these are applicable to coastal areas and resources (Setamanit 1987). Some of the major laws are dealt with in this section.

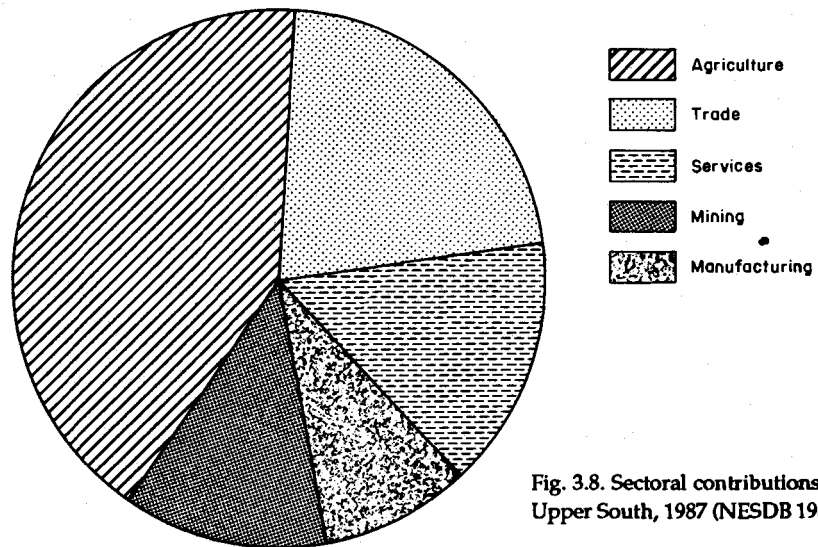


Fig. 3.8. Sectoral contributions to GRDP, Upper South, 1987 (NESDB 1989).

*More than 30 statutory laws on the management of land, water, forest, minerals, wildlife and fisheries are applicable to coastal areas and resources.*

The National Environmental Quality Act (NEQA) of February 1975, established ONEB which is charged with the functions of policy and planning as well as advising the prime minister on matters related to the environment. The ONEB can recommend standards as well as measures for the protection and conservation of environmental quality to government agencies which have regulatory powers. The NEQA was amended in 1978 to make EIA mandatory for certain types and sizes of development projects (including hotels and resort facilities with 80 rooms or more).

The 1978 amendment also allows ONEB to check and evaluate the enforcement of environmental quality regulations issued by various government agencies. Moreover, it provides for prohibiting orders to be issued by the prime minister in the case of serious pollution violations. The power to issue such orders can also be delegated to provincial governors on behalf of the prime minister. The ambiguous status of NEQA is evidenced by the fact that in 1984 when ONEB halted offshore tin mining in the area adjacent to Hat Patong so that ONEB personnel could carry out a survey to formulate water quality standards and ensure safe bathing for tourists, private sector interests which had received concessions to conduct offshore tin mining sued the government for breach of contract. The court has not yet reached a decision.

Several other government agencies deal with the various aspects of the environment and resources. Environmental quality as it relates to health falls largely within the jurisdiction of the Ministry of Health as provided by the Public Health Act of 1941. The control of industrial pollution and the granting of licenses to operate come under the purview of MOInd. The relevant law is the Factories Act 1969 (amended 1975 and 1979). Environmental control of public waterways falls within the jurisdiction of the Harbour Department (HaD) (Ministry of Communications) and the Department of Irrigation (Ministry of Agriculture and Cooperatives [MOAC]).

### **Chapter 3. Resource Utilization and Existing Management**

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Water supply and sewerage in provincial towns and cities are the responsibility of the various municipalities if the areas concerned are within municipal boundaries. Many of these, however, have transferred their responsibility for water supply to the Provincial Water Works Authority (PWWA), which is responsible for areas outside the municipalities. Eventually, according to a Cabinet Resolution, all piped water schemes, urban (except Bangkok Metropolitan Area) and rural, are to be handed over to PWWA.

The RFD administers the Wildlife Preservation and Protection Act of 1960 which identifies various species for preservation and protection and provides for the establishment of WSs and NHs.

The work is carried out by the Wildlife Conservation Division. The RFD also has jurisdiction over all forests, mangroves, coral reefs and other ecosystems which are designated NPs under the National Park Act (NPA) of 1961. According to this act, the function of NPs is to preserve land in a natural state in the interest of public education and recreation. The RFD is also responsible for reforestation and for granting and managing logging concessions.

The DOF is responsible for policy formulation, planning and management of fisheries including the restriction and limitation of fisheries grounds and equipment. It also grants fishing licenses, collects taxes and fees, and grants permits to construct shrimp ponds. The DOF can also exercise authority to prevent damage to coral reefs located outside NP boundaries, and prosecute offenders. The relevant legislation is the Fisheries Act of 1947.

#### **Protected Areas**

In Ban Don Bay, there are two national parks (NPs) and one wildlife sanctuary (WS). The Mu Ko Ang Thong (84 km<sup>2</sup>) is the only marine protected area (PA). The Khao Sok NP (645 km<sup>2</sup>) and Khlong Saeng WS (1,155 km<sup>2</sup>) protect upland moist evergreen forests (Fig. 3.9). There are also two nonhunting areas (NHs) (34 km<sup>2</sup>) and two forest parks (24 km<sup>2</sup>) (Table 3.11).

These are the most important PAs in terms of resource conservation:

1. Khlong Saeng WS, a large area of high regional and national significance, has a good population of several rare wildlife species such as *banteng*, tiger, clouded leopard, elephant, gibbon, argus pheasant and helmeted hornbill.
2. Khao Sok NP is contiguous with Khlong Saeng WS and is of similar importance.
3. Of considerable significance, Mu Ko Ang Thong NMP is one of the few remaining areas in the Gulf of Thailand which contains relatively well-developed and undamaged coral reefs.

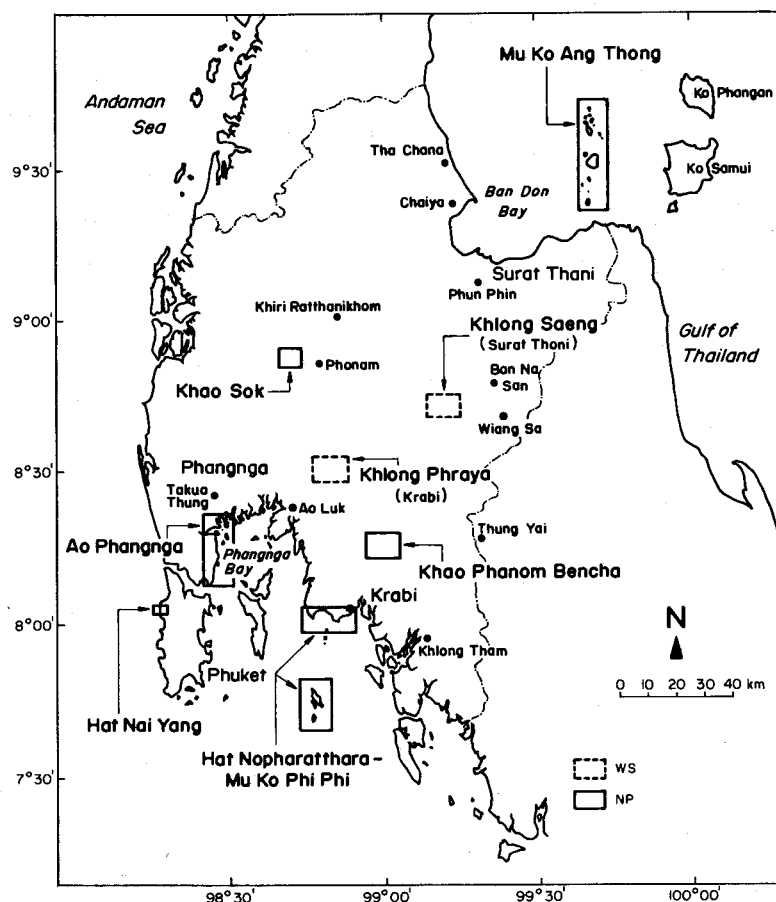


Fig. 3.9. Major PAs in the Upper South, Thailand (Ngampongsai 1988).

Table 3.11. Upper South PAs.

Name	Location	Category	Area (km <sup>2</sup> )	WS	NP	Other	Other
Khao Sok	Surat Thani	NP	64,552	x	-	-	x
Khao Luang	Nakhon Si Thammarat	NP	57,000	x	-	-	x
Khao Phanom Bencha	Krabi	NP	5,000	x	-	-	-
Ko Surin	Phangnga, Andaman Sea	NMP	13,500	x	x	-	x
Mu Ko Phi Phi/Hat Nopparatthara	Krabi	NMP	38,900	-	x	-	x
Ao Phangnga	Phangnga Bay	NMP	40,000	-	x	x	x
Khao Lam Pi	Phangnga	NP	7,600	-	x	x	x
Hat Thai Muang	Phangnga	NP	-	-	x	x	-
Hat Nai Yang	Phuket	NMP	9,000	x	-	-	x
Mu Ko Ang Thong	Surat Thani, Ban Don Bay	NMP	10,200	-	x	-	x
Khlong Saeng	Surat Thani	WS	115,615	x	-	-	-
Khlong Phraya	Krabi	WS	9,500	x	-	-	x
Khao Phra Tao	Phuket	NH	2,228	x	-	-	x
Nong Thung Thong	Surat Thani	NH	2,956	x	-	-	x
Khao Tha Phet	Surat Thani	NH	463	x	-	-	x

Ao means "bay."  
 Hat means "beach."  
 Khao means "mountain."  
 Source: Ngampongsai (1988).

### **Chapter 3. Resource Utilization and Existing Management**

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4. Other areas include Surat Thani eastern mountains, which encompass intact humid evergreen forests. Although not included in the PA system, these forests extend to Khao Luang NP in Nakhon Si Thammarat and are considered valuable for species conservation and watershed protection.

The waters around Ko Samui-Phangan and Mu Ko Ang Thong contain undamaged coral reefs, some of which have been recommended for PA status.

Phangnga has four NPs and one WS. Three NPs cover upland moist evergreen forests. The Phangnga Bay NMP (347 km<sup>2</sup>) has most of the region's protected mangrove areas and is important for mangrove-dependent bird species.

In Krabi, there are two NPs (one NMP) and one WS. The Hat Nopparatthara-Mu Ko Phi Phi has some exquisite corals and beaches, which are now under pressure from tourism. A management plan for this park has been produced by the University of Rhode Island (URI) CRMP (Lemay and Chansang 1988). The Khlong Phraya WS (95 km<sup>2</sup>) and Khao Phanom Bencha NP (50 km<sup>2</sup>) in Krabi consist mainly of upland evergreen forests and play important roles in watershed protection. There is one NH (22 km<sup>2</sup>), and four forest parks (2 km<sup>2</sup>) which are primarily used by domestic tourists.

This chapter has described the socioeconomic characteristics of the Upper South. The region's AGR of population is high compared to the national average but its contribution to the national total is less than 3%. The decline in the CPUE in the marine fisheries sector is in distinct contrast to the growth of the aquaculture industry. Other important sectors are mining and manufacturing. The regulatory framework for the government's administration of natural resources management is complicated. Chapter 4 explores the management issues regarding coastal resource use.

## CHAPTER 4

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# COASTAL ZONE MANAGEMENT ISSUES

The CZM issues facing the Upper South can be divided into three overlapping categories: environmental quality, resource exploitation, and institutional and organizational issues. A summary of specific management problems is given in Table 4.1. The categories overlap because individual issues often involve aspects of all three categories. For example, public health is threatened by pollution, an environmental quality issue, while tin mining can cause pollution, a resource exploitation issue. Problems with the HD structure are organizational and will determine how the public health threat is dealt with.

Environmental quality issues are those that deal with changes in the natural state of ecosystems including those that may cause health problems. Threats to rare and endangered species, loss of critical habitats, and air and water pollution are all environmental quality issues. Resource exploitation issues are those that involve utilization of natural resources such as minerals, forests and fish. Those that involve the organizational setup of the government and implementation of government policies are institutional and organizational issues.

### ENVIRONMENTAL QUALITY

#### Water Pollution

A wide diversity of pollution problems threatens the quality of life in the Upper South. Untreated sewage is discharged into waterways from residences and tourist facilities resulting in a public health problem in both freshwater and marine areas (Fig. 4.1). A high count of the indicator bacterium, *Escherichia coli*, in some areas of Ban Don Bay (e.g., nearshore areas of Ko Samui) suggests sewage pollution is a serious threat (Table 4.2). Because of this, a common tourist activity, eating raw oysters gathered in Surat Thani, poses a potential health threat via hepatitis A and gastroenteritis vectors. A similar pollution problem exists in Phangnga Bay areas. One major cause is that only hotels with 80 rooms or more are required to have sewage treatment facilities.

## Chapter 4. Coastal Zone Management Issues

Table 4.1. A summary of the management problems in Ban Don and Phangnga Bays.

Problem	Cause and/or problem description	
Environmental quality	Water pollution	<ul style="list-style-type: none"> <li>• Untreated domestic/industrial sewage; dumping of waste petroleum products from boats; and sediment runoff from agriculture, logging, construction and tin mining</li> </ul>
	Solid waste pollution	<ul style="list-style-type: none"> <li>• Indiscriminate dumping from domestic/industrial sources and low handling capacity of waste collection system</li> </ul>
	Loss of wildlife habitats Loss of scenic value	<ul style="list-style-type: none"> <li>• Forest destruction</li> <li>• Construction of buildings, fences and walls close to the shoreline</li> </ul>
	Tourism-related problems	<ul style="list-style-type: none"> <li>• Destruction of natural assets and tourist overcrowding</li> </ul>
Resource exploitation	Mangrove forest conversion	<ul style="list-style-type: none"> <li>• Conversion into shrimp ponds and agricultural uses; extractive uses of mangroves for construction and fuel</li> </ul>
	Upland forest conversion	<ul style="list-style-type: none"> <li>• Conversion into agroforestry and rubber plantations</li> </ul>
	Improper agricultural practices	<ul style="list-style-type: none"> <li>• Crops planted to unsuitable soil, e.g., rubber on sandy soil</li> </ul>
	Over- and destructive fishing	<ul style="list-style-type: none"> <li>• Too much fishing effort; use of small-meshed nets; blast-fishing; displacement of artisanal fishers; and inadequate enforcement of fisheries laws</li> </ul>
	Shoreline erosion Coral reef damage	<ul style="list-style-type: none"> <li>• Sand/gravel mining</li> <li>• Illegal trawling, blastfishing, muro-ami and cyanide fishing; siltation; and tourist activities such as anchoring and collecting corals</li> </ul>
	Illegal hunting	<ul style="list-style-type: none"> <li>• Demand of specialty restaurants for exotic meat</li> </ul>
Institutional and organizational issues	Adoption of integrated management plan	<ul style="list-style-type: none"> <li>• Plan may not be used effectively because accelerated developments "overshadow" planning</li> </ul>
	Insufficient or overlapping regulations	<ul style="list-style-type: none"> <li>• Sectoral nature of laws on resource use in coastal areas which are geared towards short-term economic benefits and nonintegration of development and environmental policies</li> </ul>
	Lack of interaction among government agencies Inadequate extension work and low public awareness Ineffective law enforcement	<ul style="list-style-type: none"> <li>• Lack of coordination and the need to transfer some functions, e.g., fish licenses, from HaD to DOF</li> <li>• Few extension personnel in agriculture/aquaculture; and inadequate public awareness program</li> <li>• Lack of enforcement due to scarce manpower, equipment and budget</li> </ul>
	Socioeconomic inequities	<ul style="list-style-type: none"> <li>• Outside entrepreneurs favored over local residents</li> </ul>

Another form of water pollution is high turbidity caused by large amounts of suspended sediment. This problem affects both Ban Don and Phangnga Bays and is caused by erosion related to poorly managed farming, logging and construction activities which expose soil to the action of wind and rain, and by tin mining. High turbidity threatens sensitive marine life directly (in both natural systems and aquaculture ponds) and makes the ocean unattractive for tourists, particularly those who enjoy watersports (e.g., scuba diving).



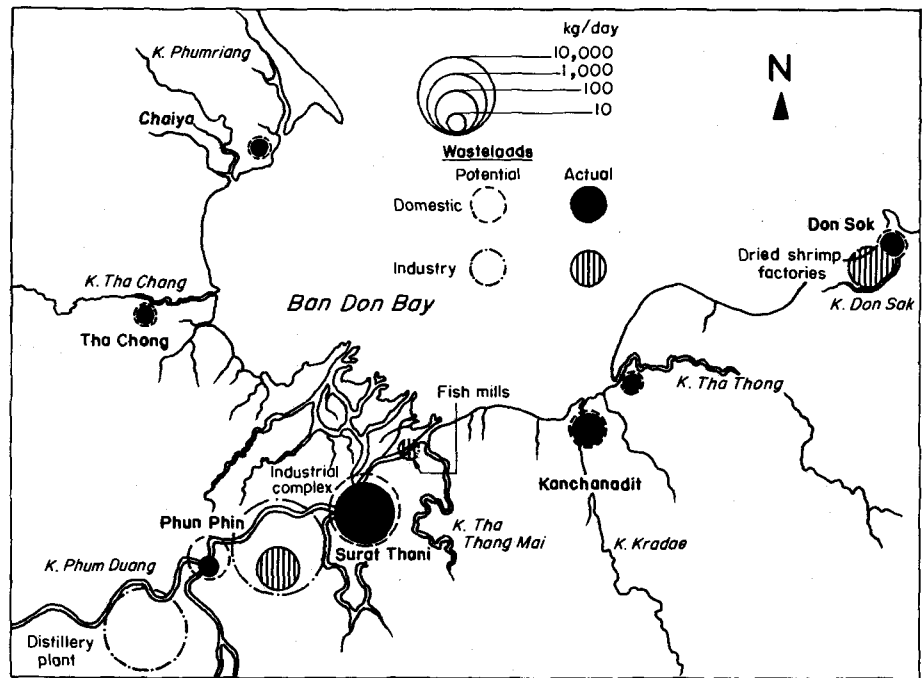


Fig. 4.1. Potential and actual wasteloads from land-based pollution sources in Ban Don Bay (Kositratana and Kajornatiyudh 1988).

Increased dumping of refuse petroleum products by small- and medium-sized boats pollutes marine waters. Oil tankers of up to 2,000 GT in size make about 300 trips/year along the east coast, threatening Ban Don Bay with a potential oil pollution.

A special pollution problem faces the aquaculture business. Aquaculture ponds owned by different companies are often packed tightly together and use the same waterbody as their water source and depository of effluent. Pond water becomes high in nutrient content from decomposing food and animal wastes. When this water is discharged, it is used as influent to neighboring ponds after only minimal dilution in the receiving water.

Most surface water discharge into the estuaries of Ban Don Bay is from the watershed of K. Tapi-Phum Duang. Significant influences on water quality are those of silt from upland activities and extreme fluctuations in salinity which have implications for aquaculture activities in the bay and coral reef growth in the offshore islands.

Water pollution in Ban Don Bay is due primarily to domestic and industrial wastewater from rural and urban sources and natural watershed sediment and agriculture runoff (Paw et al. 1988). Discharge of wastewater into the river either directly or through sewer systems is the main problem. Distillery plants, an industrial complex in Phun Phin, fish mills near the mouth of K. Tapi and dried shrimp factories also generate large wasteloads (Fig. 4.1)

Water pollution is caused by untreated sewage, refuse petroleum products in marine waters, pesticide-loaded pond water, domestic and industrial wastewater, natural watershed sediment and agricultural runoff, upland deforestation and soil erosion.

## Chapter 4. Coastal Zone Management Issues

Table 4.2. Seawater quality in the nearshore areas of Ko Samui.

Beach/resort	Fecal coliform (MPN/100 ml)	Total coliform
<b>Hat Chaweng</b>		
Saeng Thip	40	200
Ko Samui	none	400
Sun Shine	90	400
Pan Sea	-	-
White House	40	1,000
First	none	400
<b>Hat Lamai</b>		
Marina Villa	none	400
Weekender	none	>10 <sup>6</sup>
Aloha	230	1,200
Rocky	40	13,000
White Sand	40	600
Marine Park	-	-
<b>Hat Mae Nam</b>		
Golden Hut	none	none
Laem Sai	none	600
<b>Hat Cheong Mon</b>		
Cheong Mon	none	>10 <sup>5</sup>
P.S. Villa	none	1,000
<b>Hat Bo Phut</b>		
Sophon	40	1,200
<b>Hat Thong Yang</b>		
Lipalodge	40	800
<b>ONEB standard of sea-water quality for:</b>		
Swimming	-	<1,000
Conservation	-	-

MPN - most probable number.

Source: TISTR (1988).

(Kositratana and Kajornatiyudh 1988). Chiew Larn Dam, completed in the mid-1980s, has also contributed to the pollution problems in the inner bay due to the release of large quantities of water with high biological oxygen demand (BOD).

The water quality along the shoreline of Ko Samui is not seriously polluted with coliform bacteria except at Hat Lamai (TISTR 1985). Nevertheless, during the rainy season, surface water from the island brings debris to the inshore areas because its solid waste disposal is not properly managed.

The water quality around Mu Ko Ang Thong is deteriorating from upland deforestation and related soil erosion in the mainland of Surat Thani and from trawling near the islands. Increasing turbidity is a limiting factor in the growth of coral reefs and varies during the year in relation to season, current and wind along the coast of the Gulf of Thailand.

**Solid Waste Pollution**

Coastal pollution by solid waste is caused by inadequate public collection, indiscriminate dumping and improper disposal. For example, Ko Samui's refuse collection service can only handle approximately 20% of the island's garbage. Solid waste pollution is a problem on beaches in Mu Ko Ang Thong, Ko Punyee and both pollution and damage to natural features have degraded caves in Phangnga Bay.

Facilities for waste management include well-marked trash bins, incineration facilities and landfill sites. There are some sewerage and sewage treatment systems in rural areas and a few in urban areas. Sewage treatment was not a high priority among municipalities surveyed by NESDB in late 1984 as part of the preparation of the Sixth NESDP.

**Loss of Wildlife Habitats**

Habitat destruction for a variety of causes has reduced habitats for a number of rare and endangered wildlife species. All types of habitats are being converted into other land uses but forests are of primary concern in both the uplands and lowlands.

**Loss of Scenic Value and Public Access**

A lack of enforcement of setback standards has caused the physical beauty of the Upper South coastal environment to be marred by the construction of buildings, fences and walls too close to the shoreline. Some of these structures block the public's access to the sea. Such access is guaranteed by the Land Code of Thailand 1954 (Section 8-9) and was upheld by the Supreme Court's decision (Dika No. 214/2481) that private ownership of a beach is illegal in Thailand.

**Tourism-related Problems**

Tourism in Ban Don Bay relies heavily on the diversity and quality of the environment on the offshore islands. About 65% of the tourists to Surat Thani Province are attracted to Ko Samui's beaches, clean waters and coral reefs. In 1987, Ko Phangan attracted an additional 10% of the provincial tourists totaling over 300,000 for the two islands (Dobias 1991). These tourists are primarily interested in the relatively "natural" and "undeveloped" atmosphere of the area compared to larger resort areas such as Pattaya (TISTR 1985).

*The beauty of the Upper South coastal environment is marred by the lack of enforcement of setback standards.*

Ko Taen, another major island south of Ko Samui, has no bungalows or other visitor services and, thus, receives only day visitors, most of whom go to see coral reefs and enjoy the beaches. Other islands near Ko Samui and Ko Phangan as well as Mu Ko Ang Thong NMP receive day visitors but have minimal tourist development. Some of these outlying sites have local residents who engage mostly in fishing or aquaculture for their livelihood (Dobias 1991).

#### **Chapter 4. Coastal Zone Management Issues**

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Between 1984 and 1987, hotel and bungalow establishments on Ko Samui increased to more than 160 resorts with about 3,000 rooms (October 1987). By 1988, Ko Phangan was in the beginning stages of rapid tourist development similar to Ko Samui's in the early 1980s. The influx of visitors and extensive building of shoreline facilities have brought about increasing concern for the carrying capacity of the islands, the impact of such activities on the coastal environment and the sustainability of the local tourism industry.

TISTR (1988) studied the carrying capacity of Ko Samui in terms of infrastructure and facilities, water resources, wastewater and solid waste disposal, and the social attitudes of both tourists and local residents towards tourism development. The most important limiting factor to further expansion of tourism on the island was the availability of potable water. The TISTR accordingly recommended a maximum tourist density of 14,200 visitors/day, compared to the 1987 average of 3,544 visitors/day. Given the existing rate of increase in the number of visitors, the carrying capacity of the island is likely to be reached in 1994. The TISTR report did not address coastal or marine environment impacts comprehensively although numerous improvements in refuse collection, land-use control and zoning were suggested. This present plan will build on the recommendations proposed by TISTR and expand on the management planning for shoreline and marine resource use.

The national policy toward tourism is to promote and develop the industry for the benefit of the national and local economies. Another important policy with respect to tourism development is "to conserve and restore natural resources, environment, arts, cultures, and places of archaeological and historical importance which will contribute to social development in the locality" (TISTR 1985). This objective, also part of this plan, is often overlooked in the rapid development typical of tourism in Thailand.

Tourism's economic contribution to the islands and the national economy is significant. Based on the 3000-room capacity of Ko Samui assuming full occupancy, a yearly gross revenue is about \$10 million from room rental alone. The annual contribution from tourist activities directly dependent on coral reefs, nearshore water quality and fisheries, e.g., scuba diving, snorkeling and boat hire is estimated at \$500,000, excluding the expenditures of tourists on amenities and travel to and from the sites (Sudara et al. 1989b). The volume of tourism in this area is expected to more than double by the year 2000, thus generating substantial economic benefits to the country and the region (TISTR 1985). There may be unacceptable costs, however, in the form of environmental degradation if coastal resource planning and management is not improved.

**RESOURCE  
EXPLOITATION**

**Mangrove Forest  
Conversion**

About 5,300 ha of mangrove forest have been converted into shrimp ponds in Ban Don Bay over the past 10 years, some from areas within forest reserves (Aksornkoae et al. 1988). Poor enforcement of forestry laws, a lack of appreciation of the value of mangrove areas and the incentive of high profits from shrimp farming have been the major causes. Other mangrove areas have been used for agriculture, e.g., rice, rubber and coconut. In addition, some mangrove areas are subject to harvesting for fuelwood, charcoal and construction material.

**Upland Forest Conversion**

Much upland forest conversion is taking place in the Phangnga Bay area and is accelerating soil erosion and flooding. This process also exacerbates turbidity of waterways and bay waters. A high suspended sediment load can damage marine organisms and entire coral reefs. Some forest areas, particularly evergreen and *Melaleuca* forests, have been converted into agroforestry, e.g., rubber plantation. In areas with steeply sloping land, this can create severe erosion problems.

**Improper Agricultural  
Practices**

Sandy soils have been planted to oil palm, rubber and fruit trees. These crops will not prosper in such soils, thus, production will be limited. These areas should be used as pastureland and for growing cashew and coconut.

Large areas in A. Don Sak have been planted to oil palm. The soils have a high pH (alkaline) and are poorly drained--both factors will reduce yield.

Paddy areas in A. Don Sak, A. Kanchanadit and in the delta of K. Tapi have been abandoned due to the lack of a reliable water supply, but are suitable for rice production.

**Overfishing and  
Destructive Fishing**

Overfishing is caused by too much fishing effort and use of small-meshed nets. Fish and shrimp catches are greater than MSY. A lack of public understanding of fisheries management principle is evident.

Artisanal fishers are being outcompeted by large-scale commercial operations. Direct damage to artisanal fishers' nets has occurred. Artisanal fishers' income is declining. Large anchovy boats using fine-meshed nets close to coral reefs have reduced reef fish catch.

The remoteness of Ko Tao constrains the enforcement of existing regulations on blastfishing and other illegal activities. A 1989 decision by DOF to place a field station there should help solve this problem.

## Chapter 4. Coastal Zone Management Issues

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*The problems of the Ban Don Bay and Phangnga Bay fisheries are overfishing, fishing of the juveniles of high-value fish, conflicts between artisanal and commercial fishers, and lack of alternative livelihood for fishers.*

The basic problems with sustainable development of fisheries resources in both Phangnga and Ban Don Bays are overfishing, fishing of juveniles of high-value fish, conflicts between artisanal and commercial fishers, and lack of alternative livelihood opportunities for fishers.

In Ban Don Bay, decreasing catches of mackerel prompted DOF to regulate exploitation of the species offshore of Prachuab, Chumphon and Surat Thani, their most fertile spawning and nursery grounds. The DOF announced a four-month closed season (1 February to 31 May) for trawl and push-net fishing in these areas in 1983. This measure was not accepted by the fishers. The closed season was reduced to two months with an exemption for selected small-scale gear. At present, trawl, pair trawl and purse seine fishing are banned in these areas from 15 February to 15 May. Push-net, small trawl, and light-lure fishing are still allowed at night time during that period.

In 1987, a survey by the Marine Fisheries Division (MFD) revealed that catches from these areas increased by 24% after the closed season. The increase was mostly for low-value and pelagic fish while the increase was low for demersal fish. The low increase in demersal catch can be explained by the exemption for push-net, small trawl and light-lure fishing and the catch of juvenile demersal fish (classified as low-value fish) immediately after the closed season.

The main fishing gear in Ban Don Bay is the push-net. Most are small push-nets catching mainly shrimp using cod-end mesh as small as 0.5-1.5 cm. Besides 800 push-net vessels, there are about 400 small trawlers also using small mesh sizes.

The MFD study indicated that 62% of the catch from these push-nets and trawls in Ban Don Bay are low-value fish of which 60% were juveniles of high-value fish. If the mesh size were to be increased, the loss of juveniles of high-value fish would be reduced.

In Phangnga Bay, although push-netters and trawlers are not supposed to fish within 3 km of shore, many boats are known to encroach. Stricter enforcement of the current laws is necessary.

### Shoreline Erosion

Shoreline erosion has been exacerbated by indiscriminate mining of sand, gravel and rocks for construction materials. Shoreline erosion threatens coastal structures.

### Coral Reef Damage

Damage to coral reefs is caused by illegal trawling, blastfishing, muro-ami fishing and chemical fishing. Coral reefs are also damaged by siltation from inappropriate land use, improper farming practices and nearshore construction. Some coral reef damage is caused by activities of tourists who are not

#### Chapter 4. Coastal Zone Management Issues

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aware of the fragility of the shallow coral reefs. Anchor damage at popular picnic and dive sites as well as souvenir collection of marine organisms further degrade these areas (Dobias and White 1988).

The chief measure by which ONEB attempts to achieve its policy objectives is the EIA process established under Sec. 17 of NEQA, 1975 as amended in 1978. In order to facilitate the implementation of this process, a Proclamation of Types and Sizes of Projects or Activities Requiring EIAs (including mitigating measures) was issued on 14 July 1981. Notable omissions to the list of projects or activities included in this proclamation which have already had a deleterious effect on coral reef resources are roads and resort facilities with less than 80 rooms. Supplemental environmental impact statement (EIS) guidelines for coastal areas have also been published but are considered unsatisfactory due to a lack of information on the value of coral reefs and how they can be damaged. Among mitigation measures imposed by the EIA procedure is the requirement that resort facilities and hotels over 80 rooms install a waste treatment system.

Another measure by which ONEB could contribute to the conservation of coral reefs is through the recommendation of water quality standards under Section 5 of NEQA. However, so far the Environmental Quality Standards Division has not yet produced these. A water quality plan which should fill this gap is in Chapter 7.

*Damage to coral reefs is caused by illegal trawling, blastfishing, muro-ami and chemical fishing as well as siltation from unplanned land use, improper farming practices and nearshore construction.*

Neither DOF nor the National Parks Department (NPD) has an explicit policy statement which reflects their recognition of the unique values and management needs of coral habitats. Still, to some extent, relevant policies are embedded within two major legal statutes, i.e., the Fisheries Act of 1970 (as amended) and NPA of 1961.

If coral is located within the boundaries of an NMP, it is protected under both laws, and DOF and NPD can exercise authority to prevent damage, prosecute offenders, etc. If the coral is located outside NMP boundaries, it is protected under the Fisheries Act only.

Coral is not actually mentioned in the Fisheries Act but it is subject to legal interpretation. A number of prohibitions contained in the act indirectly protect coral. Sections 19 and 20 prohibit the use of poisons and explosives, respectively, in all fishing areas. Section 32 prohibits fishing in areas of the Gulf of Thailand from 15 February to 15 May; the actual prohibited area extends from Changwat (meaning "first-order administrative district") Prachuap to Ko Samui thus indirectly offering some additional protection (e.g., from anchor damage or sedimentation) to the coral in Mu Ko Ang Thong and nearby areas. Only four boats patrol the entire area. Thus, enforcement is extremely difficult.

#### **Chapter 4. Coastal Zone Management Issues**

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The Fisheries Act does not specifically refer to habitat management but focuses on fish stocks and fishing practices. Thus, there is no directive, and presumably, minimal staff and funds to monitor the conditions of reefs and to formulate and implement habitat management plans. Considerable emphasis is now being placed on technologies popularly believed to act as replacements for natural resources such as artificial reefs (ARs) and shrimp breeding stations. Although these technologies are useful supplements to natural systems, clearly, they cannot replace them.

The NPA was originally placed on the statute books for the establishment of terrestrial parks, thus marine parks are not specified and significant issues pertinent to them are not addressed. Coral reefs are not mentioned in the act and it does not consider certain features of marine parks which make them particularly vulnerable to a variety of threats. For example, marine areas can be used for multiple pursuits, particularly marine transportation and fishing, which need careful management. As ocean currents, winds and tides can deliver pollution from outside of park boundaries, there is a special need to include such considerations in park management and to create institutional forms that can deal with such matters. Indirect protection of coral in Mu Ko Ang Thong is provided by Section 16 of NPA as it gives NPD authority to prohibit fishing within park boundaries. This should prevent fishing boats from entering and causing damage with their anchors. The use of explosives is also prohibited under Section 14, as is the collection of coral (the law does not actually refer to coral but specifies "natural resources").

The NPA does not specifically promote positive measures for marine park management. Thus, so far neither Mu Ko Ang Thong nor any other marine park has a comprehensive management plan. Similarly, park staff have no statutory responsibility to implement, review and revise such a plan if it was formulated. The lack of a plan and associated responsibilities has serious consequences for park management because without consistent policies and strategies, resource conservation will almost certainly prove to be ineffective. Consequently, other relatively straightforward park functions such as receiving tourists, will almost certainly take precedence when budgets are being requested and money and manpower are being allocated.

Section 6, Chapter 1 of NPA defines the criteria for NP designation but unfortunately restricts these to education and recreation. Scientific criteria are not mentioned. This could lead to a reluctance to control the flow of visitors and the development of visitor-related services. Also, it could pose a serious threat to coral sometime in the future when the demand for park use (including coral viewing) is expected to be much greater as mobility and incomes increase and as the 2- to 3-week annual leave becomes a normal part of Thai life.



#### **Chapter 4. Coastal Zone Management Issues**

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It is generally agreed that the shortage of boats, fuel, staff and equipment poses problems for marine park management. A related factor of considerable significance is that the vast majority of park staff, from the highest levels down, has been trained in terrestrial forestry, and whatever park management training they have is related to terrestrial parks. Moreover, park superintendents can be moved from one park to another regardless of qualifications or preferences. Thus, a park chief can easily be moved, without suitable preparation, from a terrestrial park in the north to a marine park in the south.

Coral is also explicitly protected under two other regulatory measures. Firstly, a Ministerial Notification, the Prohibition of Fishing for Certain Animals (Coral) (No. 3) 1978 issued by MOAC and secondly, a Royal Decree, the Control of the Import and Export of Certain Goods (No. 41) 1975, issued by the Ministry of Commerce which prohibits the export of coral. Neither of these regulations prohibits the sale of coral within Thailand. A recommendation that a notification to this effect be issued has been submitted to the Cabinet by DOF. However, it is unlikely that this will be dealt with in the near future given the infrequency of Cabinet meetings and the urgency of many other matters requiring their attention.

Another Ministerial Notification, the Specification of Coastal Areas Where Trawl Nets and Push-nets Used With Motor Boats are Prohibited, issued on 20 July 1972 by MOAC, prohibits trawling within 3,000 m of shore. While this was issued to protect nearshore fisheries, it indirectly offers protection to nearshore reefs.

Control of offenders under the Fisheries Act and NPA is extremely difficult and the shortage of enforcement officers and high speed-boats usually ensures that the law is broken with impunity. For example, DOF has only four boats to patrol the entire Gulf of Thailand and Mu Ko Ang Thong NMP has only one boat at its disposal and has no radio communications system. Moreover, these material problems are compounded by more intractable sociolegal problems:

1. Offenders must be caught "in the act" before they can be prosecuted. Therefore, on spotting enforcement officers they simply dispose of their catch and illegal equipment or flee the site.
2. Prosecution of offenders is complex and protracted and therefore many enforcement officers prefer not to make arrests. They prefer simply to chase offenders away, despite the fact that they are certain to return.
3. Government officials are often sympathetic because of their perception of the economic pressures on fishers. Moreover, they know little about the serious ecological and economic effects of the illegal activities on fish habitats and communities. Hence, they tend not to strictly enforce the law.

## **Chapter 4. Coastal Zone Management Issues**

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4. Local police officers have reportedly been bribed to let offenders go.
5. The law is often worded vaguely and there is no precedent to suggest it can be interpreted broadly.
6. As provincial governors are under the authority of MOI, they invariably focus on security issues rather than on environmental issues. Moreover, as they are commonly transferred to another province after a term of five years, there is little incentive for them to get involved in programs which bear mainly long-term results and which appear to conflict with short-term gains.

The chief land-based activity which has been identified as causing coral damage is the building of hotels and beach resorts. Problems associated with this include silt runoff due to construction activities and the disposal of untreated wastewater. Hotel and resort facilities having less than 80 rooms are not subject to EIA requirements.

### **Illegal Hunting**

Some species of wildlife that should be conserved are hunted to supply exotic meats to specialty restaurants. The common mouse deer, porcupine, palm civet and Malayan pangolin have been reported to be on sale at restaurants.

## **INSTITUTIONAL AND ORGANIZATIONAL ISSUES**

### **Adoption of Integrated Management Plan**

The major potential impediment to the effectiveness of this integrated management plan is that it will not be formally adopted and used. Economic development has proceeded so fast in recent years in the Upper South that many "plans" have been left behind, particularly for tourist sites such as Phuket and Ko Samui. A consensus has developed in both the government and among the public that development has been allowed to go too fast. Certain cases wherein lack of planning has caused not only economic hardship but even injury and death can be pointed to as clear evidence of the need to follow a good plan. For example, upland forest conversion and floods that brought death and destruction of property have been linked in a cause-and-effect relationship. Tourists' rejection of Pattaya as an upmarket tourist destination has been attributed to unplanned development and destruction of natural assets. These warnings should be sufficient to all parties concerned that development plans are desperately needed if the future of the Upper South is to be prosperous over the long term.

**Insufficient or  
Overlapping  
Regulations**

*Coastal resources management in Thailand is not governed by a single comprehensive law but by many laws which are purely sectoral by design and largely oriented toward resource exploitation.*

Management of coastal resources in Thailand is not governed by a single, comprehensive law but by many laws governing the use of the various resources. They are generally purely sectoral by design and largely oriented toward resource exploitation for economic benefit. In many cases, the laws are outdated and have become very complex due to piecemeal legislative amendments and complicated regulatory processes associated with their implementation.

As regards ONEB's environmental policy function, no mechanism is provided by NEQA to integrate national environmental policies into national development policies at the stages of planning and implementation. In the absence of such a mechanism, sectoral agencies are left to their own judgment about what steps to take to balance their own objectives with national environmental policies and it is no surprise that short-term resource exploitation is usually given priority.

The Upper South zoning regulations for mangrove forests have not been adopted under the National Reserve Forest Act of 1964 and Forest Act of 1975.

The Nature Conservation Act and the National Resources Exploitation Act are not effective and difficult to implement. Taxes are too low on steep-land forest plantations. Farmers do not have titles to their land.

Regulations have not been established regarding silt containment at construction sites and no EIA is required for projects proposed for mangrove areas. There are few management plans for parks.

A system for territorial use rights in fisheries (TURF) is not well defined. Fishing license fees are too low; thus, economic rents are not being returned to the government for the exploitation of common property resources.

There is a lack of planning at the island level for tourist development in terms of land-use practices, setbacks from the beach, waste disposal, simple zoning and guidelines for tourist activities and conduct. Local operators are not organized for cooperation among themselves or with the national or provincial authorities except in special instances partly because of competition.

Regulations and guidelines for nearshore construction are lacking because of the shortcomings of the Building Construction Control Act (BCCA) of 1979 and the Town and Country Planning Act (TCPA). The BCCA and TCPA are difficult to apply because land rights are restricted by these laws especially in areas where the price of land is rising rapidly.

Simple guidelines for waste disposal do not exist in BCCA for local application unless the resort facility has more than 80 rooms and this comes under ONEB regulations.

## **Chapter 4. Coastal Zone Management Issues**

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### **Lack of Government Agency of Interaction**

Fish licensing authority, currently with HaD, is difficult to monitor. The NPD and DOF are not coordinating with law enforcers with respect to fisheries laws.

There is a lack of communication between tourism companies and park authorities. Cooperation is lacking among TAT, DOF, NPA, and provincial and district governments in planning for tourism development and environmental concerns. Tourism promotion tends to outweigh other considerations for planning and resource management.

There is no single authority to implement CZM plans.

The RFD has authority over mangrove forest management and sells concessions to logging companies without checking with the Department of Town and Country Planning (DOTCP) or DOF regarding possible downstream effects.

There is a lack of communication between the government and the private sector. For example, the government is insufficiently promoting the need for a diversified industrial base for the Upper South. Line agencies are also not cooperating closely enough with the mining industry to show them how and why the new environmental regulations should be followed.

### **Inadequate Extension and Low Public Awareness**

There are not enough qualified extension personnel in agriculture and aquaculture in the region. More education is needed in proper agriculture and aquaculture management practices along with a soil testing program to identify poor soils for aquaculture. Public awareness is low concerning the value of natural systems and coastal management planning due to the lack of media programs. There is a lack of education regarding the rights of the public to access to the seashore. The LGs and PGs have been overwhelmed with the recent upsurge of tourism to the islands and few people have been trained in addressing the CRM problems which they now face.

The dependence of tourism and other more traditional activities, e.g., fishing, on intact and clean coastal ecosystems is often not understood and appreciated by the local people and government officials. Knowledge of resource management among locals, fishers and tourist operators is poor. Basic knowledge about the dynamics of the coastal area and its beaches, coral reefs, land forms, water quality and watersheds is lacking among island residents, tourism operators and tourists. Benefits derived from coastal environments particularly, beaches, coral reefs are not adequately credited economically as contributing to the tourism industry and the income of resort owners and employees. Thus, they tend to be undervalued in most economic calculations.

**Ineffective Law Enforcement**

There is not enough coordination between law enforcement agencies regarding fisheries, forestry and conservation (park) laws. Illegal fishing, particularly by trawlers (single- and twin-types) is practiced on the northern side of Mu Ko Ang Thong and Ko Samui-Phangan. Enforcement of the fisheries management regulation is not effective because of lack of manpower, equipment and budget.

Regulations controlling construction, particularly of tourist facilities are not properly enforced, in the coastal zone. The enforcement of tin mining regulations is inadequate, particularly rehabilitation of mined land. Also, the enforcement of hunting laws is weak.

**Socioeconomic Inequities**

There is an increasing incidence of off-island ownership of tourist facilities which tends to remove control and benefits from the island residents. Many residents who do not benefit economically from tourism are nevertheless subject to the effects of tourism-related inflation. The lack of skills, knowledge and capital inhibits local participation in tourism development. Tourism brings influences which change the local culture and may exacerbate social problems caused by a breakdown of traditional cultural values and lines of authority.

This chapter has discussed the management issues facing the Upper South. These issues can be divided into three overlapping categories: environmental quality, resource exploitation, and institutions and organizations. Environmental quality issues include pollution of land and water and loss of wildlife, beautiful scenery and public access to coastal areas. Resource exploitation issues include utilization of coral reefs, mangroves and other forests; poorly planned agriculture and aquaculture; overfishing, destructive fishing; illegal hunting and erosion. Institutional and organizational issues include problems with adopting the plan itself, the regulatory framework and law enforcement; lack of communication among government branches and between the government agencies and the private sector; lack of public awareness of the value of conservation of natural resources and planning; and lack of infrastructure such as sewage treatment facilities. Chapter 5 presents the policies to be promoted by the management plan.

## CHAPTER 5

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# *POLICY GUIDELINES FOR THE INTEGRATED MANAGEMENT PLAN*

Policies play an important role in coastal planning and management. Once adopted, they serve as guiding statements for coastal resource managers. As such, the policies guide private and public decisions with respect to resource use and conservation and should help to ensure consistency of action.

Policies also promote consensus building. Government agencies and private developers who agree to support certain policies are defining coastal problems, issues and possible solutions. Their agreement or support shows their willingness to help realize these policies through project implementation and a commitment of agency resources.

The CZM recognizes that coastal lands, waters and intertidal areas contain ecosystems that are interconnected, particularly by water. This means that any environmental change or resource transformation in one ecosystem is likely to have an impact on another ecosystem. This is reflected in the following policy statements and in many cases, policies for one resource type (e.g., mangroves) address issues that concern other resource types (e.g., aquaculture and fisheries). It must be stressed therefore that while coastal managers should assess the policies and measures for the resource type of particular concern to them, a study of all of the policies will provide a fuller understanding of the direction and philosophy of CRM adopted for the project sites.

*Once adopted, policies serve as guiding statements for coastal resource managers and guide private and public decisions with respect to resource use and conservation.*

One way of promoting these policies is for ONEB to bring up the matter at a meeting of the Committee on the Marine Environment. This group has high-level representatives of most government agencies with a direct or indirect interest in and responsibility for coastal resources. Committee members' advice should be solicited for suggestions on how their agencies intend to pursue and implement these policies.

The policy statements pertaining to the Upper South are listed below under sectoral headings (DANIDA 1986; Baker 1988; Dobias et al. 1988; Lemay and Chansang 1988; Bunpapong 1989 and Laksakundilok 1990).

## **POLICY STATEMENTS**

### **Aquaculture**

1. Aquaculture practices shall be improved on by strengthening training and extension services. The major strategy for achieving increased shrimp production will be to increase pond productivity rather than opening up new farming areas.
2. No additional productive mangrove areas shall be converted into shrimp farms. New shrimp ponds shall be located only on open land or degraded mangrove forests zoned for economic use by RFD, or behind productive mangrove areas as identified in the Upper South land use zoning plan.
3. Openwater aquaculture zones shall be established and protected against all adverse impacts originating from both land and marine sources.

### **Beaches and Dunes**

1. The authorities shall ensure that developments on beaches and sand dunes of Ban Don Bay are limited by zoning, setbacks, building controls and design guidelines, and promote the removal of structures built too close to the shore or in otherwise inappropriate locations.
2. The authorities shall initiate joint action with the private sector to manage beach pollution.
3. The right of public access to beaches shall be asserted and publicized.
4. Mining of sand or removal of beach materials such as rocks, shellgrit or gravel shall be allowed only in beaches and dunes specifically designated for that purpose.

### **Capture Fisheries**

1. Sustainable harvesting of the Upper South's capture fisheries shall be achieved through increasing net mesh sizes, controlling the entry of new fishing boats, constructing and protecting fish habitats, and enforcing seasonal and spatial limitations more effectively.
2. Greater equity and poverty alleviation shall be promoted by providing alternative employment opportunities to small-scale fishers.
3. Conflicts between large- and small-scale fishers and between mobile and stationary gear shall be resolved by introducing a TURF system and by controlling use of push-nets and trawls.
4. Fisheries institutions shall be strengthened and laws amended where appropriate.

**Coral Reefs**

1. A more effective administration of coral-related laws and regulations shall be achieved by providing relevant government agencies with more manpower and equipment, promoting interagency cooperation, revising unclear and outdated laws and regulations and adopting new ones, and including local participation in coral reef management.
2. The government shall regulate shoreline development in areas with coral reefs to protect these reefs from siltation and the effects of wastewater pollution.
3. The government shall promote understanding among local officials/local tourism industry personnel, and local citizens of the ecological and socioeconomic values of coral reefs.
4. A coral reef zoning scheme shall be implemented to promote multiple uses of coral resources so as to realize their diverse socioeconomic and ecological values and protect them from human disturbance.

**Land**

1. Deforestation of steeplands in Ban Don Bay and Phangnga Bay shall be halted as a matter of priority and maps shall be made of current land use at the scale of 1:50,000.
2. Efforts to encourage farmers already cultivating deforested areas to adopt soil conservation measures shall be stepped up.
3. Assistance shall be provided to farmers to intensify existing agricultural land use and cultivate vast areas of idle land.
4. Flood hazard zones shall be defined and mapped for management purposes.

**Mangroves**

1. Mangrove lands shall be classified according to use zones and such classification strictly adhered to.
2. Healthy mangrove areas shall, in no case, be converted into shrimp ponds.
3. Efforts to halt illegal cutting of mangroves shall be intensified.
4. Replanting of mangroves shall be carried out where necessary to ensure coastal and river border protection. Mangrove strips 75-m wide should be planted along all major rivers and tributaries.
5. In areas where mangrove harvesting is permitted, concessionaires shall be required to adopt a sustained-yield management system.



## **Chapter 5. Policy Guidelines for the Integrated Management Plan**

6. Appropriate measures shall be taken to ensure more effective administration and implementation of mangrove-related laws, programs and policies.

### **Marine Parks**

1. Tourism and recreation in the parks shall be developed and promoted in a manner compatible with natural resource conservation (e.g., ecotourism). A joint government-NGO campaign to educate the tourism industry regarding the compatibility of tourism and conservation shall be adopted to develop a target constituency that will fight for natural resource conservation.
2. Regulation of boat traffic both within and outside the park boundaries shall be strengthened.
3. The protection of mangroves and coral reefs within NMP boundaries shall be given a high priority by park managers.
4. The NPD shall seek the cooperation of all agencies concerned with activities outside the park boundaries which have negative impacts on park resources.

### **Coastal Water Quality**

1. Monitoring of on-site treatment systems and effluent discharges shall be increased and industrial effluent standards strictly enforced.
2. Beneficial uses of the bays shall be classified and protected by setting surface water quality standards and implementing town planning measures.
3. Standards for waters being discharged from dams and impoundments shall be established and strictly enforced.
4. Treatment systems for community wastewater shall be established.
5. Adverse impacts on water quality associated with tin mining and shrimp farming shall be reduced or eliminated.
6. A national contingency plan for oil spills shall be established, including a detailed action plan for Ban Don Bay.

### **Wildlife**

1. Lowland habitats such as mangrove and *Melaleuca* forests shall be included and maintained in the Upper South's PA system.
2. Illegal hunting shall be halted.

## Chapter 5. Policy Guidelines for the Integrated Management Plan

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3. More effective protection and management of the PA system shall be introduced.
4. A continuing program of monitoring and research on the region's wildlife species (resident and migrant) and their habitats, whether in PAs or not, shall be undertaken as a basis for identification and control of factors important for their survival.

### APPROACH OF THE PLAN

The present plan is not intended to be a comprehensive economic development and/or environmental management plan similar in scope to the *Songkhla Lake Basin planning study* (1985), for example. This approach has been rejected because experience shows that such plans, despite their logic and attractiveness, cost too much, take up too much time and are generally too detailed to be useful. Neither is the plan a typical integrated regional development plan whereby improvements in infrastructure, industrial development, agricultural productivity, marketing, human resources, etc., are all combined to hasten a region's economic development.

The approach adopted here is more properly referred to as an issue-based action plan. Thus, what is being proposed is a limited number of strategies and projects which address crucial coastal management issues facing the Upper South. All projects have been specifically designed with a limited time horizon but are consistent with the longer-range goals of the plan.

*This plan is composed of four issue-based action plans: land use, water quality management, fisheries and tourism.*

This plan is integrated in that all linkages, downstream effects and externalities are carefully considered for each management issue. But to make the plan more accessible to readers, the action plans have been divided into four sections: land use, water quality management, fisheries and tourism (coral reefs and islands). Each section consists of a zonation scheme and a list of strategies and actions that will provide a framework for individual projects. There are three land use, four water quality, five fisheries, and three tourism projects. For each project, some background, objectives, benefits, phasing and a budget are provided.

This chapter has presented the policies that are considered essential to the plan's successful implementation. The policies fall into nine categories: aquaculture, beaches and dunes, capture fisheries, coral reefs, land, mangroves, marine parks, coastal water quality and wildlife. Chapter 6 discusses the land use action plan in detail.

## CHAPTER 6

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# LAND USE ACTION PLAN

The proposed land use action plan principally involves zoning the coastal areas surrounding Ban Don and Phangnga Bays in the Upper South Region. Ban Don Bay is situated on the east coast and has a total area of about 1,068 km<sup>2</sup> while Phangnga Bay is on the west coast and covers about 1,176 km<sup>2</sup>. The main objective is to minimize conflicts in land use for mangrove and upland forests, aquaculture and agriculture and to derive the maximum benefits from sustainable development.

### **POLICY FRAMEWORK**

Recommendations for land use zonation should be consistent with existing laws, regulations and time-honored traditions.

### **POLICY RECOMMENDATION**

The first step is to designate land use zones that match the needs of resource users with the available resources in the context of sustainable development and conservation. Specifically, the zones delineate where aquaculture, mangrove and upland forestry, and agriculture activities would be most appropriate (Vijarnsorn 1991).

The success of the plan depends on the cooperation of the local residents. Therefore, promoting public awareness of the value of plan implementation will play a vital role in the success of individual projects.

### **MANAGEMENT STRATEGIES AND ACTIONS**

These strategies and actions are for the Ban Don Bay and Phangnga Bay project areas (Figs. 1.1-1.3).

#### **Conflicts among Mangrove Forestry, Aquaculture and Agriculture**

##### **Strategy 1**

Design a land use zonation scheme for the Ban Don Bay project area based on a 1:50,000 topographical map with the following zones (Fig. 6.1):

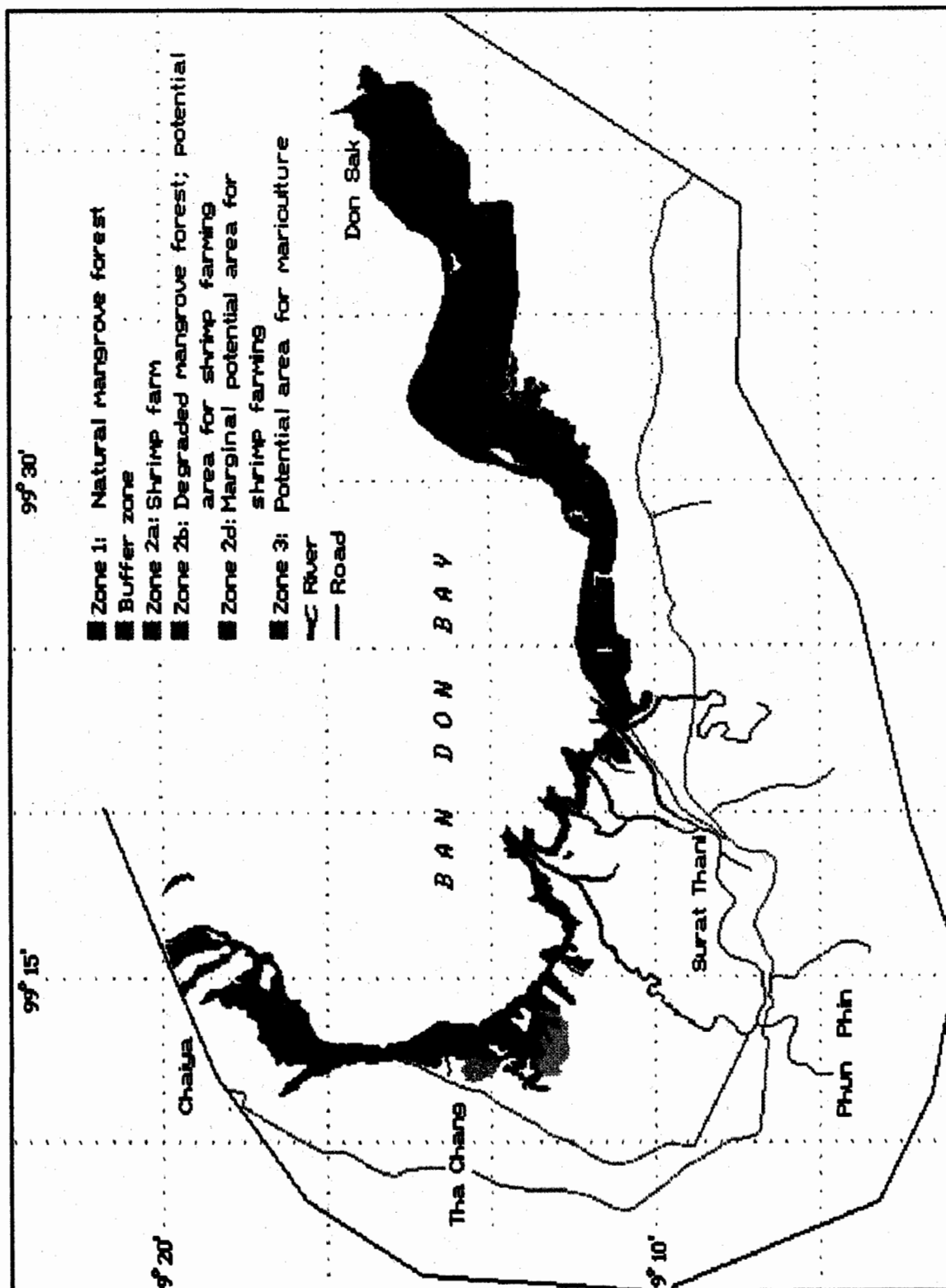


Fig. 6.1. Land zonation scheme for Ban Don Bay.

## Chapter 6. Land Use Action Plan

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Zone 1 : Mangrove conservation

Zone 1a: Preservation of existing mangrove forests

Zone 1b: Reforestation of mangroves

Zone 2 : Brackishwater aquaculture

Zone 2a: Ongoing culture

Zone 2b: Potential shrimp culture area

Zone 2c: Potential nonshrimp culture area

Zone 2d : Marginal potential area

Zone 3 : Bay aquaculture

Zone 3a: Oyster culture

Zone 3b: Cockle culture

### Actions

Zone 1: Mangrove conservation (4,608 ha)

This mangrove action plan was approved by the Cabinet in late 1989 and is being implemented.

1. Protect strictly a core zone of 3,680 ha of mangrove forest.
2. Reforest 928 ha of degraded mangrove areas, particularly in river and stream banks. Plant suitable mangrove species, i.e., *Rhizophora apiculata*, *Avicennia alba* and *Excoecaria agallocha* in their respective habitats.
3. Rehabilitate low-productivity aquaculture ponds in this zone.
4. Implement an education and public awareness program to enhance RFD's relations with villagers.
5. Plant newly formed mudflats to mangrove if natural seeding is not occurring.
6. Give RFD full responsibility for the mangrove rehabilitation and management program.

Zone 2a: Ongoing brackishwater culture, especially shrimp (10,464 ha)

Zone 2b: Potential area for shrimp culture (864 ha)

1. Train farmers on intensive and semi-intensive culture techniques.
2. Research on solving technical problems of lack of seed stock, inadequate feeding, inferior breeding stock and diseases.

## **Chapter 6. Land Use Action Plan**

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3. Identify and mitigate sources of water pollution, including the improper discharge of aquaculture pond water.
4. Use soil maps to define appropriate boundaries for aquaculture development.
5. Align all aquaculture development with the Cabinet Resolution of 15 December 1987 for the coastal protection of Economic Zone B.
6. Fully utilize the degraded mangrove forest areas (Zone 2b) for shrimp culture.

### **Zone 2c: Potential area for nonshrimp brackishwater culture (5,600 ha)**

1. Use Zone 2c for the culture of species such as snakehead (*Ophicephalus* spp.), climbing perch (*Anabas testudineus*), snakeskin gourami (*Trichogaster pectoralis*) and featherback (*Notopterus* spp.).
2. Carry out trials of new culture species.

### **Zone 2d: Marginal potential area for brackishwater culture (area to be finalized).**

1. Consider this zone a standby area as this land will need considerable inputs, especially soil improvements to control acidity, before it can be used for aquaculture. If it is needed in the future, the action plan for this zone should be similar to Zone 2c's, following soil treatment.

### **Zones 3a and 3b: Potential bay areas for oyster and cockle culture (areas to be finalized).**

1. Establish a monitoring program to check the level of contamination of mollusks by sewage.
2. Focus research on increasing productivity per unit area.

## **Improper Cropland Use**

### **Strategy 2**

Intensify land use in Ban Don and Phangnga Bays with appropriate production facilities and technology.

### **Actions**

1. Select crops according to land capabilities.
2. Improve irrigation for paddy rice.

3. Improve soil fertility in accordance with crop requirements and soil type.
4. Intercrop tree plantations in order to increase productivity. For instance, on the K. Tapi deltaic plain, coconut grown on raised beds should be intercropped with cocoa.
5. Establish a price guarantee program for common crops to encourage farmers to improve productivity and maintain the soil's quality.

## **Land Use Zonation**

### **Strategy 3**

Resolve land-use conflicts and conserve the resources of the Phangnga Bay area with these zones:

Zone 1 : Mangrove preservation

Zone 2 : Upland forest preservation

Zone 3 : Upland reforestation

Zone 4 : Upland agriculture

Zone 5 : Potential areas for aquaculture

Zone 5a: Cage culture

Zone 5b: Oyster culture

Zone 5c: Cockle culture

### **Actions**

Zone 1: Mangrove preservation (19,600 ha)

1. Preserve and place all mangrove forests in Phangnga Bay under the jurisdiction of Ao Phangnga NP.
2. Discourage pond aquaculture expansion due to the low slope of the tidal flat in Phangnga Bay. Also, the intertidal area exposed at low tide is quite wide. This situation is not conducive to the pond culture of shrimp and fish because water needs to be pumped at long distances from the shore.
3. Control forest conversion strictly.
4. Reforest degraded mangrove areas. The recommended species are *R. apiculata*, *R. mucronata*, *A. officinalis*, *B. cylindrica*, *B. parviflora*, *C. decandra*, *C. tagal*, *X. granatum* and *X. moluccensis*.

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5. Encourage public awareness and cooperation among the government agencies and NGOs for mangrove conservation.
6. Continue the monitoring program for the mangrove ecosystem to evaluate the effectiveness of reforestation and law enforcement. Although strongly discouraged, harvesting should use the "clear-felling in alternate strip" system if the logging concessions are granted.

### **Zone 2: Upland forest preservation (15,700 ha)**

1. Give strong protection to the existing tropical evergreen forests on the uplands on the Phangnga Bay project area. Some are already protected by the National Forest Reserve Act.
2. Establish a sound forest protection program to increase forest cover and productivity to complement the government's withdrawal of all logging concessions.
3. Strengthen public awareness of the importance of the forest to the environment and community through outreach programs sponsored by government agencies and NGOs.

### **Zone 3: Upland reforestation (2,300 ha)**

1. Rehabilitate all degraded upland forests with fast-growing trees.
2. Implement an organized and methodical reforestation program through the private sector and NGOs in coordination with RFD.

### **Zone 4: Upland agriculture (11,100 ha)**

1. Maintain all upland rubber plantations.
2. Devise a special system of land entitlement so that residents can be given the "right to farm" on these areas. It will not include the right to sell the land. Also, the land can only be transferred from person to person within a family.
3. Conduct a soil conservation program to minimize soil erosion and landslides.

Terraces 1 m-wide have already been built along the contour lines in many upland areas but rill and gully erosion is still a problem. Thus, there is a need for an integrated soil conservation program which should account for the following factors:



*Because most of the original mangrove forests have been converted into shrimp ponds, a mangrove replanting project is essential.*

- soil conditions and slope characterization;
- intended land use, i.e., fruit tree orchard or rubber plantation; and
- local capacity to design, construct and maintain soil conservation works.

There is little indigenous expertise in designing soil conservation programs for rubber plantations built on steeply sloping land in Thailand. Still, work in other countries, particularly Malaysia, should be applicable. The MOAC could negotiate with its Malaysian counterpart.

Zones 5a, 5b and 5c: Potential areas for aquaculture (areas to be finalized)

1. Monitor pollution through a local institution under ONEB's supervision and enforce laws strictly.
2. Focus future activities on the promotion and expansion of mollusk aquaculture and cage culture into other productive areas to increase the income of fishers and reduce pressure on mangrove exploitation.

## **PROJECTS FOR IMPLEMENTATION**

These projects are designed to address land use management issues and to implement the strategies and actions described above.

### **PROJECT 1: Mangrove rehabilitation in Ban Don Bay.**

#### **Background**

Most of the original mangrove forests in Ban Don Bay have been converted into shrimp ponds. A mangrove replanting project is therefore necessary to restore mangrove cover. A high priority is the reestablishment of mangroves along rivers where their function can be maximized as they can contribute the most nutrients to the lagoon system and can stabilize riverbanks. In addition, these areas can be used for scientific research, education and wildlife conservation.

#### **Objectives and benefits**

This one-year project has the following objectives and benefits:

1. restoration of adequate mangrove cover in the bay,
2. increase in the production of larval fish, shrimp and shellfish, and
3. land stabilization.

#### **Description**

The area designated as Zone 1b in the land use zonation map of Ban Don Bay has been selected as a demonstration plot to show how mangroves can be rehabilitated and how the community can participate in this.

## **Chapter 6. Land Use Action Plan**

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Funding for this high-priority project is expected to come from donor agencies, such as ADB and the World Bank (WB), which have already given financial support to some brackishwater culture projects in Ban Don Bay.

### **Phasing of activities**

1. Begin a public education program that focuses on the value of the mangrove forest to local residents and the need to reforest. Publicly announce which areas will be reforested.
2. Set up community reforestation units.
3. Create a detailed workplan, budget, working area, manpower and time schedule.
4. Procure appropriate tree stocks and equipment.
5. Implement all activities.

### **Agencies and administration**

The lead organization will be the local RFD office in Surat Thani Province. The ONEB and donor agencies will act as consultants, and follow up the action plan. The reforestation units will be recruited from the community on a voluntary basis.

### **Budget**

The budget is calculated at the rate of \$10/ha.

According to the land use zonation map, the area to be reforested totals about 928 ha at the total cost of \$9,280.

### **PROJECT 2: Pilot multiple-use management system in Ban Don Bay.**

### **Background**

There is a need to demonstrate that a sustainable multiple-use system is a viable management strategy for mangroves and aquaculture.

### **Objectives and benefits**

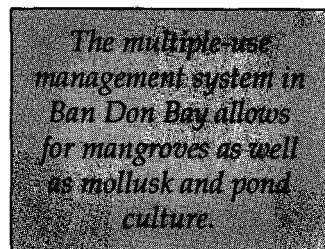
Set up a demonstration model for multiple-use management in Ban Don Bay. If the system proves promising, it can be applied to other mangrove forest areas. In addition, detailed baseline data will be obtained on the mangrove ecosystem functions.

### **Description**

The project will follow the sequence of zonation from Zone 1 (mangrove conservation) to Zone 2 (brackishwater aquaculture). In this model, the subtidal zone will be used for mollusk culture; the intertidal zone, for mangroves and

pond culture. The optimal size of the pilot area will be about 4 ha. The project period is 5 years. Financing can be sought from donor agencies like ADB, WB, bilateral aid programs and the government.

### Phasing of activities



1. Choose a suitable site for the pilot area in Ban Don Bay. The site should be under RFD's control.
2. Set up experimental designs and a monitoring program.
3. Procure equipment and facilities.
4. Stock ponds, replant mangroves and monitor.
5. Collect data and interpret.
6. Evaluate results in terms of environmental change and socioeconomics.

### Agencies and administration

The lead agency should be ONEB. Operation will be under DOF, RFD and DLD. The DOF will play an important role in mangrove replanting while RFD will conduct intensive or semi-intensive culture. The DLD will study soil and water relations which will be affected by the management of pond culture.

### Budget

Item	Five-year cost (\$)
Personnel services	75,000
Travel and per diem	75,000
Equipment and materials	100,000
Contingencies	<u>25,000</u>
Total	275,000

### PROJECT 3: Pilot site for soil conservation in the upland areas surrounding Phangnga Bay.

### Background

In the Phangnga Bay project area, Zone 4 is occupied by a rubber plantation. However, because of the highly erodible soils and steep slopes, soil erosion and landslides are common, especially on land newly planted with rubber, despite the construction of terraces. Therefore, it appears that present soil conservation practices are not adequate and require more research.

**Objective and benefits**

The goal of the project is to develop an appropriate soil conservation system for upland rubber plantations. This will reduce the rate of soil erosion and downstream sedimentation and increase rubber production.

**Description**

The project will initially run for two years to establish the soil conservation model and implement fieldwork, including the planting of rubber and monitoring of soil erosion. A total of eight years is suggested for the collection of data.

Funding for the first two years of the project should be from donor agencies and/or bilateral aid program. Funding of the succeeding phases should be provided by the government.

**Phasing of activities**

*An appropriate soil conservation system is needed to reduce the rate of soil erosion and downstream sedimentation, and increase rubber production.*

1. Select area for pilot project from Zone 4 on the land use zonation map of Phangnga Bay. The optimum size should be about 10 ha.
2. Establish soil conservation models based on existing information from various sources, including other countries like Malaysia and Indonesia.
3. Conduct field operation according to the design of the model.
4. Cultivate rubber and cover crops.
5. Evaluate data obtained from field trials.

**Agencies and administration**

The lead organization will be DLD with the support of RFD and ONEB. The project will also require the participation of the community for the entire course of field operation.

**Budget**

The budget for the first two years will be \$186,000 and for the monitoring period 1996-2003, at the approximate cost of \$70,000/year.

**PLAN IMPLEMENTATION**

The zonation scheme must be implemented as soon as possible to have the greatest beneficial effect because the activities in the coastal zone change very rapidly. It is recommended that a single authority be established to implement and monitor the plan. This authority will be responsible for considering the current legal framework. Some laws and acts may need to be amended. The authority can provide financial support, follow up the plan implementation as well as give advice to the key agencies involved in CRM. Public participation is a key ingredient to the plan's success.

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*The land use action plan aims to minimize conflicts among mangrove and upland forests, aquaculture and agriculture and to derive the maximum benefits from sustainable development.*

Another important requirement for successful implementation is the political will to protect the environment from further degradation and the commitment to follow the zonation plan. To ensure this, there should be a continuous educational program to increase public awareness in CRM and conservation.

This chapter has presented a practical land use zonation scheme devised to limit resource-use conflicts and provide guidelines for future resource conservation and utilization. The three projects' total cost is \$470,280. Chapter 7 presents the water quality management plan.

## **CHAPTER 7**

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# **WATER QUALITY MANAGEMENT ACTION PLAN**

### **POLICY FRAMEWORK**

The policies adopted by the government for coastal water quality management and pollution control are based on a number of acts and regulations. An important legislation is NEQA of 1975 which coordinates the control of environmental quality and standards and the EIA requirement for development projects. The Public Health Act of 1941 regulates the disposal of rubbish, filth and dirt and authorizes local authorities to issue by-laws or rules stipulating the methods and procedures to be used in such disposals. The local authorities are also empowered to control commercial undertakings which are likely to be injurious to health, and unsanitary dwelling places, latrines, night-soil receptacles, urinals, and other sites, facilities or watercourses likely to represent hazards to health.

Another important regulatory tool is the Act of Cleanliness and Tidiness of 1960 which regulates and controls public offenses including disturbance and "anti-aesthetic" activities. It specifically prohibits the dumping of wastes into rivers or canals. The BCCA of 1979 empowers the local authority to issue by-laws controlling the number and type of bathrooms. It also controls storm- and wastewater drainage. The Factories Act of 1969 imposes certain duties on industrial concerns using processes which will lead to the discharge of defined levels of pollutants. The amended Navigation in Thai Waters Act of 1913 bans the dumping of stone, gravel, sand, clay, sludge, decaying matter, garbage, oil or chemical products into canals, rivers, lakes or coastal waters. Permission for such activities must be sought from HaD. The NPA of 1961 includes policies for the protection and management of some marine waters.

Despite all these efforts, implementation has not been effective and local participation is poor. In addition, guidelines are needed for small-scale development projects along the coasts, waste disposal, watershed management and a water quality monitoring program for coastal areas.

### **POLICY RECOMMENDATIONS**

These general policies are recommended as guidelines for the formulation of issue-based projects.

## Chapter 7. Water Quality Management Action Plan

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*An objective monitoring program will provide information for the stricter enforcement of industrial effluent standards.*

1. Increase monitoring of on-site treatment systems and effluent discharges. This will require more resources for the Department of Industrial Works (DIW) under MOInd as well as closer cooperation between DIW and ONEB to effectively monitor water quality in the bays. An objective monitoring program will provide information for the stricter enforcement of industrial effluent standards.
2. Classify beneficial uses of the bays (e.g., recreation), and set appropriate surface and coastal water quality standards to protect these uses. This should be accomplished by the Environmental Standards Division of ONEB in conjunction with the Ministry of Public Health (MOPH). Comprehensive land use zoning plans formulated by DOTCP under MOI could be used to direct potentially polluting land uses away from critical areas.
3. Strictly enforce the 1972 Ministerial Notification, which prohibits trawlers from operating within 3,000 m from the shore.
4. Establish the government's commitment to invest in large-scale, low-cost sewerage systems and central sewage treatment facilities for densely populated urban areas. For rural areas, the government should build up local capabilities to plan, implement and maintain sanitation facilities while building up MOPH's ability to guide LG.
5. Speed up the National Oil Spill Contingency Plan (NOSCP), including the detailed action plan, for Ban Don Bay. There is a regulation from the Office of the Prime Minister providing for the making of such a plan, but no action has been taken due to the lack of funds. The ONEB should use its influence to convince HaD that Surat Thani should be given the highest priority as a NOSCP substation. As an alternative, encourage the private sector which is concerned with activities dealing with oil in Ban Don Bay to join hands with the government and set up a Chronic Oil Pollution Control Group (COPCG) in the bay area.
6. Strengthen local and provincial administrations as focal points for water quality management. A number of organizational options and actual responsibilities for pollution monitoring, control and management remain to be specified.
7. Promote awareness and appreciation among local officials, NGOs and citizens regarding the ecological and socioeconomic values of the bays.

### MANAGEMENT STRATEGIES AND ACTIONS

Some of these management strategies and actions overlap because it is not possible in all cases to isolate strategies and actions relevant to only one issue.

**Water Quality Degradation**

**Strategy 1**

Reduce industrial pollution.

**Actions**

1. Work out appropriate arrangements among MOI, ONEB and the Board of Investments (BOI) for closer coordination particularly in the approval process of industrial investment applications.
2. Set up a pollution monitoring and control program to enforce NEQA and the Factories Act effectively. Monitor the environmental impacts of the effluent discharges of the existing industries. Improve the licensing procedures and develop mechanisms for more effective monitoring. Inform the tin mining companies in Phangnga and Krabi about the rationale behind effluent standards.
3. Coordinate appropriate arrangements for environmental management in the industrial sector at the provincial level.
4. Train more manpower in industrial pollution management at the regional and provincial levels.
5. Work out the details of financial requirements.

**Strategy 2**

Use on-site treatment, e.g., septic tanks, in areas which are still not densely populated and study the requirements for strengthening domestic wastewater pollution control in the municipalities of Surat Thani, Phun Phin, Tha Chang, Phumriang, Tha Thong, Don Sak, Kanchanadit, Kradae, Phangnga, Krabi, Ko Panyi and Mu Ko Phi Phi.

**Actions**

1. Make the LGs aware of the need to increase the budget allocation for sanitation and provide the direction and the means for implementing substantial sanitation programs.
2. Strengthen the roles and capabilities of LG and PG in promoting sanitation. Encourage community involvement in planning and constructing sanitation facilities.
3. Expand private sector as well as NGO involvement in the delivery of sanitation programs and explore mechanisms to do this.
4. Determine priorities. Surat Thani, Phun Phin, Ko Panyi and Mu Ko Phi Phi municipalities warrant special attention. Implement pollution



## **Chapter 7. Water Quality Management Action Plan**

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abatement measures for domestic wastewater, e.g., assess fines for pollution based on the contribution of each source.

5. Seek additional external resources for the sanitation programs.

### **Strategy 3**

Implement the land use development plan.

#### **Actions**

1. Make public announcements regarding the importance of the land use plan.
2. Encourage the cooperation of concerned government agencies and NGOs in the implementation of the land use plan through meetings.
3. Group together large- and small-scale industries in specified areas with centralized wastewater treatment facilities.
4. Designate important watershed preservation areas.

### **Strategy 4**

Enforce the 3,000-m zone for trawlers strictly.

#### **Actions**

1. Increase and strengthen the resources of the marine police so that they can prohibit the operation of trawlers within 3,000 m from the shore.
2. Improve the coordination between the marine police and coastal dwellers so that the former can be alerted more quickly to illegal activities.
3. Increase public education on the harmful effects of trawling within the 3,000-m zone.

### **Strategy 5**

Prepare for oil spills in Ban Don Bay.

#### **Actions**

1. Delineate responsibilities for the control of oil pollution. Establish a COPCG in Ban Don Bay in the interim.
2. Make the Electricity Generating Authority of Thailand a member of COPCG.
3. Conduct technical training courses for COPCG.
4. Develop a simple communication network between COPCG in Ban Don Bay and the Industrial Environmental Safety Group in Bangkok.

**Socioeconomic and Cultural Concerns**

**Strategy 6**

Conduct a series of meetings, seminars and study tours to improve public appreciation of coastal water quality management.

**Actions**

1. Conduct meetings and seminars in Surat Thani, Phangnga and Krabi to disseminate information on coastal water quality control and management.
2. Conduct seminars organized by the local people for better information dissemination and knowledge transfer.
3. Evaluate and assess the meetings and seminars.
4. Initiate a study tour for the local people to visit exploited and protected coastal environments.

**Legal, Institutional and Administrative Issues**

**Strategy 7**

Establish the principle of the devolution of power to LG and PG with respect to the enforcement of environmental regulations.

**Actions**

1. Specify actual responsibilities for pollution monitoring. These two scenarios are possible:
  - Monitor water pollution through ONEB and/or MOInd. Forward compiled data to the provincial governor's office for information and action. This arrangement is not feasible at present since the provincial governor's office lacks the technical staff in the environmental field. Hence, it calls for a Pollution Management and Control Unit (PMCU) to be created by the province. The main tasks of PMCU are to coordinate with MOInd and ONEB in enforcing environmental laws and regulations; conduct EIAs; implement water quality management and pollution control plans prepared by sectoral line agencies; prepare a provincial environmental management report which describes current problems and lists the steps being taken to resolve them; manage the environmental database; and prepare a budget for pollution management and control in the province. The PMCU will eventually have the technical staff to evaluate the data and make recommendations to the governor and in due course, be given enforcement responsibilities.

*Establish the principle of the devolution of power to the local and provincial governments with respect to the enforcement of environmental regulations.*

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- In the second scenario, monitor and control pollution through a Water Purification Board (WPB) or a River Basin Entity (RBE) to be created where NESDB or ONEB will be the lead agency. The tasks of WPB or RBE are to set standards; license and check new projects; monitor adherence to and enforcement of environmental laws; identify policy priorities and develop policy recommendations; conduct regional planning and water management; initiate and supervise water audits; and prepare routine and development budgets. This arrangement has the advantage of ensuring close linkages between the central management and the local and provincial administration, while recognizing the provincial governor as the central figure for a variety of actions that should be taken at the local and provincial levels.

2. Assign the first priority to pollution control.
3. Exercise the necessary authority and legal power.
4. Enforce existing environmental laws and regulations.
5. Limit the number of transfers of power from other government regulations.

### **Strategy 8**

Provide training for LG and PG personnel and NGO representatives on water pollution control and management.

### **Actions**

1. Establish environmental training courses and evaluate current staff levels and qualifications.
2. Assess in-country and overseas training capacities.
3. Provide a framework for overall human resource development at the local and provincial levels.
4. Implement the human resource development framework for a period of two years.

### **Education and Public Awareness**

### **Strategy 9**

Conduct a series of TV and radio programs in cooperation with local, provincial and national mass media to improve public appreciation of coastal water quality management.

**Actions**

1. Coordinate and develop environmental information.
2. Produce a series of TV and radio programs promoting the benefits of coastal management, water quality and pollution control.
3. Ensure that the programs are televised and broadcast on a regular basis.

**PROJECTS FOR IMPLEMENTATION**

Four projects will implement the overall strategies and actions. Institutional Arrangements, Ban Don Bay, focuses on better coordination and cooperation between the central agencies in Bangkok and the devolution of power to LG and PG; its success depends on the understanding and cooperation of PG and the central agencies in Bangkok. Coastal Water Quality Monitoring, Ban Don Bay and Phangnga Bay call for more responsibilities to be taken up by the local communities and ONEB's regional office to be established at Songkhla. Tin Mine Pollution Abatement, Phangnga Bay, encourages the national government to support the collaboration between the tin miners and LG.

**PROJECT 1: Institutional arrangements, Ban Don Bay.**

**Background**

The line agencies which have a major role in safeguarding water quality from pollution caused by new industrial developments are BOI, MOI and ONEB. To date, the three agencies carry out their responsibilities with a minimum of coordination. Hence, compliance and environmental consequences of development projects are rarely monitored once they have been approved by the concerned agencies.

For existing industrial discharges, the government is relying on the establishment of effluent standards. The two main agencies responsible for pollution control are DIW under MOInd and ONEB under MSTE. The DIW has the authority to monitor and enforce established standards. Thus, it can revoke the operating license of a factory found guilty of violating the relevant standards.

The ONEB, in contrast, is responsible for formulating environmental protection policies. It has been playing a lead role in ensuring that other government agencies adopt and follow the appropriate environmental standards (TDRI 1987).

**Objectives and benefits**

This project is considered essential to achieve all the objectives set forth in the larger plan of managing the coastal water quality in Ban Don and Phangnga Bays on a long-term basis. It highlights the need for each line

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agency to take into account environmental considerations. It also calls for an upgrade of local capabilities and initiative to do environmental jobs more effectively and efficiently.

Benefits accruing to the local residents, the province and the country will include:

1. more effective and efficient enforcement of environmental laws and regulations at all levels; regulations will be more effectively and efficiently enforced at all levels;
2. substantial reduction of all point sources of pollutants;
3. preservation of good coastal water quality in Ban Don Bay; and
4. better pollution control, health and human resource development.

### **Description**

At the central level, appropriate arrangements for better cross-sectoral coordination on environmental matters should be worked out. For water management and pollution control, a line agency should take the initiative to link up BOI, MOInd and ONEB. This will ensure that new industrial activities are environmentally sound and comply with environmental regulations.

The PG should assume greater responsibility for environmental management. The existing PG has no staff for water management and pollution control. Given this staff constraint, PG will have to move step by step before it can take its proper role in environmental matters. One danger with giving the PG sole control is that it may seek to promote the welfare of provincial residents to the detriment of the nation. The ONEB should coordinate with PG to avoid this.

Until PG can assume control, water quality and pollution monitoring should continue to be the responsibility of developed agencies such as ONEB and MOInd. Hence, water quality data collected by ONEB and/or MOInd should be forwarded to the governor's office for information and action. To meet the demand for PG to undertake such responsibilities on environmental matters, the governor should establish a PMCU, WPB or RBE. Specific goals and activities of PMCU, WPB or RBE will focus on the following:

1. Institute effective control and administration of NEQA with respect to land-based sources of pollution.
2. Build up manpower and revenue generation for water management and pollution control at the local and provincial levels.
3. Organize in-house training for water management and pollution control.

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4. Provide support and assistance to all training and education programs on water management and pollution control which are conducted in the province.
5. Implement the government plan and policies on water management and pollution control in the province.
6. Promote local community participation in water management and pollution control.
7. Coordinate with ONEB and MOInd in objective-oriented monitoring programs in terms of the effectiveness of the treatment of pollutants, their discharges into and pathways within the environment, and their bioaccumulation effects.

### **Phasing of activities**

1. Set up PMCU, WPB or RBE, as recommended.
2. Appoint officers with environmental knowledge.
3. Refine the detailed workplan and budget for the water quality management and pollution control work in the province.
4. Contact in-house human and resource development NGOs and donor agencies for financial and technical support.

### **Agencies and administration**

The lead agency is ONEB and the support agencies are the PG office and NESDB. Donor agencies and NGOs should also be involved.

### **Budget**

Item	Cost (\$)
Consultant's services	
1 institutional development expert	36,000
Travel and per diem	20,000
Education and training	25,000
Equipment	50,000
Contingencies	<u>20,000</u>
Total	151,000

### **PROJECTS 2 and 3: Coastal water quality monitoring, Ban Don Bay and Phangnga Bay.**

### **Background**

A monitoring program of the lower K. Phum Duang has been developed as a cooperative effort between ONEB and DIW/MOInd. The program monitors COD, conductivity, temperature, pH and DO at two sampling sites. The purpose is to determine the effects of wastewater discharges from the Suratip Sri Talung Distillery Plant. The distillery also initiated the monitoring of the river's water quality in 1986 (Paw et al. 1988).

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A number of water quality surveys were carried out in Ban Don and Phangnga Bays in the past few years for specific projects. The data, however, have not been published or disseminated.

### **Objectives and benefits**

These projects aim to do the following:

1. Monitor the effectiveness of the treatment of all land-based pollution sources.
2. Monitor the discharges of these pollution sources and their pathways within the environment.
3. Monitor bioaccumulation and the effects of waste discharges.

Benefits accruing to the local community, province and country will include:

1. safety of coastal water quality for beneficial uses on a long-term basis;
2. prevention of human activities leading to deleterious and irreversible impacts on the coastal resources; and
3. provision of better coordination across sectors.

### **Description**

These projects will monitor the coastal water quality in the proposed zones (Figs. 7.1 and 7.2) and land-based pollution and assess environmental impacts. Data will be forwarded to the PG office for action.

An ONEB regional office will be established in Songkhla and a WPB or RBE in each of the bay areas. The MOInd is expected to provide cooperative inputs.

Part of the project funding should be obtained from PG, ONEB and/or MOInd, while the other part should come from donor organizations.

### **Phasing of activities**

1. Set up the administrative structure as recommended and coordinate the monitoring program with PG.
2. Prepare the budget and contact the donor agencies for the project's financing.
3. Identify the sampling stations and procedures.
4. Procure equipment for the laboratory and management information system.

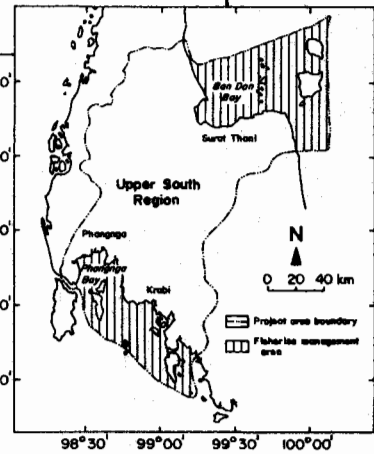
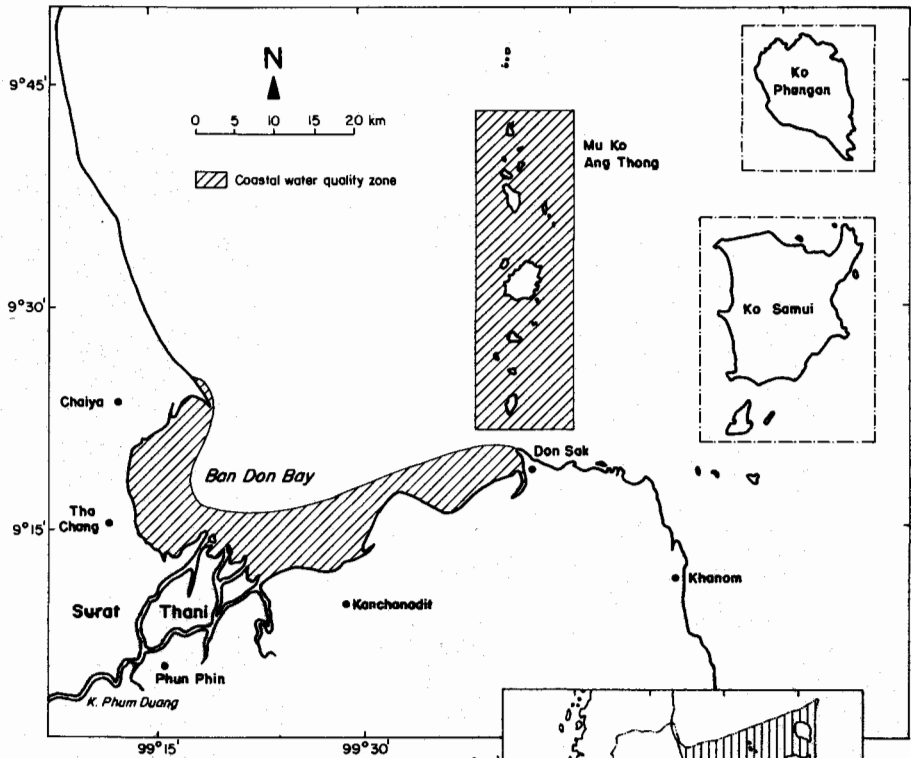


Fig. 7.1. Coastal water quality zone for Ban Don Bay.

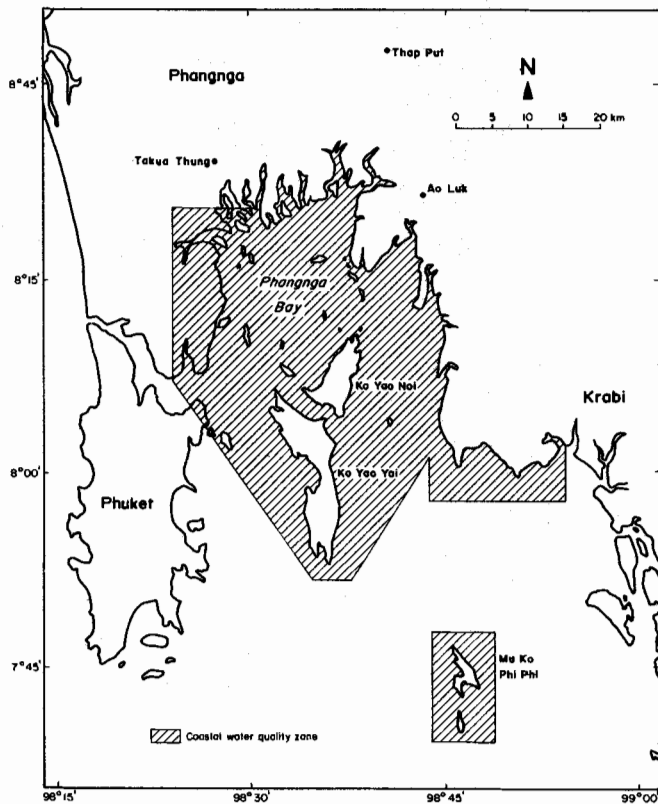


Fig. 7.2. Coastal water quality zone for Phangnga Bay.



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5. Begin the implementation of the proposed monitoring programs.
6. Disseminate information.
7. Identify the needs for human resource development.

**Agencies and administration** The lead agency should be the ONEB regional office. Donor agencies can be requested to provide technical assistance in the management information system and human resource development of the project.

**Budget** The budget estimate for each project is as follows:

Item	Two-year cost (\$)
Consultant's services	36,000
Travel and per diem	10,000
Education and training	10,000
Equipment	20,000
Contingencies	<u>10,000</u>
Total	86,000
Total for the two projects	172,000

### **PROJECT 4: Tin mine pollution abatement, Phangnga Bay.**

#### **Background**

Phangnga Bay is very rich in both renewable and nonrenewable resources. This is economically important for Thailand. The bay region is one of the richest tin mining areas in Thailand. The inland mining process is conducted through water jet extraction which uses 10,000-50,000 m<sup>3</sup>/day of water while coastal tin exploitation is done in mangrove areas through dredging.

Previously, the tailings from inland mining were discharged directly through canals into the bay. In recent years, DMR required all mines to build settling basins to reduce and control direct suspended solid (SS) discharge into waterways since little is done to control the turbidity caused by coastal dredging.

A technique for minimizing SS is still needed. High turbidity and sedimentation have been blamed for the decline in cockle stocks. World tin prices have dropped, leading to a temporary halt of tin dredging activities in the inner coastal region of Phangnga Bay. About a year after this moratorium, the cockle stocks started to rebuild.

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### Objective and benefits

The project aims to control and abate total solids and SS discharges into Phangnga Bay. Benefits derived from its implementation will be a reduction in the negative impacts caused by sedimentation from tin mine discharges, restoration of coastal aquaculture and rehabilitation of the aesthetic value of the bay.

### Description

The success of the project depends very much on the tin mine effluent standards to be established and the extent to which the companies should be convinced to follow stipulated standards after a study tour of Malaysia. Nevertheless, effective and efficient law enforcement will be compulsory.

After the study tour, the tin miners should make changes in mining site management. Engineering structures, e.g., retention ponds, silt traps and other works, can play a role in minimizing the off-site cost of tailing discharges. Collaboration between tin miners and LG on this issue should continue to receive greater support from the national government. The finances for the project should be raised mainly from tin mining companies.

### Phasing of activities

1. Review tin mine effluent standards to be approved by the concerned authority.
2. Conduct a study tour of Malaysia for tin miners to help win their commitment to abate and control tin mine pollution.
3. Render consulting and advisory services to tin miners who face problems meeting the effluent standards.
4. Begin implementation of the proposed tin mine effluent standards.

### Agencies and administration

The lead agency will be ONEB and/or DMR. The agency will coordinate with the Upper South tin miners. The PG is encouraged to participate actively.

### Budget

Item	One-year cost (\$)
Consultant's services	5,000
Administration	5,000
Travel and per diem	8,000
Contingencies	<u>2,000</u>
Total	20,000

**PLAN IMPLEMENTATION**

Although this water quality management action plan is formulated through the efforts of ONEB and with the financial support of USAID, it is not perceived at this stage as the "ONEB plan" or "USAID plan". In fact, the plan calls for close coordination among various government agencies at the local, provincial and national levels. In addition, it also promotes the participation of the local people, private sector and NGOs in the strategies.

*For coastal water quality management, the government will have to allocate adequate human and financial resources, and develop the provincial administration.*

For the sound management of coastal water quality in the Upper South, the government will have to allocate adequate human and financial resources, and develop the provincial administration so that it can take more responsibility for coastal resources. The provincial administration should be given adequate authority to safeguard resources in ways consistent with sustainable development. Given the current constraints in coastal water quality management of the Upper South, i.e., staffing and financing, the planners recognize that it will take time to implement the plan. The action plan is not intended to be divided into a long- and short-term plan since each of the projects proposed for Ban Don and Phangnga Bays will be implemented to help control water quality. Hence, it is desirable and practical to set priorities for the proposed projects.

All projects will be monitored and evaluated during and after their implementation. To ensure independence and objectivity, M&E should be undertaken by independent consultants annually and the implementing agencies requested to submit an annual report on each project. These reports are, in part, an exercise in self-evaluation. In addition to the annual evaluation, each project team will be requested to prepare quarterly progress reports.

This chapter has presented seven general policy recommendations dealing with the improvement of the regulatory framework, law enforcement, infrastructure, training, public awareness and appreciation for the value of management planning. It has outlined nine strategies and a number of actions on how to pursue each strategy. Finally, details of the implementation of the four projects have been given. These concern institutional arrangements, water quality monitoring and tin mine pollution. The total budget requirement for the projects is \$343,000. Chapter 8 is the fisheries action plan.

## CHAPTER 8

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# FISHERIES ACTION PLAN

### POLICY FRAMEWORK

*Fisheries resource management should discourage overexploitation of resources, reduce use conflicts and establish ways to rehabilitate depleted resources through appropriate technologies.*

### POLICY RECOMMENDATIONS

1. The policies and plans that are formulated for fisheries resource management should discourage the overexploitation and inappropriate utilization of marine fisheries resources and also reduce conflicts among different fisheries practices to better utilize the bays as fishing grounds and aquaculture areas.
2. Zoning should be used to deal with the overexploitation of common property resources.
3. Fisheries resource management in both bays should also be aimed at establishing ways to rehabilitate depleted resources through appropriate technologies.
4. The policies should not add more regulations but strengthen community-based resource management by assigning local communities with some management responsibilities and by building up fishers' organizations.
5. To gain their cooperation in plan implementation, the management policy should be acceptable to fishers. It should include projects on education and alternative livelihood.

1. Revise current legislation to reduce accessibility to marine fisheries resources by:
  - a. increasing net mesh size and phasing out push-nets and trawls to reduce their destructive effects; and
  - b. adjusting the license fee system to reflect the true economic value of marine fisheries resources.

This must be administered at the provincial level to reduce the improper uses and problems of common property fisheries resources.

2. Reduce the fishing effort and prevent overfishing by requiring the official registration of vessels and controlling all new entries.

## **Chapter 8. Fisheries Action Plan**

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3. Develop TURF for fishers in each zone or locality by providing them an opportunity to manage marine fisheries resources at their expense but for their own benefit. Detailed studies of fisheries zonation and a community educational program on fisheries development must be conducted prior to TURF implementation.
4. Install ARs in locations far from natural coral reefs.
5. Provide sufficient personnel, equipment and budget to district and provincial fisheries offices (PFOs) to encourage their responsibility for enforcing the regulations and provide community educational programs on fisheries management in both bays.
6. Provide an educational program to promote understanding and appreciation among local officials and citizens of the socioeconomic value of fisheries resources.

### **MANAGEMENT STRATEGIES AND ACTIONS**

#### **Resource Degradation**

##### **Strategy 1**

Increase net mesh size.

##### **Actions**

1. Conduct feasibility studies on the implementation of this strategy.
2. Require an increase in the cod-end mesh sizes of push- and trawl nets from the existing 2.5 cm to 3.0 cm and 4.0 cm, respectively. The DOF can do this under the jurisdiction of the Fisheries Act of 1947. About 23% of the total catch of trawlers in Ban Don Bay will be reduced by this measure as reflected in the reduction of their catch value at approximately 15 million baht. But the measure will allow about 1,000 t of young high-value marine species to escape from the catch of trawlers each year, which will increase the production value by about 40 million baht. The expected reduction in push-net catch is unknown. Thus, the reduction in the catch of both gear types in Ban Don Bay will be offset by the increased production value following the introduction of this measure due to the higher value of mature fish stocks.
3. Seek interagency cooperation from MOI to control the sizes of the fishing nets produced by the factories, so that their mesh sizes are compatible with this proposed measure.

4. Conduct regular surveys and provide educational services for the local communities to promote the benefits of fisheries management through DOF.

**Strategy 2**

**Install ARs.**

The ARs are not a substitute for natural coral reefs and should never be located near existing coral reefs. They can be quite useful, however, in luring fish to barren areas with sand and mud bottoms, where there were previously few economically valuable fish. In addition to acting as fish aggregating devices, ARs constructed from permanent materials (e.g., concrete), can create habitats where newly attracted fish can begin to reproduce. Thus, resident fish stocks can be created in previously barren areas within a few years.

*Strategically placed artificial reefs can deter trawling activities effectively.*

The ARs are generally very expensive to construct, even when made of so-called "cheap" materials (e.g., bamboo). Therefore, careful analysis is required of the economic costs and benefits of such projects. In some cases, the value of the fish catch will not justify the investment in ARs. Another consideration is that ARs made of inexpensive materials can only last a few years and are susceptible to storm damage. Unless replaced on a regular basis, their value as habitats for building a resident population will be lost. Strategically placed ARs made from large riprap concrete modules can be effective deterrents to trawling activities since the gear will be damaged if it snags on the concrete modules.

**Actions**

1. Carry out cost-benefit studies on the use of ARs to increase fisheries production in Ban Don and Phangnga Bays.
2. Conduct primary surveys of appropriate sites for installing ARs in Ban Don and Phangnga Bays, if cost-benefit studies indicate ARs are economically feasible.
3. Install ARs at selected sites using appropriate materials (e.g., used car tires filled with concrete riprap). To maximize the effectiveness of the program, persuade the local communities to assist in setting up the ARs.
4. Monitor the reefs to evaluate their effect on fish stocks. Information obtained can be used as a guide for future plans.

## Conflict Between Large- and Small-Scale Fisheries

### Strategy 3

Develop a long-term TURF policy.

#### Actlons

1. Conduct detailed studies and acquire information, both from primary and secondary sources, as baseline data. The focus of data collection should be the fish stock assessment of both adults and juveniles.
2. Provide an educational program for the fishing communities in the bay areas to help them understand how to use their fisheries resources sustainably and what kind of fishing gear can be used in each proposed zone. The objective of this program is to promote the future benefits of fish conservation measures.
3. Investigate the attitude of the fishers to TURF and the self-management of fisheries resources.
4. Use the detailed data to develop a draft fisheries zoning plan for the bays, if monitoring indicates that the policy is feasible. The draft will be proposed for public hearing in each community and later adjusted to become the complete fisheries zonation map of Ban Don Bay and Phangnga Bay.
5. Make both bays demonstration areas for sustainable fisheries management. Assign fishing rights on the basis of fishing vessel registration rather than on land tenure. Implement the administration of fishing activities in each zone by a local fisheries management committee.

*Develop a policy of territorial use rights in fisheries so fishers can manage the resources at their expense and for their benefit.*

## Socioeconomic Concerns

### Strategy 4

Increase the income of coastal villagers.

#### Actlons

1. Provide alternative sources of income for coastal fishers whose incomes from fishing have been decreasing due to low catches. Recommended alternative sources of income are various types of coastal aquaculture. Appropriate matches between locale and aquaculture type are shrimp culture in Don Sak and Kanchanadit, oyster culture in Kanchanadit, and cockle in Chaiya and Tha Chang. Information on other potential culture areas can be obtained from the Brackishwater Fisheries Division.

These alternative sources of income for coastal fishers are expected to reduce fishing effort by attracting these fishers to other occupations with higher income.

*Coastal aquaculture is an alternative source of income.*

## **Chapter 8. Fisheries Action Plan**

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2. Avoid unnecessary increase in fishing effort by restricting the number of fishing permits.
3. Allow fish stocks to be replenished by using regulatory measures (e.g., closed seasons).
4. Reduce the problems of common property resources by developing TURF.
5. Ensure that the benefits that accrue to the coastal villagers are greater than the costs borne by them, so that any management plan will be acted on.

### **Legal, Institutional and Administrative Framework**

#### **Strategy 5**

Adjust the license fee system.

#### **Actions**

1. Revise the current license fee system of the Fisheries Act of 1947 through DOF to reflect the true resource rents. Fees charged on fisheries resource use should be calculated based on efficiency and size of fishing vessels or other factors relating to relative fishing effort. The fees for highly efficient gear (e.g., trawl, purse seine and push-net) should be more than for low-efficiency or small-scale gear.
2. Provide the small-scale fishing communities with the income obtained from adjusting the license fee system to assist them in the fisheries resource self-management program.

#### **Strategy 6**

Improve the efficiency of district/provincial fisheries offices.

#### **Action**

Enforce regulations and provide educational programs on fisheries development for the communities through the fisheries offices. The DOF should supply adequate equipment, budget and personnel of various disciplines to these offices. It is recommended that a fisheries liaison officer, trained in the field of public relations and management, be posted at each office to take responsibility for coordinating with local community groups, PG offices, educational institutions and central government agencies.



**Strategy 7**

Provide alternatives for small-scale fishers in Phangnga Bay who use small otterboard trawls (with boom) and push-nets, and to whom the fishing grounds in the bay are completely closed.

**Actions**

1. Offer alternative occupations to fishers who are willing and ready to quit fishing through RTG. New occupations offered to fishers should adequately offset their loss from leaving. Intensive studies for finding appropriate occupations for these small-scale fishers should be conducted prior to the implementation of this action.
2. Identify those fishers' groups most likely to be willing to transfer from capture fisheries by conducting surveys in particular communities.
3. Identify potential sites for additional aquaculture activities, including sea-farming.
4. Provide educational materials for these activities and conduct the short-term training courses required in pilot villages.
5. Analyze employment trends to determine potential alternative occupations for the fishers.
6. Provide substitute fishing grounds for remaining small otterboard trawlers (with boom) and push-netters who cannot quit fishing at present. An intensive survey of fisheries resources is needed for locating substitute fishing grounds to ensure that these areas are far from vital spawning and nursery grounds of economically important marine species. All small trawlers and push-nets which operate in the substitute fishing grounds should switch to a cod-end mesh size of larger than 2.5 cm to reduce the loss of juveniles of valuable species, especially penaeid shrimp.

**Strategy 8**

Improve the efficiency of regulatory control.

**Actions**

1. Require and strictly enforce the official registration of fishing vessels with DOF, especially trawlers and push-net vessels. This action should be accompanied by a widespread public information campaign.
2. Secure coordination with other concerned agencies in the transfer of some of the income collected from fines from illegal fishing operators to PFOs for expenses for enforcing and monitoring regulatory measures.
3. Provide PFOs with equipment, budget and personnel so they can operate patrol services to enforce the law.

4. Transfer authority for regulatory control to PFOs. Each PFO should coordinate with and act as a center for other concerned agencies in enforcing regulations in its vicinity so that the patrols for illegal fishing are standardized. This can be done by setting up a specific fisheries regulation control team at the provincial level, composed of representatives of relevant agencies under the supervision of DOF.

**Education and  
Public Awareness**

**Strategy 9**

Seek cooperation from coastal communities for sustainable fishing.

**Actions**

1. Conduct seminars in cooperation with local community officials to educate the people about fisheries ecology and management in order to gain more public appreciation for sustainable resource utilization and the needs of fisheries management.
2. Incorporate the basic concepts of fisheries management and the rationale behind the conservation of natural resources into the school curricula.

**PROJECTS FOR  
IMPLEMENTATION**

Two projects are proposed for the management of the fisheries resources in Ban Don Bay; Phangnga Bay has three projects which should be implemented as a package.

**PROJECT 1: A study of the optimum fishing effort in Ban Don Bay.**

**Background**

Ban Don Bay is a highly productive fishing ground rich in fisheries resources and a fertile spawning and nursing ground for many marine organisms. Results from MFD indicate that these resources have been degraded due to overfishing by trawlers and push-netters.

*Control of trawls and  
push-nets is essential  
to sustainable resource  
use.*

To conserve this highly productive fishing ground and utilize the available resources at a sustainable rate, fishing effort has to be reduced. Without control over the fishing effort, measures targeted at increasing fish production are likely to fail.

Controlling fishing effort is not an easy task. Data on fishing units and their pattern of fishing are required for effective management planning. Cooperation from the fishers is another key requirement. Enforcement may be expensive.

**Objectives and benefit**

This project aims to determine optimum fishing effort in Ban Don Bay. The scope of the project is limited to the two most destructive gear types, the trawl and push-net. Gear control is necessary for sustainable resource utilization. The benefit will be the long-term availability of stable fish stocks.

**Description**

The project is a fisheries management plan to determine the optimum fishing effort for trawls and push-nets in the selected problem area. Financing for this project will come from donor agencies and/or bilateral aid programs, either government or nongovernment.

**Phasing of activities**

1. Compile existing secondary data on fisheries resources in Ban Don Bay. The data include the biophysical characteristics of marine resources in the selected area, fish ecology, fishing activities, socioeconomic conditions of the coastal villagers and their perceptions on fishing. Key data are number of fishing vessels, fishing effort and catch. Some of these data have already been collected but are scattered.
2. Collect baseline data on the fisheries resources in Ban Don Bay.
3. Determine the optimum fishing effort.
4. Set up a scheme to control fishing effort at the recommended level.

**Agencies and administration**

The lead agency is DOF. Providing support will be ONEB, PG and KU, which can assist in management planning.

**Budget**

The estimated expenses are in addition to the government's planned budget to facilitate additional work.

Item	One-year cost (\$)
Personnel services	60,000
Travel and per diem	27,500
Equipment and supplies	35,000
Education and training	20,000
Overhead	<u>29,500</u>
Total	172,000

**PROJECT 2:** Educational program on fisheries management and conservation for the fishing communities in Ban Don Bay.

**PROJECT 3:** Educational program and public awareness on fisheries management for the fishing communities in Phangnga Bay.

## Background

*Educational programs on fisheries management provide training in resource conservation and strengthen fishers' organizations.*

Past experience indicates that the regulatory control of fisheries resources alone is not enough to alleviate the problem of overfishing. For better management, an educational program should be conducted for fishing communities to inform the fishers about the positive benefits of management. This type of project should also help foster closer relations between the government and fishers' organizations.

It is also recognized that DOF has a long-term plan to develop and assign "coastal fisheries rights" to fishers in each area of the country. This community-based management program, if it could be implemented in the two bays, will discourage excessive fishing and also reduce conflict among different fisheries practices.

## Objective and benefits

The projects aim to provide intensive educational services and public awareness programs for the fishing communities in Ban Don Bay and Phangnga Bay. The specific objective of these projects is to inform the fishers about the relevant ecological principles for the sustainable management of fisheries resources.

Project benefits include:

1. more cooperation from fishers in solving fisheries problems;
2. training in self-management, which will strengthen fishers' organizations; and
3. information on the feasibility of the "coastal fisheries rights" concept and future fisheries management projects in both bays (e.g., AR installation).

## Description

These are demonstration projects on fisheries management and conservation. The project periods will be two years in which educational services and public relations programs will be provided to the target population by such means as the integration of fisheries management concepts into the primary school curriculum, the demonstration of fisheries conservation activities to fishers and a media campaign on fisheries conservation and management. The program will also assist each fishing community in the formation and strengthening of local fishers' organizations. The perception of fishers on future fisheries management programs in both bays will be examined during the project implementation.

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### Phasing of activities

1. Develop appropriate educational programs on fisheries management and conservation to provide for each community in both bays.
2. Provide educational services and public awareness programs to local fishing communities.
  - a. Seek cooperation from MOE and other concerned agencies to include a basic fisheries management section in the primary school curriculum.
  - b. Conduct training, demonstrations and study tours for key community personnel and fishers' groups to enlarge their understanding of fisheries resource conservation, regulatory measures and fishers' organizations.
  - c. Organize a media campaign for fisheries conservation. For better implementation, it might be necessary to employ private public relations experts to produce radio and television programs and an advertising poster for the project.
3. Investigate the perception of fishers on the future fisheries management projects, e.g., the assignment of coastal fisheries rights and AR installation. Information gained from these projects and from Project 1 will be assessed and subsequently used as an indicator in the implementation of fisheries management in the next phase.
4. Evaluate the results of these projects and use these as examples for fisheries management in other fishing zones.

### Agencies and administration

The lead organization is ONEB. Support agencies are DOF, MOE and concerned agencies both at the provincial and central levels. At least two liaison officers should be employed to help coordinate the program properly. The private business sector in the project areas should be encouraged to participate.

### Budget

Item	Two-year cost (\$)	
	Ban Don Bay	Phangnga Bay
Personnel services	24,000	12,000
2 liaison officers	16,000	-
Travel and per diem	48,000	40,000
Equipment and supplies for education	120,000	60,000
Training and study tour	32,000	50,000
Contingencies	<u>8,000</u>	<u>4,000</u>
Total	248,000	166,000

**PROJECT 4: Controlling and reducing fishing effort in Phangnga Bay through community cooperation.**

**Background**

Recent studies have indicated that fisheries in Phangnga Bay have been overexploited. The CPUE has declined and catch composition has deteriorated. The increasing number of destructive fishing gear, especially push-nets and trawls, is the main reason for overfishing. Regulations limiting fishing effort in Phangnga Bay already exist, but lack effective enforcement. Thus, compliance among fishers with the existing regulations and attempts at reducing present levels of exploitation are needed.

The actions to be taken, however, must be acceptable to the fishers themselves. Once they understand and gain confidence in the benefits to be received from the management program, their involvement in and cooperation with the management process will lessen the difficulties in effective enforcement. Education and cooperation from the local fishers are necessary for any fisheries management scheme.

The DOF should adequately involve fishing communities in monitoring efforts for fisheries management. Insufficient personnel and budget have made DOF weak in regulatory monitoring and enforcement. This project puts the focus on controlling fishing effort by the improved enforcement of existing fisheries regulations through fishing community involvement in the process after extensive community education. It targets fishers' organizations as a means to improve the level of compliance with fisheries regulations.

**Objectives and benefits**

The project objectives and benefits are:

1. improvement of the communication channels between the fishing communities and DOF in the enforcement of fisheries management regulations;
2. formulation of a fisheries management group at the community level to assist in the enforcement;
3. improved capability of DOF personnel to communicate and work effectively with the fishers in their communities, to disseminate information and education materials, and to organize these fishers for management needs;
4. production of education materials on fisheries management for extension to fishing communities and local schools;
5. better compliance with the existing fisheries management regulations, i.e., the 3-km limit offshore, PA and seasonal closure.

*Community education and cooperation can control fishing effort and improve compliance with regulations.*

## Chapter 8. Fisheries Action Plan

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### Description

The project will focus on building up the capacity of DOF's regional personnel to organize and work closely with the fishing communities in the area. It will train DOF personnel in the techniques of community education and organization by working with the existing fishers' organizations and assisting in forming new groups. It will enhance the role of DOF in educating the local fishers in fisheries management while communicating the rationale behind the existing fisheries regulations to the communities.

### Phasing of activities

1. Identify the fishers' organizations who will work with the project.
2. Contact the selected fishing communities, assign fieldworkers in each community to liaise between DOF and the community.
3. Train DOF personnel on a periodic basis through a series of seminars and fieldwork.
4. Develop initial education materials to support fisheries management in the bay.
5. Refine the action plan in conjunction with DOF and fishers' organizations, which will be part of the management network for fisheries resource management in Phangnga Bay.

### Agencies and administration

The lead agency is DOF's MFD. The DOF regional office in Phuket will serve as the base for all project operations. The project will involve provincial personnel at different times for effective training.

### Budget

Item	Two-year cost (\$)
Personnel services	80,000
Travel and per diem	16,000
Equipment and supplies	16,000
Education and training	<u>52,000</u>
Total	164,000

### PROJECT 5: Educational and training program on alternative occupations.

### Background

To effectively control fishing effort at the optimum level, alternative occupations must be provided. Phangnga Bay is recognized as an area to be developed for tourism promotion and the "Southern Seaboard Development Pro-

gram". These developments can help provide job opportunities for local residents including coastal fishers. Small-scale fishers should be made aware and trained to benefit from such developments through educational and training programs.

**Objective and benefit**

Fishers will be well prepared to engage in other occupations which will help reduce the fishing pressure in the bay.

**Description**

Small-scale fishers will be trained in alternative and supplementary occupations with the implementation of this project.

**Phasing of activities**

1. Identify job opportunities in different local communities through various development programs, including possibilities for aquaculture development.
2. Identify fishers who are willing to switch to other occupations. Priority should be given to those fishers who previously used destructive fishing methods and those who suffer from low fishing incomes.
3. Inform the target fishers of available job opportunities.
4. Provide education and training on the available opportunities to enable those fishers to undertake new occupations.
5. Provide help in terms of market outlets (e.g., for aquaculture) and the necessary infrastructure required to stimulate their entry into new occupations.
6. Seek cooperation from both the government and private sectors in providing jobs for the local fishers.
7. Issue certificates to fishers who have attended training programs so that they can use these to enter new occupations.
8. Include training on fish processing, especially for women in the local communities, so that they can increase the value-added on their catches and minimize postharvest losses.

*Fishers are equipped to engage in alternative and supplementary occupations.*

**Agencies and administration**

The lead agency is ONEB with the cooperation of the MOI provincial office and DOF, concerned provincial and central government agencies and the private sector in the region.



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### Budget

Item	Cost (\$)
Personnel services	12,000
Travel and per diem	40,000
Equipment and supplies	60,000
Training, seminar and study tour	50,000
Contingencies	<u>4,000</u>
Total	166,000

### PLAN IMPLEMENTATION

The emphasis of the plan is on the management of highly productive fishing grounds, which at present tend to be overexploited. If properly managed, these can produce optimum sustained yield. Management issues involve resource degradation due to overexploitation and the catch of juveniles of high-value species, conflict between large- and small-scale fishers in resource utilization, low income and limited job opportunities for coastal villagers, ineffective regulation and enforcement, inappropriate license fees for resource uses, low public appreciation of fisheries resources, and lack of information on fisheries resources.

The five proposed projects put the emphasis on the acquisition of sufficient information on management, planning and cooperation between the central government, including DOF and ONEB, and PG in implementing the plan.

This chapter has presented the fisheries action plan for Ban Don and Phangnga Bays which include the policy framework and recommendations for zoning, reduction in the exploitation level, and the creation of greater public appreciation of the value of management and conservation of natural resources. The seven management strategies and the series of actions which will accomplish these strategies focus on preventing resource degradation, installing ARs, resolving conflicts between large- and small-scale fisheries, providing better livelihood opportunities for fishers, improving the legal and institutional framework for fisheries and providing better education regarding sustainable fisheries. Five projects costing \$916,000 will implement the plan. Chapter 9 presents the tourism action plan (islands and coral reefs).

*The five fisheries projects focus on the reduction of fishing effort and the creation of greater public appreciation of the value of management and conservation of natural resources.*

## CHAPTER 9

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# *TOURISM ACTION PLAN (ISLANDS AND CORAL REEFS)*

*The tourism action plan's primary goals are coral reef conservation and island management.*

The tourism action plan for the management of islands and coral reefs is limited to the coastal environments of Ko Samui, Ko Phangan, Ko Tao and Ko Taen and associated satellite islands in Ban Don Bay. The plan's primary goals are coral reef conservation and island management. The Mu Ko Ang Thong NMP is not discussed comprehensively because it is under the authority of NPD which is developing a separate management plan. But because the park is an integral part of the island resources in Ban Don Bay, recommendations are made to address several major management issues, particularly, tour boat activities.

### **POLICY FRAMEWORK**

This section covers policies for those land-based activities related to the specific management needs of coral reefs and legal statutes relevant to the coral resources in Ban Don Bay.

### **Environmental Policy**

The main source of the environmental policy in Thailand is *National policies and measures on environmental development* (ONEB 1981). This includes policies and suggested measures for the protection and management of corals as well as other natural resources and therefore complements the action plan. The effectiveness of the plan will depend on the extent to which these policies and measures are adopted and enforced by the various government agencies concerned. In short, it depends on closing the "implementation gap". Unfortunately, the ONEB policies are fairly vague; sectoral agencies are left to decide what steps to take to balance sectoral and national objectives. Short-term objectives, either by design or default, are usually given priority, especially by LG and PG.

The TAT could play a larger role in managing activities that affect coral reefs. Included among TAT's major duties is the initiation of resource conservation activities. In the past, however, in an effort to boost the economy through tourism, TAT tended to focus on restoring and conserving archaeological and historical monuments instead of natural or environmental resources. National parks such as Mu Ko Ang Thong were provided with funds for

## **Chapter 9. Tourism Action Plan (Islands and Coral Reefs)**

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improving access and supplying tourism services rather than, e.g., for improving their resource conservation capabilities. The latter could be done by providing resource management training or equipment, i.e., radios, mooring buoys and coral reef educational materials advocating conservation. The TAT has expressed a willingness to make an important contribution to the sustainability of tourism in the long term by focusing directly on environmental and resource conservation.

Another possible strategy for Ban Don Bay is for PG to declare "preservation fisheries" areas, i.e., areas outside the NP jurisdiction where there are important coral resources. Sections 7-9 of the Fisheries Act empowers the Provincial Council, with the approval of MOAC, to do this. Such a declaration would prohibit fishing in these areas and thus provide protection against boat anchors which can damage corals. Also, the management of the fisheries would then become the responsibility of the local community adjacent to the fisheries. Thus, the declaration would be a means of encouraging and authorizing community participation in the management and protection of natural resources, including corals.

Hotels with less than 80 rooms are not required to install sewage treatment facilities, but they may be regulated by BCCA of 1979 (as amended) and Public Health Act of 1941. The BCCA assigns regulatory powers to MOI to control structural modifications and new buildings or the removal of buildings in areas where a Royal Decree has been issued announcing that the act will be enforced in that area. This has been issued for Ko Samui Sanitary District (SD) but not for Ko Phangan.

In the near future, a Ministerial Regulation under BCCA will be issued establishing a 10-m setback for construction in beach areas on Ko Samui. While the chief concern of the regulation is to maintain the scenic quality of the coast, it will neither compel owners to install waste treatment systems nor control silt runoffs from construction activities. If these are to be regulated, then it will be necessary to announce a new set of Ministerial Regulations making it compulsory for all resort and hotel projects in specified coastal areas, especially those adjacent to coral reefs, to install waste treatment and silt-catching systems. The enforcement of such regulations would require suitably trained local officials to act as inspectors.

For Ko Phangan, a Royal Decree would first have to be issued stating that BCCA will be enforced in that area and then a set of Ministerial Regulations can be announced with similar regulatory clauses as will apply to Ko Samui.

The problems of silt runoff and wastewater are also addressed by laws regulating water pollution, i.e., NEQA of 1975, Factories Act of 1969, Public Health Act of 1941 and the body of navigation law. There are also various laws under which municipalities, SDs and other forms of LG are delegated the power to develop rules and standards necessary for the management of municipal wastes, e.g., the Bangkok Metropolitan Administration Act of

## **Chapter 9. Tourism Action Plan (Islands and Coral Reefs)**

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1975, Provincial Administration Act of 1955, Tambon Administration Act of 1956, Municipal Act of 1953, and the Local Health Administration Act of 1952. Although all of these LG forms are empowered to issue by-laws and ordinances to maintain clean waters under their jurisdiction, they have not developed municipal waste treatment systems and regulatory standards for management and control because of the lack of technical and management skills to do so.

The Public Health Act gives LGs responsibility for controlling "nuisances" within their areas of jurisdiction. Rather than define "nuisances", the act lists various sources from which they arise which includes any source of water pollution. The public nuisance concept is quite broad as it covers situations likely to be detrimental to "the safety or right and liberty of the public" as well as situations where health is likely to be threatened. Thus, one could interpret the act in a much wider context than public health to control activities which pollute coastal waters and cause the degradation of reef habitats.

It would appear therefore that the best option for controlling the construction of coastal resort facilities and hotels with less than 80 rooms is to request MOI to issue a set of Ministerial Regulations under BCCA, compelling all accommodation owners in specified coastal areas to install low-cost waste treatment systems in their units and to set up a silt-catching system during the construction stage. Guidelines for each could be produced by ONEB in conjunction with DPW. It would be relatively simple to carry out and inexpensive for construction project proponents to comply with. It would, however, require local officials to conduct field inspections and take legal action to halt construction when there is a failure to comply. Local officials would therefore require some form of training. As it may take some time for the regulations to be issued, a Ministerial Notification, again under BCCA, could be issued in the meantime with similar requirements. This only takes approximately one month and can be effective for up to one year; thereafter, it can be renewed on an annual basis, if necessary.

Although the Public Health Act also could be used for this purpose with little additional cost, it would be a more complex procedure due to the lack of precedent. It would also require local officials to be trained to carry out regulatory duties. It is not considered a practical plan to require all resort facilities and hotels, regardless of size, to submit EIA reports. The main disadvantages are: first, it would be a heavy burden for small-scale investors—an initial environmental examination is estimated at \$1,000 while a detailed EIA could cost \$50,000-800,000. Second, it would be very time consuming, and third, it would not deal with synergistic effects (i.e., the combined effects of more than one project). Fourth, as there seems to be a consensus emerging that all coastal resort facilities, hotels and even private residences should have an appropriate waste treatment system and that all project proponents

should take action to prevent silt runoffs during the construction stage, it hardly seems necessary to go through all the expense and time of an EIA to conclude this once more. It would be simpler to impose appropriate mitigation measures in the first place.

Although voluntary cooperation would be the ideal method of implementing waste management through education and advice, experience suggests that this alone will not work. But these and demonstration projects should be used to complement and strengthen the mandatory program.

## **Socioeconomic Policy**

Past and present TAT policies have generally included spreading the benefits of tourism to provincial areas in the form of employment and income generation. Measures, however, need to be taken to spread the benefits to more groups on Ko Samui and mitigate the social costs which accompany the expansion of tourism. The TAT can play a more active part by providing advice and support to local small-scale resort owners to enable them to retain a share of the tourism market through physical or service improvements and by helping more locals find tourism-related employment.

While it is often difficult to determine the specific cultural effects of tourism from other influences, a possibility is to establish some kind of forum where locals can have a say in defining type and intensity of tourism they wish to see on the islands. The policies of TAT can be interpreted as being concerned with such issues and could coordinate between locals and entrepreneurs. The legal basis for asserting and promoting public access to beaches is the Land Code of Thailand, 1954 (Sections 8-9) and a decision of the Supreme Court of Thailand (Dika. No. 214/2481) which prohibit private ownership of "seashores." A ruling of the Judicial Council of Thailand defined "seashores" as "those land areas submerged when the level of tidal waters reaches the ordinary low watermark". Under existing Thai customary law on public domain, beaches and dunes forming part of the shorelands which are traditionally open for public access are classified as public property and they have the same legal status as seashores.

## **POLICY RECOMMENDATIONS**

1. Coral, beach and water resources have value as marine habitats, tourism and recreation areas, scientific research sites and contributors to the local and national economy. Thus, these shall be protected by means of appropriate policies, laws and institutions.
2. A zonation plan for nearshore habitats in the islands shall be implemented through community organizations and the cooperation of appropriate government agencies which effectively protects the habitats from destructive uses and incorporates three basic zones into the scheme as follows:

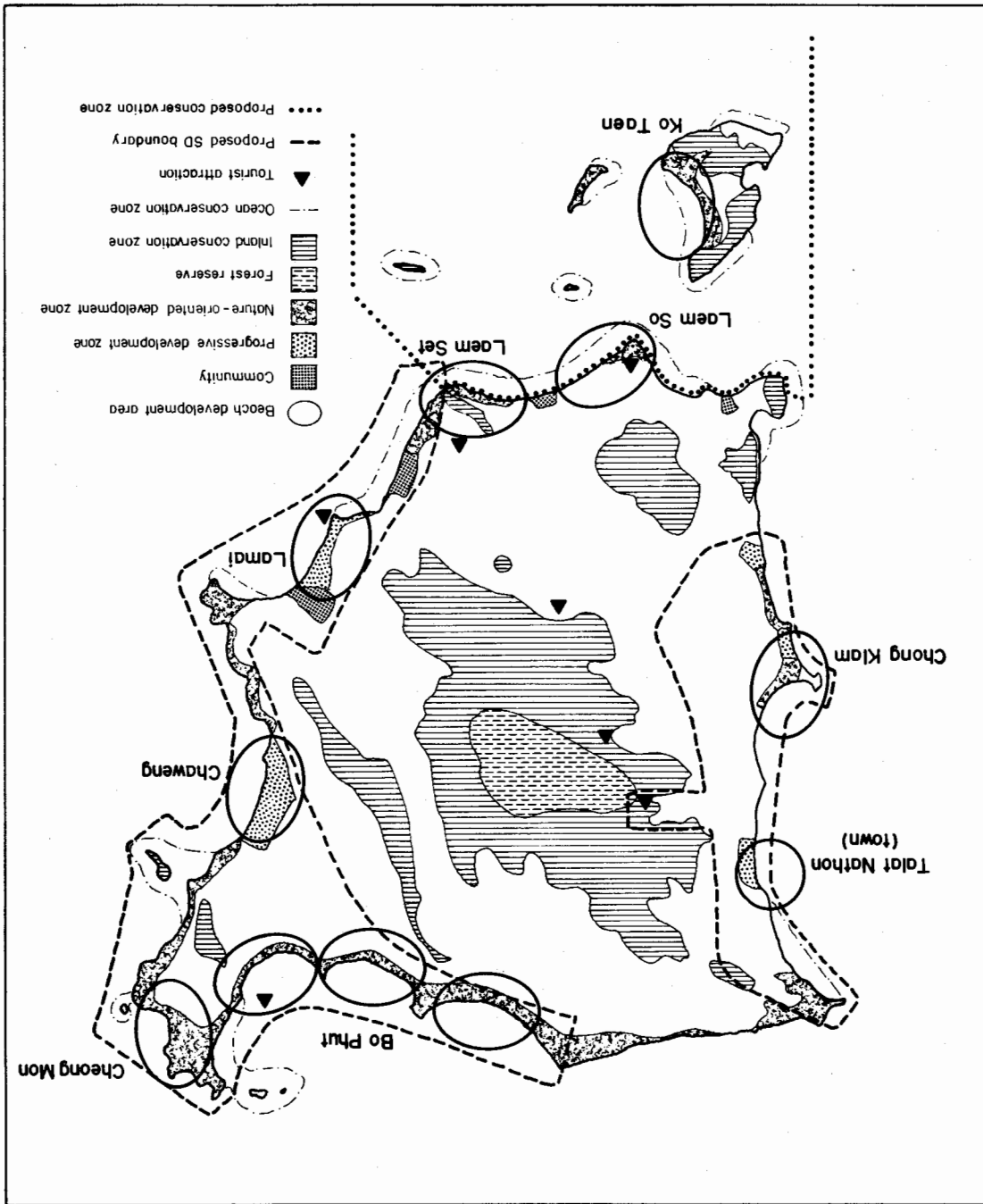
## **Chapter 9. Tourism Action Plan (Islands and Coral Reefs)**

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*A zonation plan for nearshore habitats in the islands includes the sanctuary, conservation and development zones.*

- a. Sanctuary zone: no fishing, collecting or boat anchoring are allowed and only "no-touch" research is permitted. Living coral cover should exceed 75%. The appearance of the reef should be attractive and there should not be any serious conflicts of interest in protecting the area.
  - b. Conservation zone: traditional fishing and most recreational activities are allowed, but no boat anchoring on the reef or any destructive fishing methods are permitted. Areas selected should have living coral cover of more than 50% and the general aesthetic value of the reef should still be good. There should not be any serious conflicts of interest in implementing this type of zone.
  - c. Development zone: those activities necessary for tourism development, e.g., boating and traditional fishing, can continue unabated but destructive fishing methods are not permitted. The zone is selected based on proximity to tourist attractions and noninterference with Zones a and b.
3. More effective administration of coral and coastal environmental laws and policies shall be achieved by providing relevant government agencies with more manpower and equipment, promoting improved inter-agency cooperation, revising unclear and outdated laws and regulations and adopting new ones, and including resort owners and the local community in coastal environmental and resource management.
  4. Shoreline development in the islands shall be regulated so that water quality, beaches and coral reefs are maintained in their natural condition. As much as possible, it should be facilitated by government agencies in cooperation with local organizations and developers. A revision of the current SD boundaries is recommended (Fig. 9.1).
  5. Awareness and understanding shall be promoted among local officials, resort owners, local citizens and visitors of natural endowments of the coastal area.
  6. Local and traditional community values shall be incorporated in the development of tourism so that some of these values are maintained and benefits accrue to the community.
  7. The right of public access to beaches shall be asserted and promoted.
  8. Planning and environmental management skills shall be upgraded at the local and district levels through the implementation of training courses for government employees and private tourism organization officials as needed.

Fig. 9.1. Ko Samui general zoning and revised SD boundaries proposed by TAT (TISTR 1985).



## Chapter 9. Tourism Action Plan (Islands and Coral Reefs)

### MANAGEMENT STRATEGIES AND ACTIONS

The strategies and actions necessary to carry out the action plan are described here. Some of the strategies and actions overlap because it is not possible in all cases to isolate those relevant to only one problem area. A summary of these strategies and actions is shown in Table 9.1.

Table 9.1. A summary of strategies and actions that address management issues and problems.

Issues/problems	Strategies (S) and actions (A)
Resource degradation	
Coral reef destruction	<p>S1 Implement the zonation scheme for near-shore habitats through CBOs.</p> <p>A1 Set up ITF.</p> <p>A2 Mobilize communities through education and consultation.</p> <p>A3 Form CBOs.</p> <p>A4 Establish the zoning scheme.</p> <p>A5 Implement zones through CBOs, DOF and NPD in coordination with ITF.</p>
Beach and water quality degradation	<p>S2 Manage the shoreline through community action and appropriate regulations.</p> <p>A1 Regulate and enforce setbacks.</p> <p>A2 Encourage resort owners to install wastewater treatment systems.</p> <p>A3 Request MOI to issue regulations under BCCA for wastewater treatment.</p> <p>A4 Offer incentives to resort owners.</p> <p>A5 Designate solid waste disposal sites, organize trash collection and build incinerators.</p> <p>A6 Organize small bay associations to monitor the change in water quality.</p>
Socioeconomic and cultural concerns	
Inequitable distribution of income from tourism	<p>S3 Provide incentives to the locally owned and controlled small-scale tourism industry.</p>
Poor local participation in tourism	<p>A1 Arrange for TBA representation in ITF.</p> <p>A2 Determine appropriate support and incentives through community consultation.</p> <p>A3 Encourage the use of local products and services.</p> <p>A4 Request support for small resorts which comply with regulations.</p>
Eroding traditional and cultural values	<p>S4 Formulate and publicize acceptable codes of conduct for tourists.</p> <p>A1 Conduct sample surveys to determine cultural concerns and solutions to cultural displacement.</p> <p>A2 Agree on codes of conduct through CBOs and ITF.</p> <p>A3 Publicize codes of conduct.</p>

Continued



## Chapter 9. Tourism Action Plan (Islands and Coral Reefs)

Table 9.1. (continued)

Issue/problems	Strategies (S) and actions (A)
Lack of public access to beaches	<p>S5 Assert and promote right of public access to beaches.</p> <p>A1 Investigate present public access arrangements, identify points where access is or should be available and make arrangements with developers for public access to beaches through ITF and TBA.</p> <p>A2 Publicize the public's right of access to beaches through ONEB news releases or brochures.</p> <p>A3 Create signs with a common logo, informing the public of access routes through LG.</p> <p>A4 Investigate the possibility of reserving Hat Phra Nang as a public beach and reserving the adjacent area as a historical park through a committee set up by the Fine Arts Department and ONEB.</p>
<p>Legal, institutional and administrative issues</p> <p>Inadequate legal support</p>	<p>S6 Improve law enforcement.</p> <p>A1 Ban destructive fishing methods from reef areas.</p> <p>A2 Provide the Mu Ko Ang Thong NMP staff with radios and at least a boat.</p> <p>A3 Improve cooperation and communication among DOF, NPD and the marine police.</p> <p>A4 Review the burden-of-proof requirement.</p> <p>A5 Regulate purse seining within the 3-km limit.</p> <p>A6 Give more authority to DOF and NPD officers.</p> <p>A7 Allow park staff to develop and revise plans and include scientific criteria in NPA.</p> <p>A8 Extend Mu Ko Ang Thong NMP to include Ko Tao and Ko Taen or declare the islands "preservation fisheries."</p> <p>A9 Include coral reef habitat protection policies in the Seventh NESDP.</p> <p>A10 Decide if coral collection and sale should be prohibited or allowed to continue as a cottage industry.</p> <p>S7 Synthesize and draft all legal actions by a special committee.</p> <p>A1 Form a legal aid group in ONEB.</p> <p>A2 Draft necessary amendments in cooperation with ITF.</p> <p>A3 Pursue the acceptance of amendments at the provincial and national levels.</p>

Continued

## Chapter 9. Tourism Action Plan (Islands and Coral Reefs)

Table 9.1. (continued)

Issues/problems	Strategies (S) and actions (A)
Lack of control over tourist development	<p>S8 Set up local guidelines for controlling the planning and impact of tourist facilities and operations.</p> <p>A1 Strengthen TBA with the assistance of ITF and in cooperation with TAT, LG and PG.</p> <p>A2 Synthesize guidelines and conduct workshops and seminars for local tourist operators.</p> <p>A3 Formalize cooperation among TAT, DOF, NPD, CBOs, LG and PG.</p> <p>A4 Strengthen promotion, publicity and support for CRM.</p> <p>A5 Support and strengthen SD.</p>
Lack of planning and management skills	<p>S9 Provide training for government personnel and nongovernment representatives from the tourist sector on CRM and appropriate resort development.</p> <p>A1 Conduct training courses for LG, PG and NGOs on Ko Samui for at least two years.</p> <p>A2 Conduct technical training courses for resort owners on shoreline management and waste disposal.</p>
Education and public awareness Low public appreciation coastal resources	<p>S10 Implement a public education program on CRM.</p> <p>A1 Conduct four seminars per year on island ecology and CRM.</p> <p>A2 Conduct seminars in sites where problems occur.</p> <p>A3 Study the economic contribution of coastal resources to islands and disseminate the results.</p> <p>A4 Incorporate conservation principles in the local school curriculum.</p> <p>A5 Establish a tourist information and island conservation center on Ko Samui.</p>

CBOs - community-based organizations.

ITF - island task force.

TBA - Tourism Business Association.

### Resource Degradation

#### Strategy 1

Implement the zonation scheme for nearshore habitats through CBOs.

The high quality of coral reefs (Fig. 2.9) will be protected by means of fisheries and park regulations and the demarcation of all sites by signs and

## **Chapter 9. Tourism Action Plan (Islands and Coral Reefs)**

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buoys will be managed by CBOs near the areas. These CBOs will coordinate with an island-wide task force supervised by DOF, NPD and TAT.

### **Actions**

1. Set up an ITF headed administratively by an NGO contracted to coordinate and implement projects at the island level. The ITF will organize the plan's implementation in the island communities, but will carry no legal mandate to implement laws outside the LG agencies.
2. Mobilize the island and resort communities with the help of ITF through a process of education, consultation and facilitation in implementing the zonation plan recommended for coastal areas.
3. Form CBOs for each project site.
4. Declare the sanctuary areas with outstanding coral reefs recommended by CBO leaders by using the Fisheries Act, specifically Article 7 which allows the establishment of zones where all types of fishing activities are prohibited. The process would include:
  - a. the preparation by the province of a report of the CBO nearest the proposed area consenting to the establishment of the zone and a 1:50,000 scale map and a schematic presentation of the proposed area;
  - b. the submission to DOF; and
  - c. the declaration of the zone by the Provincial Governor following the approval of DOF.
5. Implement the following sanctuary and conservation zone designations through CBOs, DOF and NPD in coordination with ITF (Table 9.2). The particular locations are in relation to the main island.

### **Strategy 2**

Manage the shoreline through community action and appropriate regulations.

### **Actions**

1. Regulate and enforce a standard setback of 10 m or more from the maximum high waterline or the highest level of a sandy beach, whichever is farther inland, for all structures (Fig. 9.12).
2. Encourage resort owners to install low-cost wastewater treatment systems and set up silt-catching devices during construction after a practical set of regulations has been agreed upon with SD and TBA.

## Chapter 9. Tourism Action Plan (Islands and Coral Reefs)

Table 9.2. Sanctuary and conservation zones in Ban Don Bay.

Island/site	Location	Description	Zone classification
Ko Samui (Figs. 2.9 and 9.1-9.4)			Conservation
Ko Tao Pun	NE	<ul style="list-style-type: none"> <li>• High diversity of corals and other invertebrates.</li> </ul>	
Ban Bang Po	N	<ul style="list-style-type: none"> <li>• Popular tourist destination.</li> <li>• Good coral cover.</li> <li>• Diversity to a 12-m depth.</li> <li>• Includes a variety of soft corals and gorgonians.</li> </ul>	
Laem So	S	<ul style="list-style-type: none"> <li>• The best reef borders the island with a variety of gorgonians and large fish.</li> </ul>	
Laem Set	S	<ul style="list-style-type: none"> <li>• Good water visibility.</li> <li>• Good coral cover.</li> <li>• Popular tourist destination.</li> <li>• In critical need of management.</li> </ul>	
Ko Phangan (Figs. 2.9, 9.2 and 9.5)			Sanctuary
Hat Khom	N	<ul style="list-style-type: none"> <li>• Live coral cover of up to 90% with a high diversity of corals and associated organisms.</li> <li>• Good variety of fish.</li> <li>• Not frequently visited by tourists.</li> </ul>	
Mae Hat	NW	<ul style="list-style-type: none"> <li>• Corals in good condition.</li> <li>• Good variety of associated organisms (e.g., sting rays).</li> </ul>	Conservation
Ao Hat Yao	W	<ul style="list-style-type: none"> <li>• Moderate coral cover with a variety of fish in the area.</li> <li>• Frequently visited by tourists.</li> </ul>	
Ko Tao (Figs. 2.9, 9.2 and 9.6-9.7)			Sanctuary
Laem Tian	E	<ul style="list-style-type: none"> <li>• Live coral cover of up to 90% in shallow areas and a high diversity of abundant fish extending into the deeper areas.</li> </ul>	
Ao Tian	SE	<ul style="list-style-type: none"> <li>• Coral cover of up to 98% in very good condition.</li> <li>• Not often visited by tourists.</li> </ul>	
Hat Sai Lee	W coast	<ul style="list-style-type: none"> <li>• A wide reef with live coral cover of about 70%.</li> <li>• Dominated by coral heads formed by <i>Porites</i>.</li> </ul>	Conservation
Ko Nang Yuan	NW	<ul style="list-style-type: none"> <li>• Popular tourist destination.</li> <li>• Coral cover of about 75%.</li> <li>• Shows evidence of dynamiting but is recovering.</li> <li>• General scenery is pleasing and attracts many visitors.</li> <li>• Area needs management.</li> </ul>	

Continued

## Chapter 9. Tourism Action Plan (Islands and Coral Reefs)

Table 9.2 (continued)

Island	Location	Classification	
Ko Taen and the Southern Islands (Figs. 2.9, 9.2 and 9.8-9.9)		Sanctuary	
Hin Ang Wong	E	<ul style="list-style-type: none"> <li>• Karst island.</li> <li>• Reef coral cover is excellent with a wide variety of coral species, associated organisms and fish.</li> </ul>	
Ko Rap	S	<ul style="list-style-type: none"> <li>• Habitat is valuable for research.</li> <li>• Very clear waters with a high density and variety of coral growth.</li> <li>• Reef descends to about 15 m.</li> <li>• Considered the best reef among the island groups because of its steep topography and the variety of corals below the drop-off.</li> </ul>	
Ko Taen	S of Ko Samui	<ul style="list-style-type: none"> <li>• On the east and south ends, a calm protected site with high coral diversity and cover of 70%.</li> <li>• Local community interested in setting up a management scheme for surrounding reefs.</li> </ul>	Conservation
Ko Mat Sum	E	<ul style="list-style-type: none"> <li>• High density and variety of corals on the E and W coasts.</li> <li>• The eastern reef is about 400 m wide and covered with live corals.</li> <li>• The western reef descends rapidly and has many fish.</li> </ul>	
Mu Ko Ang Thong (Figs. 2.9, 9.2 and 9.10-9.11)		Sanctuary	
Ko Mae Ko	W	<ul style="list-style-type: none"> <li>• High coral cover and a variety of life forms and associated invertebrate animals.</li> </ul>	
Ko Tai Plao	N	<ul style="list-style-type: none"> <li>• Not usually visited by tourists.</li> <li>• Relatively clean waters.</li> <li>• Lagoon with surrounding reef growth.</li> <li>• Wide variety of corals and organisms.</li> </ul>	Conservation
Ko Sam Sao	E	<ul style="list-style-type: none"> <li>• Abundant and diverse coral growth with many fish.</li> <li>• Heavily visited by tourists.</li> <li>• Viewing area for glass-bottomed boats.</li> <li>• Area needs management.</li> </ul>	

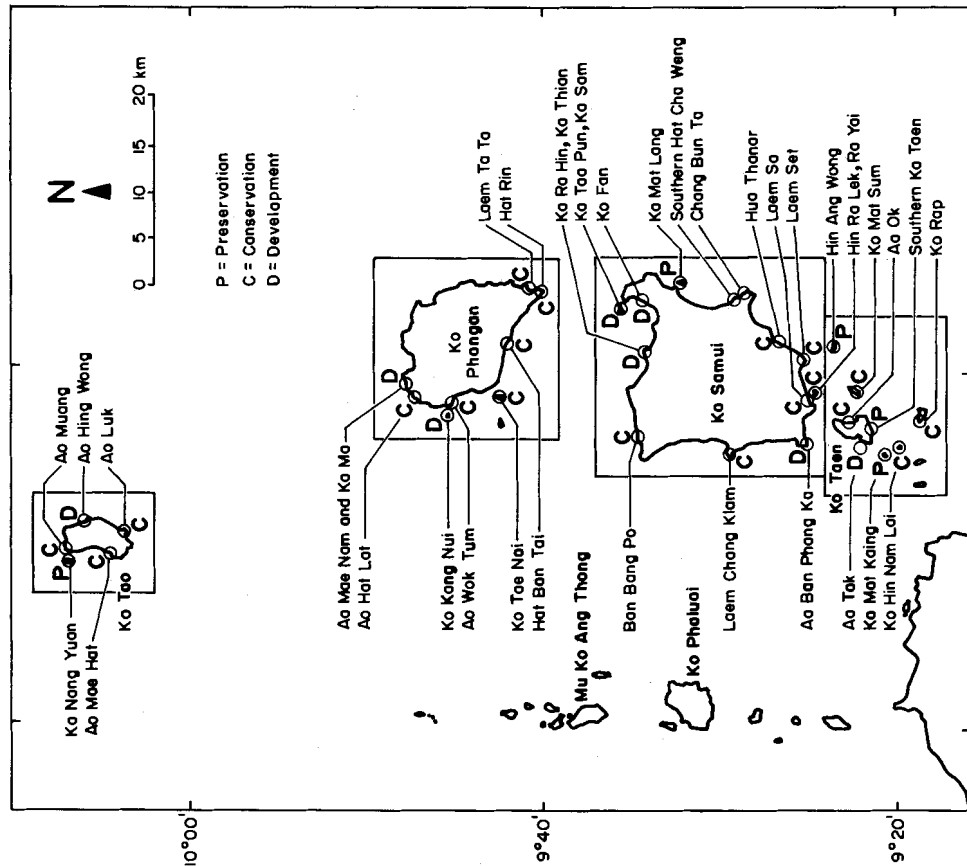
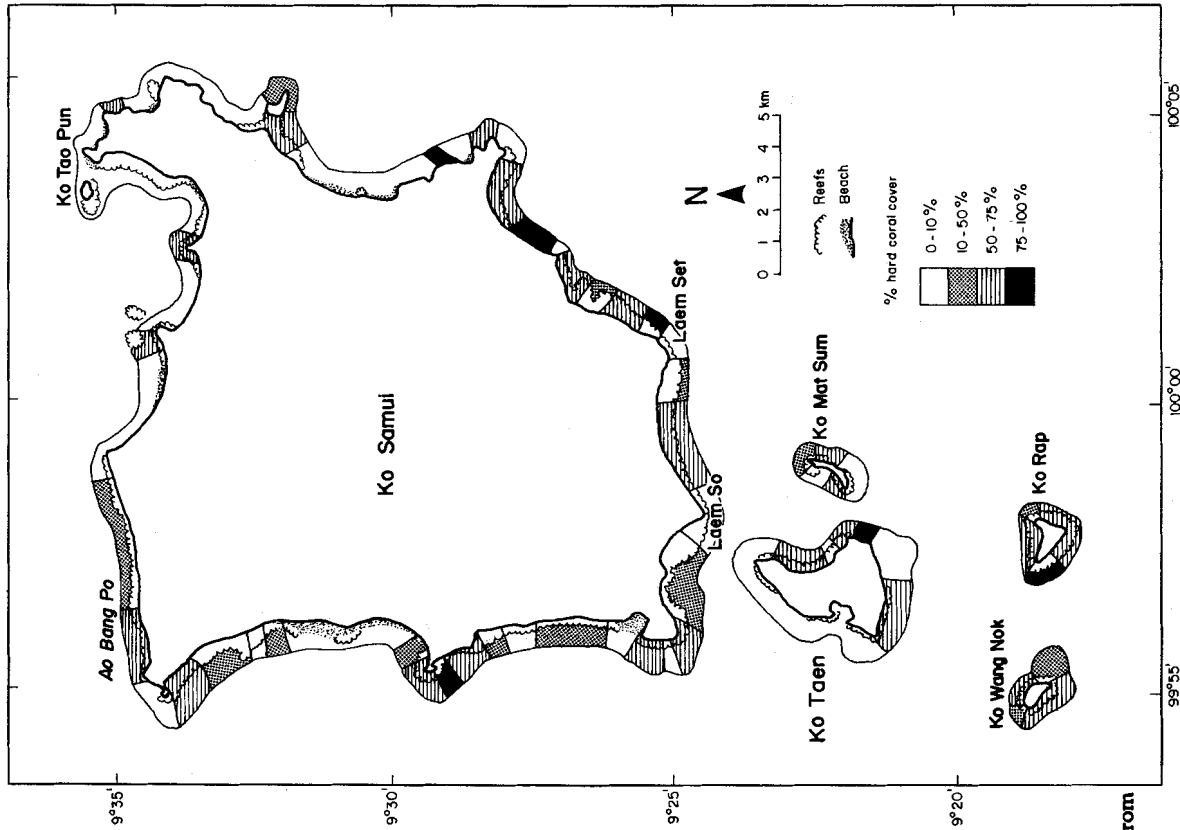


Fig. 9.2. Coral reef use classification recommended by TAT (TISTR 1988).

Fig. 9.3. Coral reef quality on Ko Samui from recent surveys (Sudara et al. 1989b).

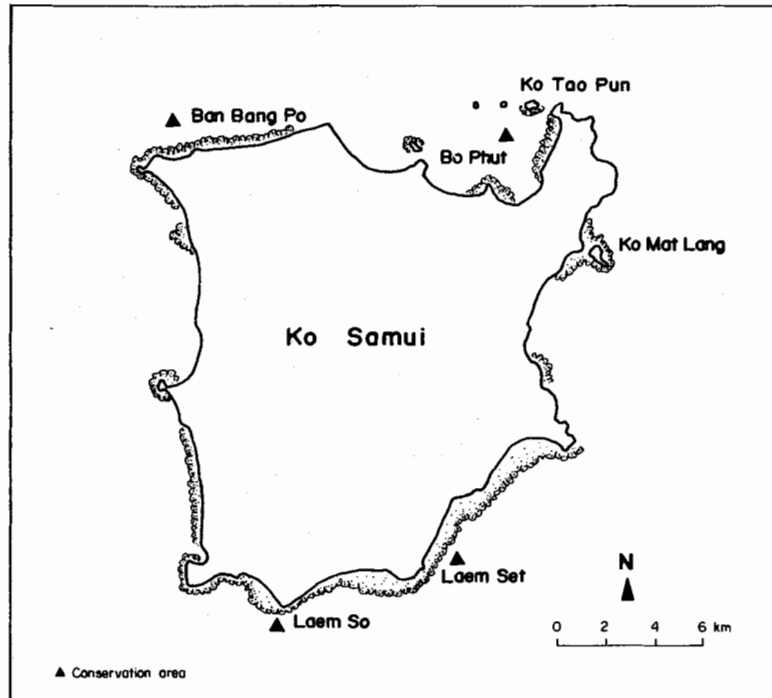


Fig. 9.4. Coral reef zoning and management scheme for Ko Samui.

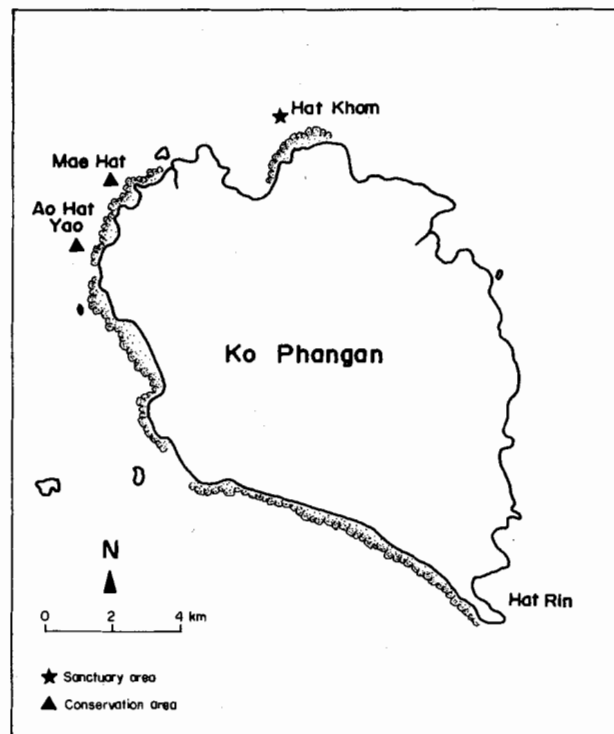


Fig. 9.5. Coral reef zoning and management scheme for Ko Phangan.

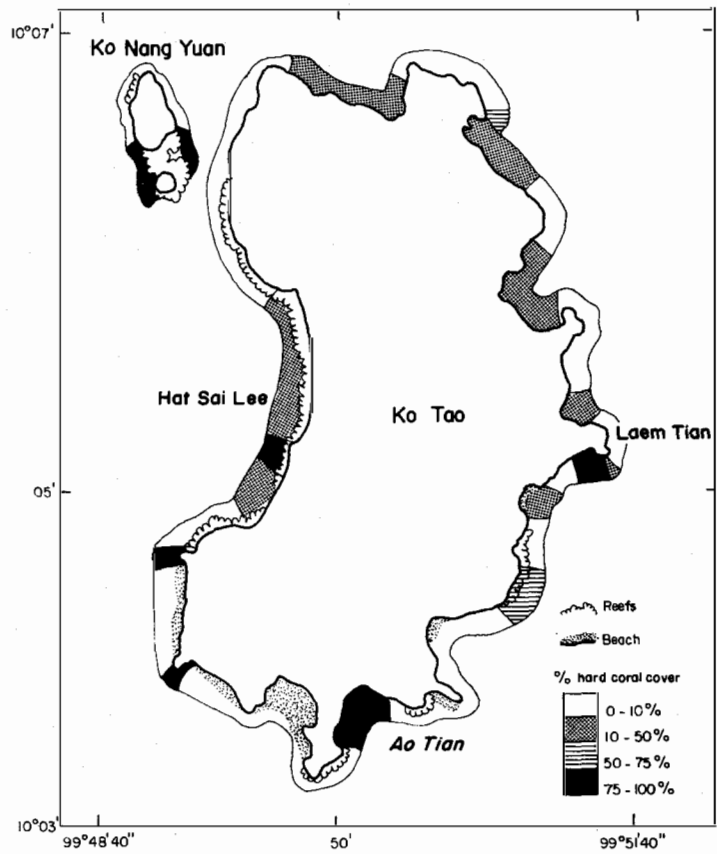


Fig. 9.6. Coral reef quality on Ko Tao from recent surveys (Sudara et al. 1989b).

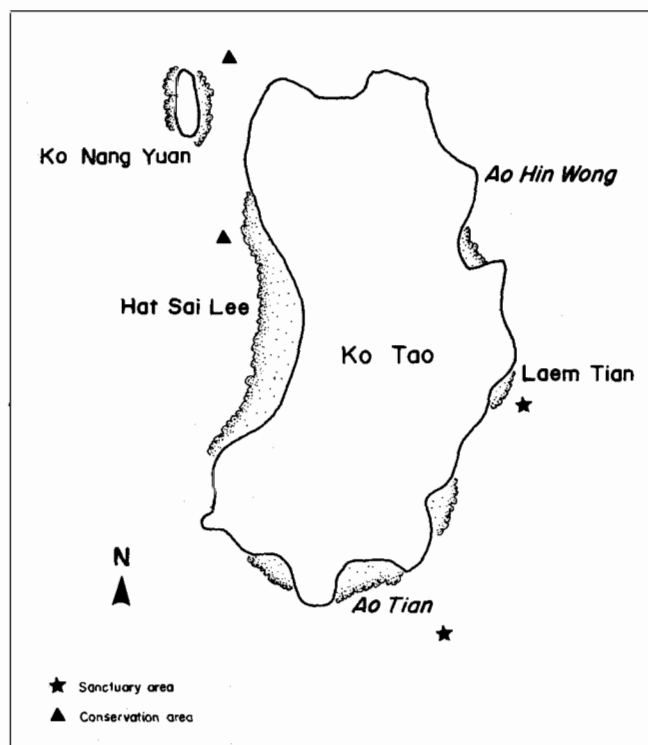


Fig. 9.7. Coral reef zoning and management scheme for Ko Tao.



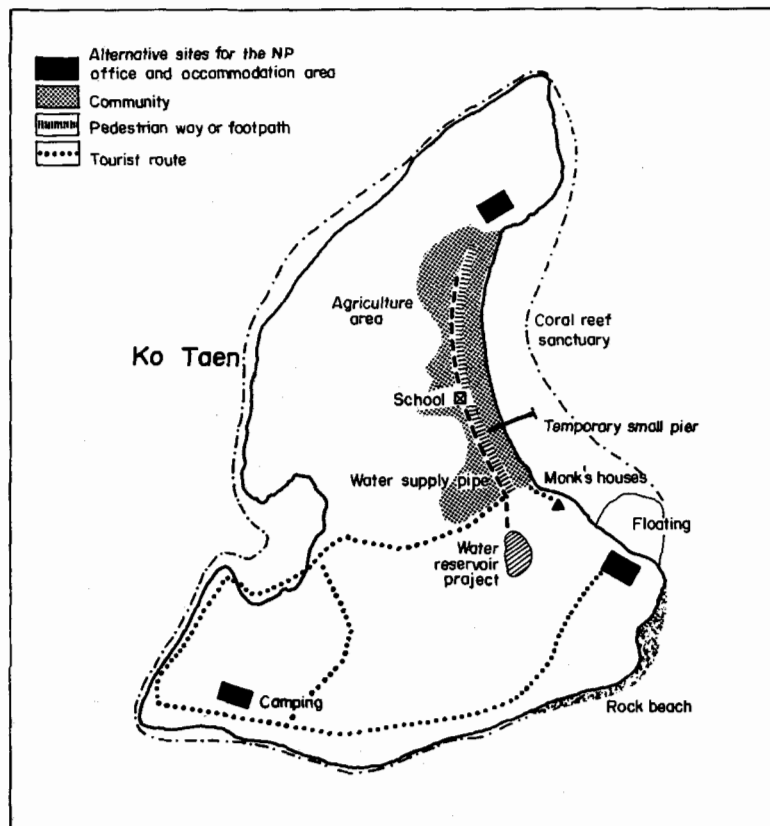


Fig. 9.8. Geography and important landmarks of Ko Taen.

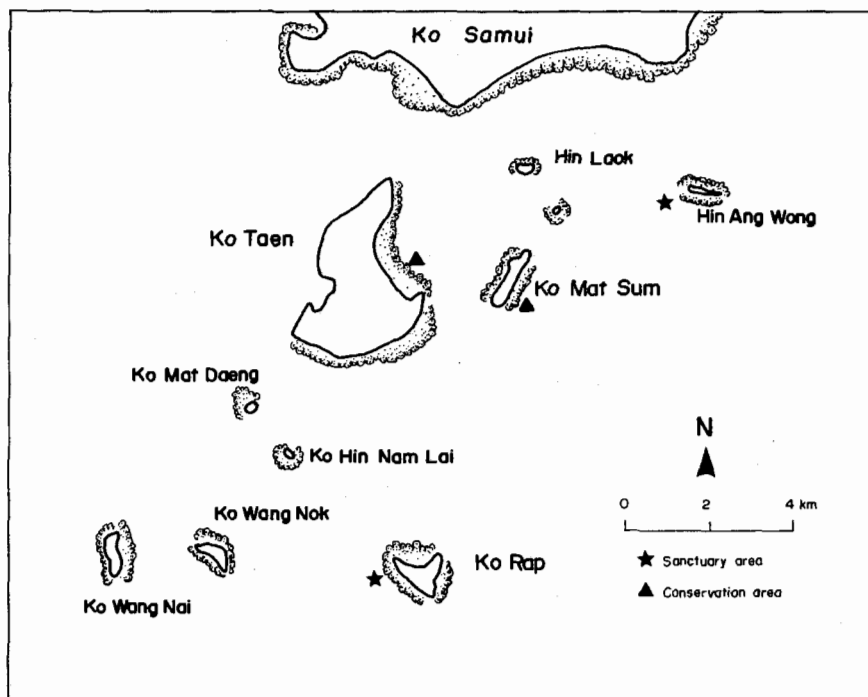


Fig. 9.9. Coral reef zoning and management scheme for Ko Taen and the Southern Islands.

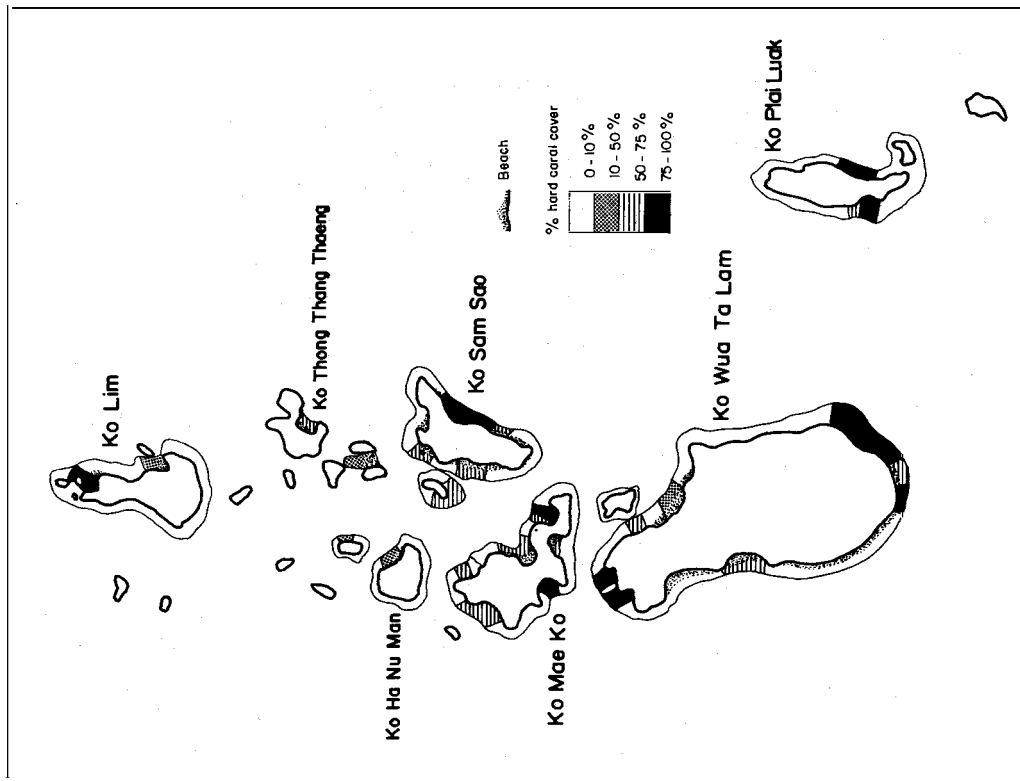


Fig. 9.10. Coral reef quality and beaches on Mu Ko Ang Thong NMP (Sudara et al. 1989b).

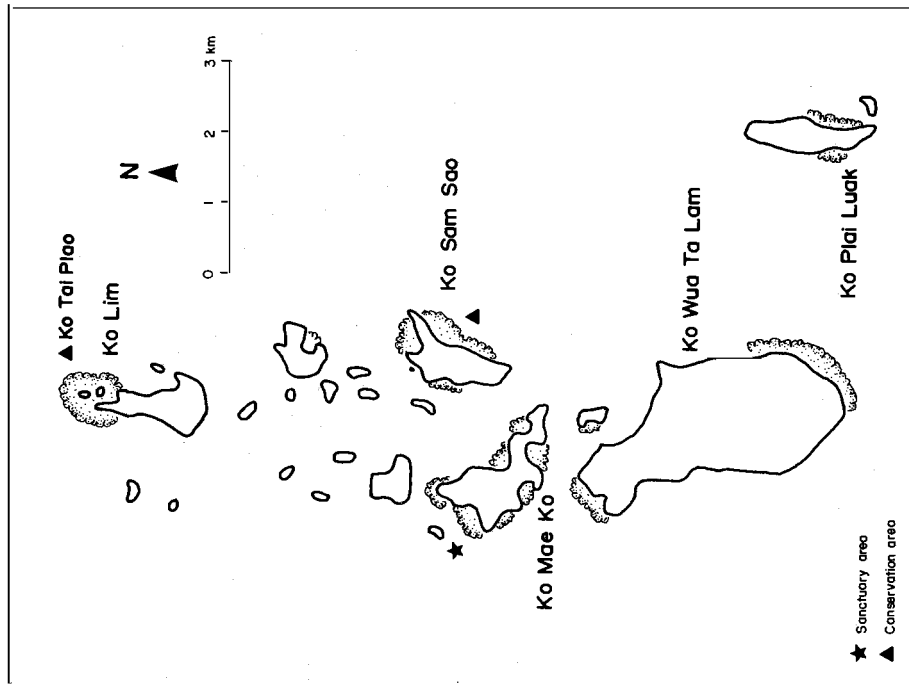


Fig. 9.11. Coral reef zoning and management scheme for Mu Ko Ang Thong NMP.

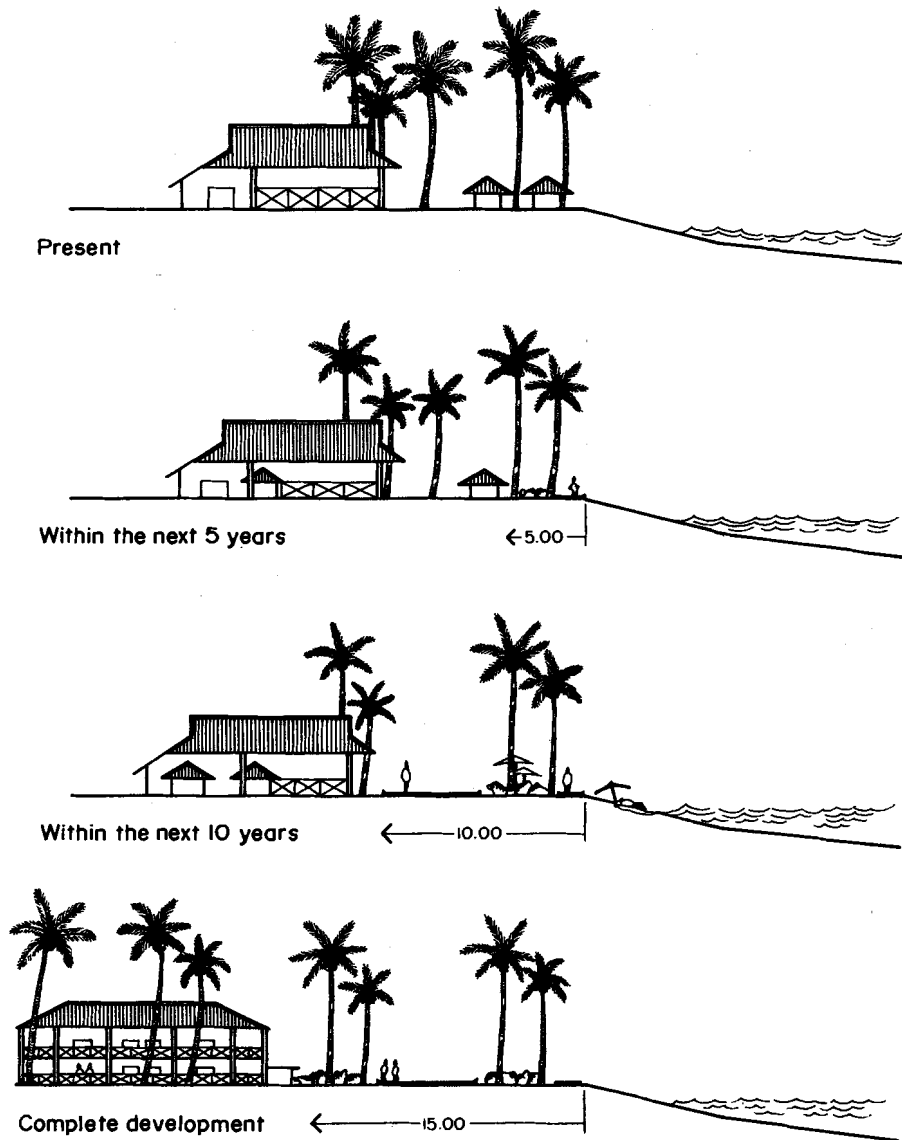


Fig. 9.12. Beach setback phasing (m) recommended by TAT (TISTR 1985).

3. Request MOI to issue a set of regulations under BCCA requiring all resort owners to install wastewater treatment systems as decided at the island level which will be coordinated by ITF, TBA and SD.
4. Offer incentives to resort owners who contribute to the costs of the installation of wastewater treatment systems and soil erosion control mechanisms by direct payment.

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5. Designate solid waste disposal sites; organize a means for collecting trash; build incinerators; and provide waste containers in cooperation with resorts and shoreline communities in prime beach and tourist areas. Make these community activities to be facilitated by ITF, SD and private beach clubs, with the provision of economic incentives.
6. Organize small bay associations to implement beach management systems and monitor the change in water quality. The most popular areas should be given priority as these are likely to be the most subjected to environmental damage.

### **Socioeconomic and Cultural Concerns**

#### **Strategy 3**

Provide incentives to the locally owned and controlled small-scale tourism industry.

#### **Actions**

1. Arrange for TBA representation in ITF once it is formed.
2. Determine appropriate support and incentives to help distribute income from tourism at the island level through meetings and a workshop which will define the exact problems and possible solutions.
3. Encourage the use of locally produced products and services in tourism (e.g., crops, prepared food, motorcycle hire, guides and boats) through better advertisements and marketing channels.
4. Request consideration of tax incentives for small resorts which implement environmental protection programs and lobby for policies to favor locally controlled small resorts coexisting with the larger, off-island-owned resorts.

#### **Strategy 4**

Formulate and publicize acceptable codes of conduct for tourists.

#### **Actions**

1. Survey the various islands' social and economic strata to determine traditional and cultural values of concern to the people and the appropriate solutions, if any, to the problem of cultural displacement.
2. Agree on the codes of conduct for tourists to the islands through CBOs and ITF.

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3. Publicize codes of conduct for tourists in a manner which explains why they are important, while also informing them about disciplinary actions, if necessary.

### **Strategy 5**

Assert and promote the right of public access to beaches.

### **Actions**

1. Investigate present public access arrangements, identify points where access should be available and make arrangements with developers for public access to beaches through ITF and TBA.
2. Publicize the public's right of access to beaches through ONEB news releases or brochures, perhaps with a beach conservation message.
3. Create signs with a common logo informing the public of access routes from the Ko Samui main road through LG.
4. Investigate the possibility of reserving Hat Phra Nang as a public beach and reserving the adjacent area as a historical park through a committee set up by the Fine Arts Department and ONEB.

## **Legal, Institutional and Administrative Issues**

### **Strategy 6**

Improve law enforcement.

### **Actions**

1. Pass a Ministerial Notification under the Fisheries Act to prohibit fishing methods which damage the reef and the dropping of boat anchors on live coral areas.
2. Provide the Mu Ko Ang Thong NMP staff with radio communications and at least one additional boat.
3. Continue to promote better communication and cooperation among DOF, NPD and the marine police. The NPD office and the marine police in Ban Don Bay in a recent policy allowed DOF officers and two marine police to act as NPD officers.
4. Review the Fisheries Act and NPA to determine if the burden of proof could be removed from DOF and NPD staff, thus making it unnecessary to catch offenders in the act.

## **Chapter 9. Tourism Action Plan (Islands and Coral Reefs)**

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5. Regulate purse seining within the 3-km limit for catching anchovy.
6. Increase the flexibility of park and fisheries administrative procedures in the field so that illegal fishers could have their licenses revoked by the officer-in-charge.
7. Amend NPA to include the promotion of park management plan development and revision at the park level by the field staff and the addition of scientific criteria on park selection, designation and the setting of boundaries which are relevant to marine areas.
8. Extend the Mu Ko Ang Thong NMP boundary to include Ko Tao and Ko Taen or to give these sites "preservation fisheries" status under Sections 7-9 of the Fisheries Act. Give the local people assistance, training and support to manage the reef areas.
9. Include the coral reef and related habitat protection and management policies in the Seventh NESDP.
10. Convene a panel of experts to decide if coral collection and sale should be prohibited or allowed to continue as a cottage industry. If the latter is chosen, designate specific areas where coral collection may be done.

### **Strategy 7**

Synthesize and draft all regulations by a special committee.

### **Actions**

1. Form a special and short-term legal aid group of three persons based in ONEB who are familiar with the legal aspects of environmental management as applied under DOF, TAT, NPD, MOI and PG in the islands.
2. Draft the necessary amendments to the appropriate legal acts in cooperation with ITF.
3. Pursue with vigor the acceptance of these legal amendments at the provincial and, if necessary, the national levels.

### **Strategy 8**

Set up local guidelines for controlling the planning and impact of tourist facilities and operations.

### **Actions**

1. Strengthen TBA with the assistance of ITF and in cooperation with TAT, LG and PG.
2. Synthesize guidelines for construction, waste disposal, tourist activities and conduct, and other environmental concerns as agreed upon with the

## **Chapter 9. Tourism Action Plan (Islands and Coral Reefs)**

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local tourist operators, publicize these guidelines and conduct workshops and seminars to inform the local operators about their implementation.

3. Formalize cooperation among TAT, DOF, NPD, CBOs, LG and PG to facilitate environmental and tourist management of the islands.
4. Strengthen promotion, publicity and support by TAT and other agencies for CRM in relation to tourism promotion until the capacity for environmental planning and management and for controlling tourist development and activities is improved.
5. Support and strengthen SD through training, improving regulations, setting up field examples and financing waste disposal plans implementation.

### **Strategy 9**

Provide training for government personnel and nongovernment representatives from the tourist sector on CRM and appropriate resort development.

### **Actions**

1. Conduct a series of training courses on coastal resource planning and management, which will systematically involve the appropriate personnel from LG and PG and nongovernment groups and which will be held on Ko Samui for a period of at least two years.
2. Conduct a series of training courses for all resort owners and/or their representatives on the technical aspects of implementing acceptable waste treatment facilities, controlling soil erosion during construction or otherwise, disposing of solid wastes, and assisting in the maintenance of the nearshore zonation scheme for coral reefs and related habitats.

### **Education and Public Awareness**

### **Strategy 10**

Implement a public education program on CRM.

### **Actions**

1. Conduct four seminars per year on the islands to educate the people about island ecology and CRM in cooperation with the local communities and facilitated by ITF and provincial and national agencies.
2. Conduct special monthly seminars in areas where problems, i.e., waste disposal, soil erosion or reef destruction, occur.

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3. Initiate a study involving local participants, which will evaluate the economic role of coastal environments supporting tourism and other island livelihoods, the results of which will be disseminated periodically to the local residents and tourists.
4. Incorporate conservation principles in the local school curriculum.
5. Establish a tourist information and island conservation center on Ko Samui which will develop and distribute brochures.

### **PROJECTS FOR IMPLEMENTATION**

Three area-specific projects will be used to implement the overall strategies and actions. Ko Phangan Community-based Resource Management and Ko Taen Marine Reserve are similar in nature. They will both provide pilot sites to implement the basic objectives of the action plan at the community level. These two projects will fully implement Strategies 1-5 and 8-10 as they pertain to those sites. Ko Samui Shoreline Management, Education and Overall Plan Coordination focuses on the problems of using the shoreline and nearshore areas for tourism, taking into account the perspectives of the island's residents, the district government and the resort owners dependent on the island's coast. It will initially focus on particular sites designated for zonation in Strategy 1 and the beach/bay management areas suggested in Strategy 2. It will also implement Strategies 3-10 as they apply to the Ko Samui pilot project.

The specific recommendations for the Mu Ko Ang Thong NMP should be carried out by the park service in cooperation with the Ko Samui ITF, DOF and the marine police.

#### **PROJECT 1: Ko Phangan community-based resource management.**

### **Background**

During the past decade, Thailand has undergone rapid, largely unplanned tourist development in several coastal areas such as Pattaya, Phuket and Ko Samui. Associated environmental problems are becoming apparent, e.g., declining water quality, coral reef degradation, beach erosion and pollution (see Chapter 4).

Tourism on Ko Phangan is highly dependent on a pristine environment and the efforts of the residents to develop tourism. Yet the residents have neither the expertise nor the financial resources to embark on a sustainable development program.



*The priority need at Ko Phangan is to link tourism development with the appropriate use and conservation of coastal resources.*

The priority need at Ko Phangan, therefore, is to link tourism development with the appropriate use and conservation of coastal resources. This effort will require on-the-ground, intensive assistance from experts through the establishment of a pilot project. Support for such a project will encourage the decisionmaking process to affect development rather than be affected by development. It will encourage proactive rather than reactive decisionmaking, which can prevent many of the problems now being experienced at other coastal resort areas.

Projects of a similar design have been successful in Thailand and the Philippines. Near Khao Yai NP in Thailand, community-based action has achieved conservation and an improved livelihood for the local people consistent with park management. In the southern Philippines, several small island communities manage their marine resources in a manner consistent with sustainable fishing and increasing tourism (White and Savina 1987). In both of these cases, NGOs have played prominent roles in creating site-specific formulas where the local people actively participated in and benefited from development projects. The Ko Phangan project should adopt this approach.

### **Objectives and benefits**

This project will demonstrate how community action can carry out a program for coastal environmental improvement applicable to the needs of tourism development on the island. It will provide a useful model that may be replicated in other areas where communities can take responsibility for managing their own resources with minimal support from outside agencies and the government. This project aims to:

1. Implement the nearshore habitat zonation plan for Ko Phangan (Strategy 1).
2. Implement actions to address improper wastewater and solid waste disposal, minimize soil erosion from resort constructions and other structures, and implement regulations for setbacks and aesthetics of shoreline use and beach management (Strategy 2).
3. Provide education and training in tourism development and management, marine conservation, management of nearshore habitats for tourism and fishing, and alternative economic activities (Strategy 9).
4. Promote and use nearshore habitats for tourism and traditional uses to sustain and improve income.
5. Promote alternative economic activities, e.g., handicraft production, aquaculture, vegetable cultivation, and other activities to supply essential commodities to the tourism industry.

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6. Develop infrastructure to support the implementation of field management through a community center, small boats, buoys, signs and small-scale wastewater processing equipment.

Benefits accruing to the local community, province and country will include:

1. collection of long-term revenues from appropriate and sustainable tourism development with minimal national investment;
2. management of coral reefs, beaches and coastal areas for multiple uses without degrading the environment or impairing ecological functions;
3. substantial local control over tourism resources by means of community participation;
4. improved appreciation for the quality of the environment among locals and tourists;
5. elimination of destructive fishing and damage to the nearshore environment by activities on land;
6. establishment of several shoreline and coral reef sanctuaries where no fishing or collecting is allowed; this will allow fish diversity and abundance to increase and coral reef quality to improve within two years to enhance adjacent areas; and
7. establishment of conservation and development areas adjacent to the sanctuaries where multiple uses, e.g., traditional fishing, diving, snorkeling, educational and other recreational activities, are permitted but controlled by the community.

### **Description**

The project will establish CBOs in the targeted villages. The membership will elect from its ranks an executive committee with decisionmaking authority. Outside agencies with expertise in community development, tourism and marine management will provide guidance and training to CBO. Two or more full-time fieldworkers will be based at the site to facilitate all project activities and guide the formation of CBO.

The CBO activities will be financed by the project and managed by ITF. The CBO will be based either at an existing community meeting place or at a community center to be built by the villagers with the project's funds.

Specific goals and activities initiated through CBO will be identified during the joint consultation between CBO members and cooperating agencies.

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### Phasing of activities

1. Set up an administrative structure with a project office on Ko Samui and representatives from agencies which will coordinate in the project's implementation on Ko Phangan.
2. Identify and hire fieldworkers who will assist in site reconnaissance and complete a detailed workplan for two years.
3. Identify specific village sites where the project will operate and contact village and island leaders who will cooperate and assist in the implementation.
4. Refine the workplan and budget, and coordinate with the island and provincial agencies who can support the implementation.
5. Begin implementation with monthly meetings of project staff and quarterly reporting to the implementing agencies.

### Agencies and administration

The lead agency is ONEB while the coordinating and administrative agency should be an NGO such as PCDA. It will be contracted by ONEB or MOI, as appropriate, to execute the project. This agency will coordinate with the Ko Phangan District Office. An office on Ko Samui should be the base for ITF which will facilitate all the plan's activities and serve as a liaison with the appropriate government agencies and the communities involved. The other government agencies instrumental in the project will be TAT, DOF and PG. The Department of Marine Science at Chulalongkorn University can provide research support on the marine management component.

### Budget

The budget will be in addition to the central plan budget necessary to coordinate the other projects, ITF and general strategy implementation.

Item	Two-year cost (\$)
Personnel services	40,000
Travel and per diem	10,000
Education and training	15,000
Infrastructure and equipment	35,000
Overhead	20,000
Total	120,000

### PROJECT 2: Ko Taen community marine reserve.

### Background

The background for the Ko Phangan project is applicable to the Ko Taen Marine Reserve project, except that the construction of tourist facilities on Ko

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*In Ko Taen, the village headman has already built a base of support for protecting coral reefs and beaches.*

Taen has not yet started. At present, there are only day visitors to Ko Taen and surrounding islands who are attracted by the coral reefs and beaches. The site harbors the best quality coral reefs in the Gulf of Thailand. The water quality is also better than at any other location in Ban Don Bay because it is to the south of the bay, so that the sediments which generally move east and north do not affect the area.

Quite often, the success of this type of project depends on the quality of the leadership available. The village headman of Ko Taen, using his strong influence with the people in the area, has already built a base of support for protecting coral reefs and beaches. The headman has facilitated the formation of a local conservation club to manage the marine areas for nondestructive uses and sustainable fishing and tourism. These efforts have already been recognized by ONEB, URI's Coastal Resources Center and ASEAN/US CRMP. All have recommended that direct assistance be given to the village to promote the efforts started. Since these links have already been made and strong local interest displayed, Ko Taen is a logical project site.

### **Objectives and benefits**

This project will demonstrate how a community can carry out programs of marine conservation for its tourism's benefit by having access to good quality coral reef areas. This project aims to:

1. Implement the nearshore habitat zonation plan for Ko Taen and surrounding islands (Strategies 1 and 2).
2. Provide education and training in tourism-related development and management, marine conservation and the management of nearshore habitats for tourism and fishing (Strategy 9).
3. Promote and use nearshore habitats for tourism and other traditional uses to sustain and improve income.
4. Develop infrastructure to support the implementation of field management; establish a community center and obtain small boats, buoys, signs and small beach huts for day visitors to the island.

Benefits accruing to the local community, province and the country will include:

1. provision for long-term revenues from the preservation of a pristine coral reef close to Ko Samui to be managed by the local community without cost to the provincial or national governments;
2. protection of pristine coral reef, good beaches and an island environment for multiple uses without degrading environmental or ecological functions;

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3. enhancement of revenues from fisheries and tourist visitations to the local community;
4. local control and maintenance of marine resources by means of community participation; and
5. elimination of destructive fishing and damage to the marine habitats by land-based development.

### **Description**

This project will be organized in a manner similar to the Ko Phangan project. Activities will center on a CBO which has already been formed by the village headman. The CBO on Ko Taen will be assisted by two full-time fieldworkers assigned to the site. The focus of their work will be to help the CBO organize and implement the zonation scheme for Ko Taen and surrounding islands and to conduct training which will improve the ability of the CBO to manage the coral reef and beach areas.

Specific goals and activities initiated through CBO will be identified during joint consultations between CBO members and LG.

### **Phasing of activities**

1. Set up an administrative structure with a project office on Ko Samui and representatives from the agencies which will coordinate in the project's implementation on Ko Taen.
2. Hold the initial meeting with the community leaders and CBO at the site to discuss the project and its objectives.
3. Identify and hire fieldworkers who will assist in site reconnaissance and complete a detailed workplan for two years.
4. Refine the workplan and budget after all initial contacts with the community and outside assisting agencies have been made.
5. Begin implementation with monthly meetings of project staff and quarterly reporting to the implementing agencies.

### **Agencies and administration**

The lead agency is ONEB and the administrative agency should preferably be PCDA. Coordination with the Ko Samui District Office and ITF will be necessary for this project. The same government agencies will also be involved.

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### Budget

The estimated budget will be in addition to the central plan budget.

Item	Two-year cost (\$)
Personnel services (fieldworkers)	25,000
Travel and per diem	5,000
Education and training	10,000
Infrastructure and equipment	25,000
Overhead	<u>15,000</u>
Total	80,000

**PROJECT 3: Ko Samui shoreline management, education and overall plan coordination.**

### Background

New investors are buying out Ko Samui's local resort owners. Those locals who are not selling are unable to compete with outside management skills and finances. Yet environmental protection and resource management remain a low priority and there is no organized means to deal with these needs. Thus, soil erosion, pollution, coral reef degradation and haphazard building continue at an increasing rate without any government or nongovernment organization taking control.

There is much reparation work to be done to mitigate the damage already incurred, but it is still at a scale which can be managed by resort owners, residents and the government. If support is given to facilitate the actions necessary to deal with poor planning and environmental degradation, the situation can be reversed. This project offers a means to ensure sustainability. It could make Ko Samui a prototype.

The Ko Samui SD is not effective in addressing the issues of wastewater and solid waste disposal. A TBA has been formed, but it is only beginning to discuss solutions to some of the resource management, socioeconomic and education/awareness problems of tourism development. These groups want and need to improve their effectiveness in addressing the issues, but have not yet been given adequate support and are lacking creative approaches in finding solutions.

### Objectives and benefits

This project aims to manage the nearshore and onshore island environments in a manner consistent with long-term use in selected areas on Ko Samui. It will implement all the plan's strategies and serve as a model for the projects on Ko Phangan and Ko Taen by setting up ITF and the necessary linkages with local and national government agencies.

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*Ko Samui's onshore activities need to be managed so that the impacts on water quality are minimized and environmental awareness improved.*

In contrast to the two community-based projects on Ko Phangan and Ko Taen, this project will focus on managing onshore tourist activities and construction, so that the impacts on water quality and beaches are minimized and environmental awareness and organization among the island tourist operators is improved. The project will organize the activities of the private and LG sectors in shoreline planning on Ko Samui. It will coordinate a comprehensive education program to facilitate the implementation of the general tourist resource management plan.

Project benefits will accrue to the island residents, resort owners and the national economy. Specific benefits and outputs are:

1. implementation of the zonation and management schemes for coral reefs and beaches (Strategies 1 and 2);
2. coral reef and beach stabilization and protection, which will allow long-term nondestructive uses;
3. establishment of practical guidelines for water quality management on the island, as decided by local tourism businesses and residents;
4. management of recreation so that it is not detrimental to beach and reef conservation;
5. improved distribution of benefits arising from tourism through the involvement of local organizations;
6. greater awareness and appreciation of the benefits to be obtained from shoreline and marine resource management;
7. greater understanding of the impact of tourism on cultural and traditional values so that more caution can be taken in protecting some of these values;
8. maintenance of public access to beach areas and minimized likelihood of public tourist friction on this issue;
9. improved legal and institutional support for tourism resource management of the islands; and
10. improved management skills among LG and NGO officials in environmental management and the control of tourism development's impact on the shoreline environment.

### **Description**

An ITF will be formed which will operate autonomously to encourage proper organization and cooperation among island groups, and between national agencies and the island groups to achieve the plan's goals.

*The island task force will serve as an administrative and coordinating body and provide technical advice on shoreline management.*

The ITF will be composed of three full-time professionals who will fill the roles of coordinator/administrator, marine resource and coastal management specialist and community organizer/educator. In addition, there will be seven part-time members who will represent each government and nongovernment agency on the island and in the province, with two other representatives from the local communities. The ITF will serve as an administrative and coordinating body, which will also provide technical advice on the various shoreline management problems. It will be a catalyst in the process of organizing communities and generating support from island residents and resort owners as well as linking government agencies.

Once the administrative structure is in place and specific workplans have been finalized, pilot areas on Ko Samui will be chosen for a more direct implementation of the objectives set forth under the zonation scheme (Strategy 1) for coral reefs and water quality (Strategy 2) and the beaches on the island. Nevertheless, the whole island will be targeting to meet the broader objectives of improving its socioeconomic situation, addressing legal and institutional problems, and developing adequate training and educational opportunities to enhance resource management.

#### **Phasing of activities**

1. Set up the administrative structure of ITF on Ko Samui in cooperation with the district office and PG with representatives from TAT, DOF, MOI and ONEB.
2. Organize a project office on Ko Samui which will serve as a coordinating unit for all the plan implementation activities.
3. Hire fieldworkers who will assist in site reconnaissance and make a detailed workplan for two years with its community groups and district governor.
4. Identify the specific field pilot sites based on the interest of the communities and the sites recommended as conservation areas.
5. Begin implementation of all activities.

#### **Agencies and administration**

The lead agency is ONEB and the administrative agency should be an NGO, e.g., PCDA, which should work closely with the Ko Samui District Office and PG. Other agencies and links are described in the general plan and community-based projects for Ko Phangan and Ko Taen.

#### **Budget**

The estimated budget for this project will cover all the administrative expenses, including those of the Ko Taen and Ko Phangan projects. The ITF



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and office expenses are included since Ko Samui will be the center of operation.

Item	Two-year cost (\$)
Personnel services	
1 coordinator/administrator	100,000
1 marine resource and coastal management specialist	100,000
1 community organizer/educator	100,000
9 liaison officers	4,000
3 fieldworkers	40,000
Travel and per diem	50,000
Education and training	40,000
Infrastructure and equipment	50,000
Overhead	<u>40,000</u>
Total	524,000

### PLAN IMPLEMENTATION

*The crux of the action plan is coordination among various existing organizations at the district or island and provincial and national levels of government.*

This plan is designed to be implemented by an autonomous organization formed explicitly for this purpose. The crux of the plan is coordination among various existing organizations at the district or island and provincial and national levels of government. The plan also promotes the participation of coastal residents, resort owners and local private and government groups in the strategies. Given this general approach to the implementation which involves all these groups at various levels of government and nongovernment, it is suggested that ITF be set up to coordinate and administer the project and to involve all the participants as facilitators.

The ITF will need an umbrella organization to work under which, on the one hand, will advise ITF and, on the other, will channel funding from the central government or international sources and serve as an overall project administrator and accountant. The Department of Technical and Economic Cooperation or ONEB should be the starting point for funding, which will originate from a foreign donor. National support should originate from the ministerial level, such as MOI or MSTE. Given the type of logistical and technical support required by ITF, it is suggested that the umbrella organization be one that has technical expertise in community-level work and is well versed in coordinating a variety of participants to achieve the goals of coastal management.

An NGO like PCDA would be appropriate to administer and coordinate these projects. The PCDA has extensive experience in administering rural health projects in Thailand and has been very successful in gaining the support of government and nongovernment sectors. It is based in Ko Samui and

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is interested in expanding into resource management through community participation.

Once the implementing agency is chosen and ITF is formed, most of the working relationships necessary to implement the plan will occur at the island level, as described in the plan's strategies and projects. The ITF will coordinate with the district offices on Ko Samui and Ko Phangan and SD on Ko Samui. It will also work with the resort owners' association on Ko Samui and any other private groups formed to implement the plan's objectives for Ko Phangan and Ko Taen. The ITF, in conjunction with the executing organization, will elicit the cooperation of DOF, TAT and NPD when needed to assist in the implementation of the various components. These agencies will also be represented on ITF and the periodic meetings at the ITF office on Ko Samui.

This chapter has presented recommendations, strategies and actions as well as priority projects for coral reef conservation and island management. The tourism action plan's budget requirement is \$524,000. Chapter 10 discusses the plan's implementation arrangements.

## CHAPTER 10

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# IMPLEMENTATION ARRANGEMENTS

The operational and institutional arrangements vital to the successful implementation of the management plan are public participation, project funding, plan coordination and M&E.

### PUBLIC PARTICIPATION

Experience in the field of resource management suggests that the participation of the local residents from a project's target area is a requisite for success since they are often the *de facto* resource managers.

Public education and the provision of adequate information to the public are important aspects of public participation. Also important is the public's need to express preferences regarding activities which may affect their livelihood. To some extent, this has already taken place at the various project workshops held in Surat Thani and Phangnga and later in Pattaya. This dialogue with the public should be continued and strengthened.

### PROJECT FUNDING

The management plan has been integrated with other CZM projects under ONEB's coordination, namely, CRMP-Thailand (University of Rhode Island) and the ASEAN-Australia Cooperative Programme on Marine Science, which produced the "National policy, measures and action plans for coastal resources management of Thailand". The plans received Cabinet approval on 17 February 1992 and were allocated a budget of approximately \$117 million for the 1993-1994 implementation of urgent measures on mitigation and protection of coastal resources.

### PLAN COORDINATION, MONITORING AND EVALUATION

The plan calls for support by a wide range of government ministries and agencies at the local, provincial and national levels and is designed to enable the local communities to participate fully in the process of refining the various projects and implementing them (Table A.2). Therefore, it is necessary that a single body acts as a coordinating unit to carry out M&E and ensure that there is ample cross-sectoral review and an adequate exchange of information. It is recommended that ONEB be vested with this role as it has, in effect, been performing it until now. It is then suggested that ONEB creates project implementation groups consisting of:

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- ONEB;
- representatives of other central government agencies involved in the plan's implementation;
- LG and PG representatives;
- representatives of local community groups or organizations; and
- representatives of NGOs mentioned in the plan.

Each group should refine the project profile until all participants are clear about and agree on the project's objectives, its scope and component steps, how the budget will be spent, the timetable and their role in the project's implementation.

### **CONCLUSION**

Public awareness of the problem facing Thailand's coastal resources has probably never been so widespread as at present. This has been due in part to the more or less regular and informed coverage of the subject in the country's mass media. The ONEB wisely began to implement specific projects during the period that CRM plans were being formulated for Phuket and the Upper South; in the latter case, public education programs on corals and mangroves have already been implemented and numerous buoys for boat mooring and guidance have already been installed at Ko Taen in Ban Don Bay. Such a momentum should be maintained by the responsible agencies by devoting as much time and effort to the implementation of the projects outlined here.

## REFERENCES

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- Aksornkoe, S., S. Wacharakitti, A. Eiumnoh, W. Srisawatt, R. Onsanit, S. Panichchart, V. Jintana, C. Khemnark, J. Kongsangchai, S. Panichsuko, S. Mooksombat, S. Havanond, N. Thammachote and P. Sanguantham. 1988. Evaluation of mangrove development potential of Phangnga and Ban Don Bays for coastal zone management, Thailand. Office of the National Environment Board, Bangkok, Thailand. (Unpublished).
- Baker, I. 1988. The management of coral resources in Ban Don Bay: some policy issues. Office of the National Environment Board, Bangkok.
- Bunpapong, S. 1989. Ban Don Bay, Thailand: coastal resources management issues and planning. Paper presented at the Coastal Zone '89, July 1989. Charleston, South Carolina.
- Bunpapong S. and J.N. Paw. 1988. The Upper South: physical setting and land use, p. 1-9. *In* J.N. Paw, S. Bunpapong, A.T. White and M.S.M. Sadorra (eds.) The coastal environmental profile of Ban Don Bay and Phangnga Bay, Thailand. ICLARM Tech. Rep. 20, 78 p.
- DANIDA (Danish International Development Agency). 1986. National oil spill contingency plan. Government of Thailand, Thailand.
- Dobias, R.J. 1991. Management of coastal tourism resources at Ban Don Bay, Surat Thani Province, Thailand, p. 395-404. *In* L.M. Chou, T.-E. Chua, H.W. Khoo, P.E. Lim, J.N. Paw, G.T. Silvestre, M.J. Valencia, A.T. White and P.K. Wong (eds.) Towards an integrated management of tropical coastal resources. ICLARM Conf. Proc. 22, 455 p.
- Dobias, R.J. and A.T. White. 1988. Island resources management, Ban Don Bay, Thailand. *Trop. Coast. Area Manage.* 3(2): 14-16.
- Dobias, R.J., S. Tirasattayapituk, P. Chamchamras and R. Pichatwattana. 1988. Management of coastal tourism resources at Ban Don Bay. Office of the National Environment Board, Bangkok.
- JICA (Japan International Cooperation Agency). 1985. The subregional development study of the Upper Southern part of Thailand. Japan International Cooperation Agency for National Economic and Social Development Board, Bangkok, Thailand.
- Kositratana, N. 1988. Surface water resources, p. 10-13. *In* J.N. Paw, S. Bunpapong, A.T. White and M.S.M. Sadorra (eds.) The coastal environmental profile of Ban Don Bay and Phangnga Bay, Thailand. ICLARM Tech. Rep. 20, 78 p.
- Kositratana, N. and S. Kajornatiyudh. 1988. Land-based pollution, Upper South, Thailand. *Trop. Coast. Area Manage.* 3(3): 10-13.
- Laksakundilok, A. 1990. Beach resources mapping, documentation, planning and management recommendation for the islands of Ban Don Bay, Surat Thani. Office of the National Environment Board, Bangkok.
- Lemay, M.H. and H. Chansang. 1988. A coral reef protection strategy for Phuket and surrounding islands. The University of Rhode Island and United States Agency for International Development Coastal Resources Management Project, Bangkok.
- Lohsawatkul, S. 1988. Fisheries, p. 30-32. *In* J.N. Paw, S. Bunpapong, A.T. White and M.S.M. Sadorra (eds.) The coastal environmental profile of Ban Don Bay and Phangnga Bay, Thailand. ICLARM Tech. Rep. 20, 78 p.
- MOAC (Ministry of Agriculture and Cooperatives). 1989. Agricultural statistics of Thailand: crop year 1988-1989.
- NESDB (National Economic and Social Development Board). 1988. The Upper South region development program. National Economic and Social Development Board, Bangkok, Thailand.
- NESDB (National Economic and Social Development Board). 1989. Gross regional and provincial product 1981-1987. National Accounts Office, National Economic and Social Development Board, Bangkok, Thailand.
- Ngampongsai, C. 1988. Wildlife and protected areas, p. 26-29. *In* J.N. Paw, S. Bunpapong, A.T. White and M.S.M. Sadorra (eds.) The coastal environmental profile of Ban Don Bay and Phangnga Bay, Thailand. ICLARM Tech. Rep. 20, 78 p.
- ONEB (Office of the National Environment Board). 1981. National policies and measures on environmental development. Office of the National Environment Board, Bangkok, Thailand.
- Paw, J.N., S. Bunpapong, A.T. White and M.S.M. Sadorra, editors. 1988. The coastal environmental profile of Ban Don Bay and Phangnga Bay, Thailand. ICLARM Tech. Rep. 20, 78 p.

## References

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- RTG (Royal Thai Government). 1987. The sixth national economic and social development plan 1987-1991. National Economic and Social Development Board, Office of the Prime Minister, Bangkok, Thailand.
- Setamanit, S. 1987. Environmental aspects of development planning: a Thai experience. Thailand Development Research Institute, Thailand.
- Sudara, S., T. Thamringnawasawat, S. Nateekanjanalarp and P. Kuanman. 1989a. Coral reef management plan for conservation and tourism development in the areas of Ang Thong, Samui and Phangan Islands, West Coast of the Gulf of Thailand. Department of Marine Science, Chulalongkorn University, Bangkok. (Unpublished).
- Sudara, S., T. Thamringnawasawat and O. Patmanukasaem. 1989b. Tourism economic gain in the vicinity of Samui and Phangan Islands. Department of Marine Science, Chulalongkorn University, Bangkok. (Unpublished).
- TDRI (Thailand Development Research Institute). 1987. Thailand natural resources profile. Thailand Development Research Institute, Thailand.
- TISTR (Thailand Institute of Scientific and Technological Research). 1985. Master plan for tourism development of Ko Samui, Surat Thani. Tourism Authority of Thailand, Bangkok.
- TISTR (Thailand Institute of Scientific and Technological Research). 1988. Summary: a study on carrying capacity for tourism development of Ko Samui. Tourism Authority of Thailand, Bangkok.
- Vijarnsorn, P. 1988. Soils, p. 17-19. In J.N. Paw, S. Bunpapong, A.T. White and M.S.M. Sadorra (eds.) The coastal environmental profile of Ban Don Bay and Phangnga Bay, Thailand. ICLARM Tech. Rep. 20, 78 p.
- Vijarnsorn, P. 1991. Land zonation for appropriate land use in Phangnga and Ban Don Bays, Upper South, Thailand, p. 438. In L.M. Chou, T.-E. Chua, H.W. Khoo, P.E. Lim, J.N. Paw, G.T. Silvestre, M.J. Valencia, A.T. White and P.K. Wong (eds.) Towards an integrated management of tropical coastal resources. ICLARM Conf. Proc. 22, 455 p.
- White, A.T. and G.C. Savina. 1987. Community-based marine reserves: a Philippine first, p. 2022-2036. In Proceedings of Coastal Zone '87, 26-30 May. Seattle, Washington.

## APPENDIX

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List of CRMP technical reports.

Task code	Task leader	Title of report
210	Mr. Yodchai Karnasuta	Coastal aquaculture Coastal aquaculture (Annex)
230	Mr. Somporn Lohsawatkul	Natural marine resources survey in Ban Don Bay Natural marine resources survey in Phangnga Bay (in Thai)
240	Dr. Manuwadi Hungspreugs	Assessment of the coastal environment of Ban Don Bay
250	Mr. Prawin Limpsaichol	Coastal environment of Phangnga Bay Guidelines for the environmental management of Phangnga Bay
260	Ms. Nisakorn Kositratana	Land-based pollution study/pollution control from coastal zone development Volume 1 A (Technical Report) Volume 1 B (Annex) Volume 2 (Executive Summary and Management Plan)
270	Dr. Sanit Aksornkoae	Evaluation of mangrove development potential of Phangnga and Ban Don Bays for coastal zone management, Thailand
280	Dr. Choompol Ngampongsai	Wildlife resources of Ban Don Bay Wildlife resources of Phangnga Bay
290	Dr. Pisoot Vijarnsorn	Evaluation of land capability use development potentials
310	Dr. Subarn Panvisavas	Knowledge, attitudes and behavior of villagers and business people on natural resource conservation and the government program for tourism promotion, Samui Island District, Surat Thani Province (in Thai) Administration and management of the Upper South Region coastal resources associated with tourism: a case study of Surat Thani Province (in Thai) Mangrove deforestation and uses in Ban Don Bay, Thailand (in Thai)
320	Dr. Subarn Panvisavas	A plan for the utilization of natural resources in Ban Don Bay (in Thai) A qualitative socioeconomic study on a natural resources utilization plan, Phangnga Bay (in Thai)
410	Mr. Panat Tasneeyanond	Legal and institutional arrangements for management of coastal resources in Thailand
420	Mr. Robert J. Dobias	Management of coastal tourism resources at Ban Don Bay Management of coastal tourism resources at Phangnga Bay
611	Mr. Ilyas Baker	An issue-based action plan for the Upper South Subregion's coastal zone: a contribution towards regional sustainable development
	Dr. Teerayut Poopetch	Integrated technical reports of the coastal resources and environmental studies of the Upper South, Thailand
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