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The
Integrated
Management
Plan for
Segara Anakan-
Cilacap,
Central Java,
Indonesia

ASEAN/US
COASTAL RESOURCES MANAGEMENT PROJECT
DIRECTORATE GENERAL OF FISHERIES
INDONESIA

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**The Integrated Management Plan
for Segara Anakan-Cilacap,
Central Java, Indonesia**

ASEAN/US Coastal Resources Management Project
Directorate General of Fisheries
Jakarta, Indonesia

Indonesia. Direktorat Jenderal Perikanan.

1992



ICLARM



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CONTENTS

List of Tables	vi
List of Figures	vii
List of Acronyms and Abbreviations	viii
Editorial Board	ix
Acknowledgments	x
Foreword	xiv
Executive Summary	1
Chapter 1. Introduction	
Significance of Coastal Areas	11
Scope of the Management Plan	11
The objectives of the Integrated Management Plan for Segara Anakan-Cilacap	14
Chapter 2. Environment and Natural Resources	
Environmental Setting	15
Coastal Resources	17
Marine ecosystem	17
Upland ecosystem	18
Estuarine ecosystem	19
Chapter 3. Demography and Economics	
Human Resources	23
The Villages	24
Udjung Alang	24
Udjung Gagak	24
Panikel	26
Services and Facilities	26
Economic Utilization of Coastal Resources	27
Fisheries	27
Forestry	32
Agriculture	33
Socioeconomics	33
Land use and ownership	34
Chapter 4. Coastal Area Management Issues	
Environmental Quality	37
Water pollution	37

Contents

Sedimentation	39
Rare and endangered species	41
Resource Exploitation	42
Mangrove forest	42
Fisheries	43
Institutional Concerns	44
Support for the management plan	44
Landownership	45
Infrastructure development	47
Livelihood	48

Chapter 5. Integrated Management Plan

Introduction	51
Zonation	52
Land-based zones	54
Aquatic zone	57
Special zones	58
Plan Implementation	60
Sediment infilling	60
Mangrove forest	61
Fisheries	62
Tourism	63
Landownership	63
Land development	64
Water, health, and pollution	64
Transportation	64
Coordination of government agencies	65
Information services	65
Education and extension services	65

Chapter 6. Projects to Implement Management Strategies

Introduction	67
Projects for Implementation	67
1. Formation of SATF and coordination of activities in Cilacap	67
2. Delineation of the zonation boundaries for Segara Anakan mangroves and land area	74
3. Training of Kampung Laut residents in the culture of crab, fish and related aquatic species	76
4. Reduction of fishing pressure in the lagoon	80
5. Improvement of crab and fishery commodity marketing channels, and training in marketing cooperatives	83
6. Involvement of women in alternative income-generating activities	85

Contents

7. Education and public awareness on resources management and ecology in Kampung Laut	88
8. Improvement of wetland management and conservation in Segara Anakan	90
9. Monitoring of water quality in Segara Anakan for long-term management, and training of local personnel	93
Policy, Coordination, Timing and Implementation	96
Plan Monitoring and Evaluation	97
References	99

LIST OF TABLES

A.1	Projects for immediate implementation and their projected budget requirements.	9
A.2	Expected benefits from IMPSA and corresponding estimated gross annual value added, and source of funds for project implementation.	10
2.1	Hydrology of rivers and their tributaries in Segara Anakan area (Ludwig 1985).	16
2.2	Numbers of livestock in uplands surrounding the management area, 1990 (SOC 1990).	18
2.3	Mangrove forest categories.	20
3.1	Population of Kampung Laut, 1975-1988.	23
3.2	Main species of fish, shrimp, crab and mollusk in Segara Anakan and offshore area of Cilacap (Naamin 1991).	27
3.3	Monthly average catch, effort and CPUE of fisheries in Segara Anakan, 1987 (Amin et al. 1988).	29
3.4	Agricultural production in Segara Anakan (CPB 1989).	33
3.5	Returns from day-labor and other livelihood activities of people in Kampung Laut (Budihardjo 1988).	34
4.1	Coastal area management issues.	37
4.2	Pollution in Segara Anakan and Cilacap (Romimohtarto 1989; Thayib et al. 1991).	38
4.3	Institutions and laws affecting land use in Segara Anakan area.	45
5.1	Area of Segara Anakan zones.	55
6.1	Summary of management issues/problems, strategies (S) and actions (A), and pilot projects for implementation.	69
6.2	Summary of projects to implement the plan, their priorities and estimated budgets.	71
6.3	Implementation schedule of projects.	97

LIST OF FIGURES

1.1	Segara Anakan-Cilacap and vicinity (White et al. 1989).	12
1.2	The Segara Anakan-Cilacap management area.	13
2.1	Landsat TM imagery of Segara Anakan-Cilacap, south Central Java, Indonesia.	16
2.2	Mangrove and land-use distribution map of Segara Anakan.	18
2.3	Mangrove forest in Segara Anakan (Soemodihardjo 1989).	19
3.1	Segara Anakan villages and subvillages collectively known as Kampung Laut (White et al. 1989).	25
3.2	Three-year average offshore shrimp and fish catch in Cilacap (FSC 1967-1991).	28
3.3	Three-year average lagoon catch of shrimp and fish in Segara Anakan (FSC 1967-1990).	28
3.4	Land use in Segara Anakan according to Perhutani (Soemodihardjo 1989).	32
3.5	Land-use patterns in Segara Anakan.	35
4.1	Changes in mangrove forest and water surface area since 1903 (high tide) (ECI 1987).	40
4.2	Land accretion and mangrove forest area from 1903 to 1986 (ECI 1987).	40
4.3	Projected shape of Segara Anakan following complete sediment infilling (ECI 1987).	41
5.1	Recommended zonation map for Segara Anakan.	53
6.1	The complementarity of the IMPSA objectives with the proposed projects and their objectives.	68

LIST OF ACRONYMS AND ABBREVIATIONS

ASEAN	Association of Southeast Asian Nations
BAPPEDA	District Planning Board, Cilacap
BAPPENAS	National Development Planning Board
CORD	Centre for Oceanological Research and Development
CPUE	catch per unit effort
CRM	coastal resources management
CRMP	Coastal Resources Management Project
CZM	coastal zone management
DGF	Directorate General of Fisheries
ECI	Engineering Consultants, Inc.
EIA	environmental impact assessment
FSC	Fisheries Service of Cilacap
ICLARM	International Center for Living Aquatic Resources Management
IMP	integrated management planning
IMPISA	Integrated Management Plan for Segara Anakan-Cilacap
KLH	Bureau for Population and the Environment
LIPI	Indonesian Institute of Sciences
MEC	Ministry of Education and Culture
MH	Ministry of Health
MHA	Ministry of Home Affairs
MJ	Ministry of Justice
MPW	Ministry of Public Works
MSY	maximum sustainable yield
MT	Ministry of Transportation
MTPT	Ministry of Tourism, Posts and Telecommunications
NGO	nongovernmental organization
NKPA	Nusa Kambangan Prison Authority
NLUB	National Land Use Board
OAA	Office of Agrarian Affairs
Perhutani	State Forest Corporation
PHPA	Directorate General of Forest Protection and Nature Conservation
ppt	parts per thousand
PVC	polyvinyl chloride
SATF	Segara Anakan Task Force
SMPE	State Ministry for Population and the Environment
US	United States
USAID	United States Agency for International Development

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FOREWORD

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

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

The coastal zones of most countries in 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, salt-making, tin mining, oil drilling, shipping, construction and industrialization. This situation is aggravated by the expanding economic activities attempting to uplift the standard of living of coastal people, the majority of whom live below the official poverty line.

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

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

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 has also attempted to develop site-specific coastal zone management (CZM) plans to formulate integrated strategies that could be implemented under the prevailing conditions in each nation. In Indonesia, the Segara Anakan area of southern Central Java was selected as the pilot site. The Indonesian Institute of Sciences (LIPI) and the Directorate General of Fisheries, Ministry of Agriculture (DGF-MA) were designated as the project's coordinating and implementing agencies, respectively. Indonesian institutions, including the Balai Penelitian Perikanan Laut, LIPI and Universitas Indonesia, undertook secondary data collection and analysis. The results of these studies were published in a book entitled *The coastal environmental profile of Segara Anakan - Cilacap, South Java, Indonesia*. The profile identified management issues affecting Segara Anakan and pertinent data gaps. Between 1987 and 1990, a series of major studies was undertaken on the ecological, social and economic structure and function of the area. Together with the profile, this information formed the basis for the CZM plan for Segara Anakan. Resolution of the management issues identified in the profile is the focus of this plan.

Chua Thia-Eng
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EXECUTIVE SUMMARY

INTRODUCTION

The goal of IMP is sustainable development; the philosophy behind it is to examine and provide solutions to development issues from a holistic perspective.

The Indonesian government chose Segara Anakan, an estuary on the south coast of Central Java as the site to apply the concepts of integrated management planning (IMP). The goal of IMP is to allow sustainable development. Its philosophy is to examine development issues in the management area from a holistic perspective as opposed to a sectoral approach. Linkages between biophysical and socioeconomic systems are taken into consideration.

A large number of individuals and agencies participated in the planning process. To begin the plan, the project staff came up with an environmental profile of the area through review of available literature. Data gaps were identified. Then, several research projects on the biophysical, socioeconomic and institutional characteristics of the pilot site were designed and carried out to fill in the missing data. Management issues were identified and the Integrated Management Plan for Segara Anakan-Cilacap (IMPSA) was developed to address these issues.

ENVIRONMENT AND NATURAL RESOURCES

The 51,700-ha Segara Anakan management area is located west of Cilacap. It includes three major ecosystems; marine, estuarine and upland, that are intimately linked with each other by biophysical processes. The estuary has 24,000 ha of mangrove forest, the largest single stand in Java. This estuary is protected from the sea by a rocky 10,300-ha barrier island (Nusa Kambangan) that runs parallel to the coast. A rich coastal marine ecosystem lies offshore.

The weather is monsoonal, with a rainy season from November to April and a mean annual rainfall of 2,907 mm. The Citanduy River supplies about 95% of water flowing into the management area. This long river drains the 350,000-ha Citanduy Basin, then flows into and drains part of Segara Anakan. Hence, land use within this catchment basin has a significant impact on Segara Anakan through erosion and sediment transport and deposition.

The mangrove forest surveyed was divided into five categories: undisturbed to slightly disturbed (32%), mildly disturbed (13%), disturbed (17%), heavily disturbed (25%) and destroyed (13%). No completely undisturbed old-growth forest remained; more than half the forest showed pronounced evidence of human disturbance. The mangrove forest is the habitat of several birds and mammals including the milky stork, an endangered species which uses the forest as one of its only two nesting sites in the country.

The characteristics of the lagoon waters were measured and found within the normal range for tropical estuaries except suspended solids which were high at almost 700 mg/l. Lagoon flushing is primarily driven by tidal action and is limited by the small size of entrances at the east and west ends of the lagoon. This hydrodynamic regimen allows a high percentage of suspended sediments to settle in the lagoon and has reduced the lagoon depth to 1.48 m.

Executive Summary

A fisheries survey found that 45 species of fish and several species of penaeid shrimp occur in lagoon waters. An abundance of larvae of commercially important marine fish and shrimp in the lagoon demonstrates the strong ecological links between offshore and lagoon waters and confirms the high value of tropical coastal estuaries for offshore fisheries stocks.

POPULATION AND SOCIOECONOMICS

Demography

Collectively known as "Kampung Laut," the three villages in Segara Anakan include eight subvillages. Another village, Majingklak, is physically located within the estuary but is excluded from the management area because it is under the jurisdiction of Ciamis District, West Java Province.

With only 7,840 inhabitants and a density of 129 people/km², Segara Anakan is thinly populated compared with other areas of Java. The population is decreasing by 0.9% annually due to migration.

Basic Services and Infrastructure

Education is available in Kampung Laut up to elementary level. The illiteracy rate is about 10%.

Transportation is limited to shallow draft ferries and canoes; navigation may be difficult during low tide.

Water and power supplies are extremely limited. Most sewage is discharged directly to the lagoon without treatment.

Employment

Fishing is the dominant source of income; however, the trend is a gradual switch to farming. As of 1987, daily wages were between Rp 1,500¹ and 5,000; however, a sizable portion of the households is believed to be earning less than the amount required to meet basic needs.

ECONOMIC UTILIZATION OF RESOURCES

Fisheries

Residents of Segara Anakan are dependent upon both offshore and lagoon fisheries for food and employment. The offshore fishing area is approximately 50 km wide and 180 km long. Target species are 10 finfish, 6 shrimp, 1 crab and 4 mollusks. The offshore shrimp catch from July 1987-July 1988 was valued at about Rp 20 billion while lagoon fisheries were worth about Rp 627 million.

¹May 1992: Rp 2,016 = US\$1.00.

Executive Summary

Offshore fish catch was high following the introduction of trawling in 1972 and decreased after its subsequent banning in 1980. In 1990, offshore catch of nearly 5,000 t of finfish and about 1,000 t of shrimp is comparable to the years prior to trawling. This is considerably lower than the estimated maximum sustainable yield (MSY) of 19,500 t of fish and 5,800 t of shrimp; i.e., these stocks appear to be underexploited.

The most recent lagoon shrimp catch of almost 1,000 t is the highest ever, exceeding the estimated MSY of 605 t, while fish catch of about 500 t is about double that of the past decade and similar to pre-1975 catches.

Aquaculture

Aquaculture development is encouraged by the government. Over 50 ha of fishponds have been developed and the area between Klaces and Motean has been recommended for future aquaculture development. Due to problems of acid soils and high silt content of the water, only a few hardy species such as tilapia and mudcrab can thrive in Segara Anakan ponds.

Forestry

Forest utilization is a cottage industry that generates an estimated 5,840 t of mangrove wood in annual harvest worth Rp 87.6 million. The major cause of mangrove forest reduction, however, is agricultural development which is taking place primarily on the periphery of the management area.

Agriculture

Over 50% of the management area is devoted to agriculture and most residents participate in this sector. The primary crop is rice at 750,000 t yearly (Rp 225 billion) with fruits, nuts and vegetables contributing a modest amount.

COASTAL AREA MANAGEMENT ISSUES

Environmental Quality

The three major categories of coastal area management issues are environmental quality, resource exploitation and institutional concerns.

This category includes pollution problems, sedimentation, and the plight of rare and endangered species. Although both inorganic and organic pollutants were detected in the lagoon waters, their concentrations were within levels considered acceptable for inland waters. A set of inland water standards was proposed in this plan, but it has not yet been formally adopted. It will be important to take action on this before development proceeds further in the area.

Sedimentation is a natural process; however, it can be accelerated by the action of people, particularly inappropriate farming activities on erosion-prone soils. This appears to be occurring in the Citanduy River basin. This river transports sediments into Segara Anakan. Accelerated sedimentation

Executive Summary

and infilling of the lagoon has been identified as a serious threat to the entire estuary's ecological function. Analysis of maps and aerial photographs clearly shows that the lagoon has shrunk from 6,400 ha in 1903 to 2,700 ha in 1986 due to the aggradation of new land. As new land forms, it is quickly colonized by mangroves such that it is stabilized against erosion. One study has predicted a time frame of from 4.5 to 31 years for complete infilling of the lagoon, leaving only narrow channels for river outlets.

Given the uncertainty associated with prediction of the rate and final endpoint of the lagoon infilling process, care should be taken in attempting to solve this problem. Clearly, if the lagoon continues to fill up, there will be a point at which fisheries will decline. Based on the fish catch data since 1966, that point has not yet been reached.

Resource Exploitation

Mangrove forest conversion

Cutting of mangrove wood for fuel and construction materials has resulted in a decline in mangrove forest area of 1,454 ha between 1974 and 1987. No pristine forest remains, and few trees with trunk diameters larger than 10 cm are now found in Segara Anakan. In addition, mangrove forest is being converted to farmland and fishponds for aquaculture. The preservation of the mangrove forest is an important objective because it supplies the nutrient and energy inputs that support lagoon fisheries and the maturation of larvae of offshore fish and shrimp species. It provides a refuge for rare and endangered wildlife. There are conflicts between the development goals of the public and responsible government agencies, primarily DGF and the State Forest Corporation, Perhutani, with respect to the mangrove resources in the management area.

Fisheries

Contrary to popular opinion, fish catch data from both offshore and lagoon areas do not support the idea that sedimentation has damaged fisheries. Offshore fisheries for shrimp and fish appear to be underexploited while lagoon shrimp catch, mostly juvenile, is above MSY. No estimate of MSY for lagoon fish catch is available; however, some evidence indicates that catch per unit effort (CPUE) is declining.

The harvest of juvenile shrimp from the lagoon benefits Segara Anakan residents but may reduce the offshore (mature) shrimp catch, reducing total economic returns. Unless the natural food source for these juveniles inside the lagoon is limited such that many would not survive to migrate offshore, harvesting the low-value juveniles rather than waiting to harvest high-value adults offshore makes poor economic sense from the viewpoint of the regional economy. But the lagoon shrimp fishery is a major livelihood of Segara Anakan residents; therefore, alternative livelihood opportunities should be made available before this fishery is restricted.

Executive Summary

Institutional Concerns

Government agencies

A major impediment to the solution of development problems is the lack of communication and coordination among the government agencies. There are also significant overlaps in their functions as well as unclear areas of authority and jurisdiction.

The agencies involved in the management plan do not meet regularly. These are the State Ministry for Population and the Environment (SMPE), Ministry of Justice (MJ), Ministry of Tourism, Posts and Telecommunications (MTPT), Ministry of Transportation (MT), Perhutani, National Development Planning Board (BAPPENAS), District Planning Board (BAPPEDA), DGF and Nusa Kambangan Prison Authority (NKPA), together with the *Bupati*.

The IMPSA was not formally adopted as part of the current Five-year Indonesian Plan (1989-1994) or included in BAPPENAS' *Blue book* of approved development projects. A central implementing agency that can act as a coordinating center has not yet been designated. At present, there is little expertise in government regarding integrated coastal management.

Landownership

Landownership is not clearly defined in some areas of Segara Anakan. There are disputes among Perhutani, local residents and NKPA regarding the priority of traditional laws versus more recent government regulations. Local residents, as represented by the *Bupati*, claim rights to newly formed lands that they occupy under *hukum adat*, i.e., the prescriptive custom or right law, whereas Perhutani claims that all new lands are colonized by mangroves and are therefore part of the mangrove forest over which it has authority. Local residents also dispute with NKPA concerning ownership of new lands formed on the north side of Nusa Kambangan. This conflict has been temporarily resolved by negotiation.

Infrastructure

All basic infrastructure including roads, health care and education are inadequate in Segara Anakan. The building of roads into the area could create additional problems for local residents such as speeding up exploitation of natural resources, exposing natural areas and endangered wildlife to exploitation, increasing immigration which will aggravate conflicts between local residents and new settlers.

Livelihood

Tourism development has been neglected as an alternative source of livelihood for residents of Segara Anakan. Furthermore, sufficient credit facilities have not been made available to local residents for the development of local businesses. While the government has encouraged fishermen to switch to farming, there are sociocultural impediments to this process.

INTEGRATED MANAGEMENT PLAN

Philosophy and Strategies

The plan strategies include a zonation scheme as a framework for plan implementation; a task force to coordinate planned activities; strengthening of government and NGO interaction to achieve common goals; and design of specific projects to implement the plan.

The guiding philosophy of the management plan is to provide an integrated approach and solutions to management issues. Specifically, this requires considering "downstream" or external effects of all planned changes on the natural or socioeconomic environment rather than just considering single issues in isolation. A simple example is that of a zonation scheme which includes a sanctuary where fishing is completely banned; for an integrated approach, the planners must consider whether the remaining fishing areas will be adequate to support local residents' fishing needs. In this case, the planners take into account both the pure natural resource management issue as well as the socioeconomic issue of livelihood.

The strategies employed in making the plan involve several steps. First, create a zonation scheme that matches available resources with current and potential needs. This provides a framework for plan implementation. Form the Segara Anakan Task Force (SATF), comprised of membership from all concerned parties, to coordinate planned activities. Identify the target constituency, in this case the Segara Anakan residents, so that there will be strong public support for the plan, even at the late stage of project implementation. Active solicitation of public participation in project planning assures continued interest during implementation. Another important strategy is to reorganize the way government agencies interact with one another and with nongovernmental organizations (NGOs) such that they will work together towards common goals. Finally, design specific projects to implement the plan.

Zonation Scheme

A zonation scheme was devised for Segara Anakan to facilitate an orderly, planned utilization of resources and to minimize conflicts. Zonal boundaries were determined by ecological suitability and may need to be adjusted to meet political or legal requirements.

One aquatic and six land-based zones have been designated. Two special zones have also been singled out, the Ministry of Justice zone which covers Nusa Kambangan, and the marine zone, which covers the coastal fishery out to the 60-m isobath. It is proposed that a separate urban plan be developed specifically for Cilacap that should take into account the recommendations of IMPSA.

Protection zone (480 ha) - a core area of mangrove forest protected from further exploitation and degradation that will serve as sanctuary for fisheries and wildlife.

Reserve zone (4,122 ha) - an area designated for conservation to maintain the ecological function of the lagoon as nursery and feeding grounds, especially for shrimps and fishes.

Executive Summary

Forest zone (2,809 ha) - a buffer between the reserve zone and the agriculture zone to be actively managed by Perhutani; harvesting of wood products will be allowed.

Development zone (4,779 ha) - designated as a multipurpose economic development zone where local residents can be free to pursue a variety of livelihood projects such as agriculture, aquaculture, horticulture, agroforestry, livestock, and even light industry and manufacturing.

Agriculture zone (1,199 ha) - an area with the ecological features to support agriculture and so has been reserved specifically for this purpose.

Human settlements (95 ha) - designated to contain the growth of human settlements in Segara Anakan in centralized areas where government services can be most easily provided.

Aquatic zone (6,029 ha) - includes the lagoon and all waterways and aquaculture ponds; allows the management and planning of fisheries utilization within these areas. Important activities are limiting overfishing and promoting aquaculture development in suitable areas.

Ministry of Justice zone (10,258 ha) - although a prison island, Nusa Kambangan is considered to have the best potential for tourism development. The management plan recommends implementation of tourism development in this zone that will be completely compatible with the prison status and significantly increase the income of local residents.

Marine zone (22,000 ha) - an important part of the zonation scheme, this zone will allow for regulation of coastal fisheries which are expected to expand in the near future.

Implementation of Management Plan

Remedial measures for sediment infilling of the lagoon

Although sediment infilling is occurring, it has not yet affected either the irrigation drainage or fisheries of the lagoon. Therefore, proposed remedial measures like dredging should be carefully assessed such that both costs and benefits are accounted for. Dredging could cause more damage to fisheries than sediment infilling by releasing large amounts of suspended sediment and toxic substances such as sulfur compounds. A complete environmental impact assessment (EIA) should be made that will include bioassays of the effects of lagoon sediment on larvae of fish and shrimp before any dredging is begun. Investments in training upland farmers regarding sustainable farming techniques that prevent erosion may be more useful in the long term than dredging.

Executive Summary

Mangrove forest

The 4,602 ha of mangrove forest designated as protected and reserve areas plus some additional mangrove forests from other zones should provide an adequate biological bank for this habitat as long as conservation is carefully implemented. A 1,551-ha area of damaged mangrove forest should be adequate to supply the fuel needs of 1,000 households.

Fisheries

Fisheries management goals include promoting offshore and coastal fisheries and limiting the use of fine-meshed nets in the lagoon. Continued efforts are needed to promote aquaculture in the area with appropriate species, namely, tilapia and mudcrab.

Tourism

Tourism development has been neglected but can be expected to provide a considerable increase in local incomes in the future. Conservation of natural areas is a complementary goal of tourism development because most visitors enjoy visiting rural areas in a pristine condition with abundant wildlife. Nusa Kambangan holds the most potential as a tourist attraction with its combination of prison facilities (Iwahig, a prison in Palawan Province in the Philippines, attracts many tourists). Handicraft manufacturing and local culture can provide livelihood opportunities, particularly for women. The *Bupati*, MJ, NKPA and tourism authorities will need to coordinate this program.

Landownership

Landownership disputes should be resolved by consultation with SATF, which will set up guidelines for this purpose. In general, the original residents of Segara Anakan should receive priority in allocation of land over government agencies such as Perhutani, as long as the intended use of the land fits within the zonation scheme.

Land development

A centralized village development plan is recommended in order for the government to supply services and infrastructure.

Infrastructure

A high priority needs to be placed on developing a reliable water supply and sanitary facilities for the area. An appropriate waste management scheme should be designed so that wastes are contained and do not flow directly into the lagoon where they can create health problems.

The opinions of residents should be solicited regarding the building of roads into the area. Although the roads would reduce transportation costs and open up markets, they would also speed up migration into the area and exploitation of natural resources, and increase conflicts between new immigrants and long-time residents.

Executive Summary

Coordination of government services

BAPPEDA is the recommended agency to coordinate government services in cooperation with SATF.

Education and information services

The educational system is currently below standard and needs to be improved. It is recommended that a middle school be built to allow students to study locally. The possibility of providing local housing for teachers should be considered to reduce commuting time.

Extension services in fisheries, aquaculture, agriculture and tourism development can be expanded by assigning extension workers to Segara Anakan on a permanent basis. All extension workers should have basic training in the philosophy and implementation of integrated management. Workers should coordinate with local media to promote workshops and seminars and to help disseminate the progress of their work.

PROJECTS TO IMPLEMENT MANAGEMENT STRATEGIES

Nine high-priority projects have been selected for immediate implementation (Table A.1).

Table A.1. Projects for immediate implementation and their projected budget requirements.

Project	Projected budget requirement (US\$)
SATF	161,000
Zonation scheme	75,000
Aquaculture extension training - crab, tilapia	82,000
Reduction of fishing in the lagoon	163,000
Improvement of fisheries product marketing channels and training in market cooperatives	26,000
Involvement of women in alternative income-generating activities	43,000
Education and public awareness on resources management	40,000
Improvement of wetland management and conservation	82,000
Water quality monitoring	74,000

Their implementation will build a framework for long-term sustainable resource management in Segara Anakan and is expected to bring substantial benefits to all sectors (Table A.2). Participation in plan implementation will bring the public, the government, the private sector and NGOs together in an atmosphere of cooperation and help prevent future conflicts among resource users. The projects will provide additional livelihood opportunities.

Executive Summary

Table A.2. Expected benefits from IMPSA and corresponding estimated gross annual value added, and source of funds for project implementation.

Benefit	Estimated gross annual value added (million US\$)
Increase offshore shrimp catch	12.0
Protect mangrove forest, wildlife and lagoon nursery function	7.5
Form a tourism industry	1.5
Create a crab export industry	0.5
Improve residents' quality of life	NQ
Foster cooperation among agencies	NQ
Preserve cultural values	NQ
Total	21.5

Source of funds	Cost of proposed projects (million US\$)
International funds	1.174
Indonesian funds	0.467
Total	1.641

NQ - not quantifiable.

Two income-generating activities, tourism and crab culture, have a potential of raising Segara Anakan residents' standard of living considerably. The plan establishes a framework wherein the problem of lagoon infilling by sediment can be resolved and future problems addressed.

There will be a need to continuously monitor the progress of the management process, to take into account changes in the socioeconomic and natural environments and to evaluate the program's overall effectiveness. The task force will be capable of undertaking its own analysis of new resource uses and should be actively involved in planning for potentially major changes in Segara Anakan that would result from the construction of facilities such as a large tourist resort.

The plan and the results of project implementation will serve as a planning model for other coastal regions of Indonesia and in other countries.

CHAPTER 1

INTRODUCTION

SIGNIFICANCE OF COASTAL AREAS

The industrialization of Cilacap has created classic developmental conflicts. These make Segara Anakan an ideal site to apply the concepts of CZM to the Indonesian setting.

Indonesia is an archipelagic state made up of more than 13,500 islands. Given this geography, it is natural that many Indonesians depend a great deal on coastal resources for food, livelihood and other needs. Conflicts among resource users may arise when large numbers of people depend upon common resources for different needs. One example is provided by coastal fish stocks; the desire of commercial fishermen to trawl close to shore may conflict with the needs of artisanal fishermen to have access to stable fish stocks within reach of their small boats. A major goal of creating a CZM plan is to try to minimize such resource-use conflicts while allowing equitable and sustainable development.

The place chosen by the CRMP team to serve as a model for CZM planning in Indonesia is Segara Anakan, an estuary located in Cilacap District on the south coast of Central Java (Fig. 1.1). As the only large mangrove forest remaining in Java, Segara Anakan is a highly valued natural resource. For example, the estuary and surrounding area provide a refuge for numerous species of rare and endangered plants and animals, and serve as vital nursery grounds for larvae and juveniles of dozens of economically important finfish and shellfish.

The management area borders the growing industrial zone of Cilacap. The important government goal of industrializing nearby Cilacap has created classic developmental conflicts. An ideal harbor there has attracted much industry and economic development, bringing pollution and rapid resource depletion. These conflicts make Segara Anakan an ideal site to apply the concepts of CZM, now well tested in other regions, to the Indonesian setting.

SCOPE OF THE MANAGEMENT PLAN

In order to develop a management plan, the area to be managed must be delimited. Ideally, the management area should include the entire drainage basin for the Segara Anakan estuarine system and the marine waters linked

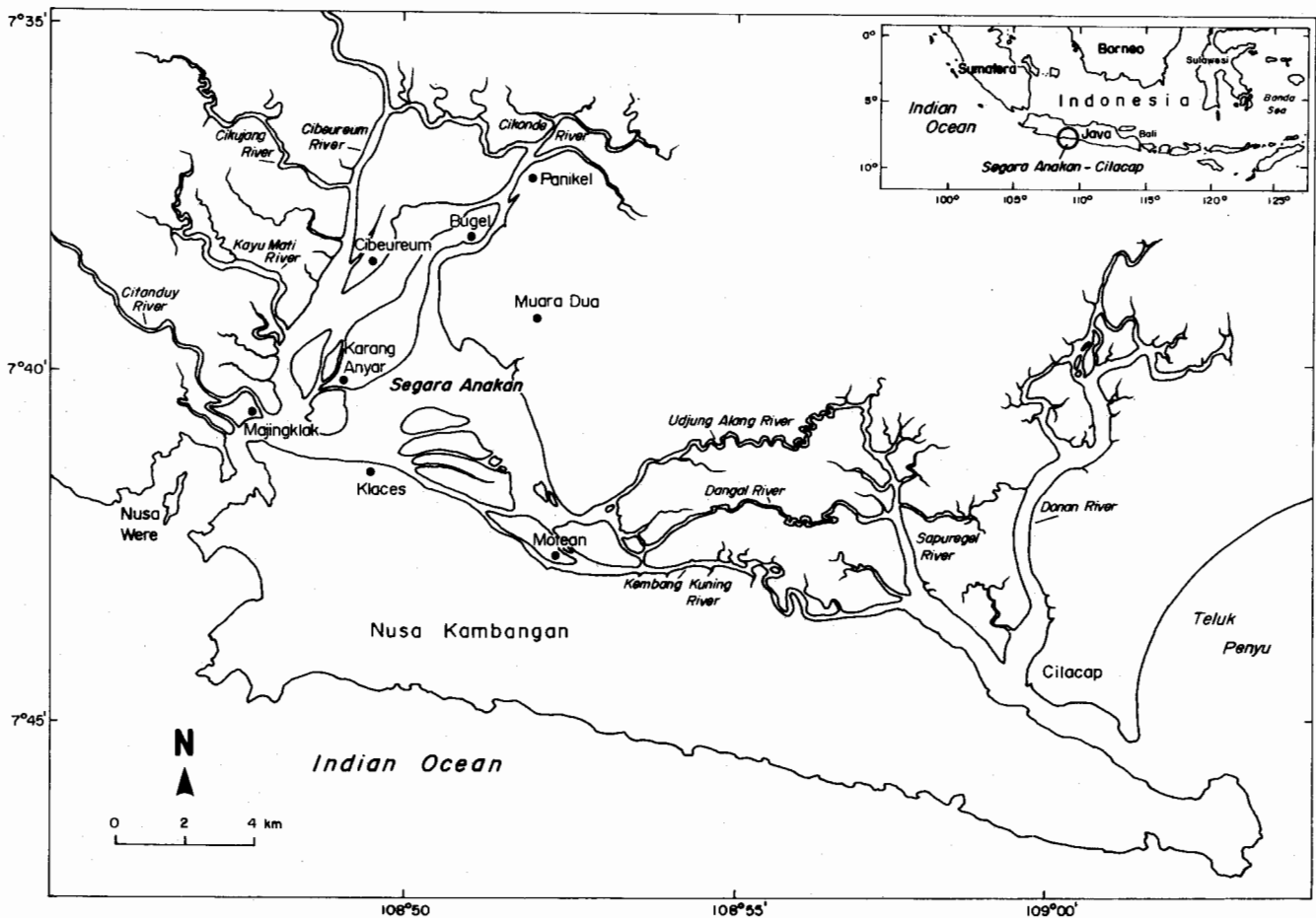


Fig. 1.1. Segara Anakan-Cilacap and vicinity (White et al. 1989).

to the estuary by physical and biological ties such as nutrient cycling, nursery functions for marine species and food webs. For practical reasons, the western border of the management area is delineated by the border between Cilacap and Ciamis Districts (Fig. 1.2). The northern border is located at the point where tides no longer influence rivers and streams. The eastern boundary is defined by the municipal boundary of Cilacap. The southern boundary extends out to sea to the 60-m isobath.

The management area thus contains Segara Anakan, including all waterways useful for fishing and transportation, and the villages which comprise Kampung Laut as well as the large island, Nusa Kambangan, currently being used as a prison colony. Although the south coast of Nusa Kambangan is administered by MJ, and the application of certain management strategies there may not be feasible, it is important to the goals of integrated

Chapter 1. Introduction

Successful implementation of IMP requires overcoming institutional barriers among government agencies and educating the people on the benefits of the plan to win their support.

management to fully account for the physical, biological and socioeconomic relationships between the south coast and the rest of the management area. The town of Cilacap, including its port and industrial areas, is not included in the management area; however, current and future side effects of Cilacap-based industries, such as pollution, are accounted for.

The effects of resource management on regions outside the management area are also considered whenever necessary. As much as possible, analyses of environmental functions take into account physical and biological linkages between adjacent ecosystems. The diversity of such linkages is one of the key factors which makes the coastal zone such a complex biophysical system. Socioeconomic analyses take into consideration practical realities such as culture and tradition.

The philosophy behind IMP is to look at the management area holistically rather than sectorally. Two special problems confront attempts to make use of integrated management strategies. One major limitation to implementing such plans is the existence of institutional barriers among government

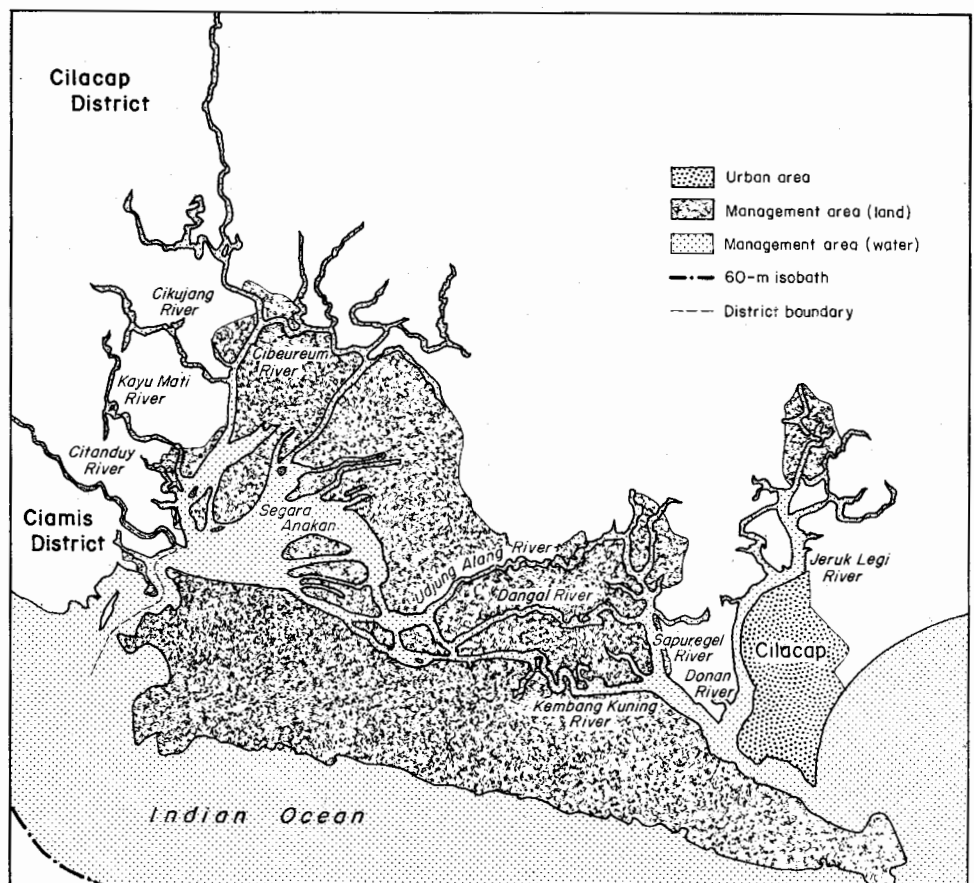


Fig. 1.2. The Segara Anakan-Cilacap management area.

Chapter 1. Introduction

agencies at all levels. These agencies may not be used to working closely with other agencies. Successful implementation of an integrated plan therefore requires overcoming these barriers and demonstrating that working together produces valuable results. A second stumbling block is that the success of the plan will also depend in large part on the backing of the people affected. Therefore, time and effort must be spent to educate the general public on the benefits of the plan, through all available channels.

The Objectives of the Integrated Management Plan for Segara Anakan-Cilacap

The ultimate goal of the planning process is to present policymakers with basic information and development options so that they can make appropriate decisions that will encourage sustainable development.

The overall objective of the management plan for Segara Anakan and its vicinity is to establish a land-use zonation scheme which satisfies the needs of different resource users; preserves ecologically important areas of the coastal forest, estuarine and marine ecosystems; and settles land-use conflicts. Specifically, the plan:

1. establishes criteria for management of the terrestrial- and marine-use zones consistent with the needs of current and future resource users;
2. determines the institutional and legal basis for management of the zones;
3. establishes guidelines for managing lagoon fisheries and mangrove exploitation;
4. recommends pilot testing of various schemes designed to stabilize sedimentation in the lagoon;
5. recommends a water quality control, monitoring and information system and promotes water quality control among industries and villages;
6. encourages community (Kampung Laut), town (Cilacap) and local government participation in the continuous planning and management of the area;
7. suggests sustainable alternative sources of income for local communities; and
8. sets out plans to educate and involve the community and the government in resource management and livelihood development.

The ultimate goal of the planning process is to present policymakers with basic information and development options so that they can make appropriate decisions that will encourage sustainable development.

Chapter 2 provides baseline information on the environment and natural resources found in Segara Anakan and Chapter 3, on its human resources. In Chapter 4, the development issues facing the area are discussed in detail, and conflicting parties are identified. In Chapter 5, a zonation scheme and general recommendations for resolving resource-use conflicts are given. Specific projects and estimated budgets are presented in Chapter 6.

CHAPTER 2

ENVIRONMENT AND NATURAL RESOURCES

ENVIRONMENTAL SETTING

The Segara Anakan management area consists of 51,700 ha of land and water located west of Cilacap on the south coast of Central Java. The geomorphology of the area includes both flat alluvial plains and areas dominated by rocky hills (Hamidjojo 1980). A coastal mountain range with peaks rising to 650 m originates at the hills of Nusa Kambangan and runs in a northwesterly direction forming one side of the 350,000-ha Citanduy Basin (Fig. 2.1). A second mountain range (South Serayu) begins north of Cilacap and runs parallel to the first, forming the northeast side of Citanduy Basin. The lithology of Nusa Kambangan is largely Miocene tuff with some limestone outcroppings at the northern side facing Segara Anakan and Donan River (Rahardjo 1982).

The management area includes part of the Segara Anakan basin (96,000 ha) and the surrounding mangrove forests, swamplands and paddy fields. The south coast of the management area is mainly occupied by Nusa Kambangan. The southern two-thirds of the island is dominated by rocky hills that rise to an elevation of 100 m. There are semi-protected bays at each end of the island. The northern side is covered by mangrove forest that borders Segara Anakan and the tidal channel; the latter is also called the Kembang Kuning River.

Although most of Citanduy Basin does not fall within the management area boundaries, the basin has a major impact on the area because Citanduy River flows into and drains part of Segara Anakan. The 446,000-ha Segara Anakan catchment area is drained by three rivers, Citanduy, Cibeureum and Cikonde. The average daily freshwater discharge into Segara Anakan from rivers is about 20.5 million m³, of which 95% is supplied by Citanduy River (Table 2.1). An additional mean of 0.2 million m³ per day is supplied by direct rainfall.

Soil eroded by rain in the two catchment basins passes into the three main rivers and small streams, and some sediment is transported to the 2,700-ha Segara Anakan. About 20% of the land within Citanduy Basin is steeply sloping with fine-textured soil and is easily eroded (ECI 1975). Citanduy

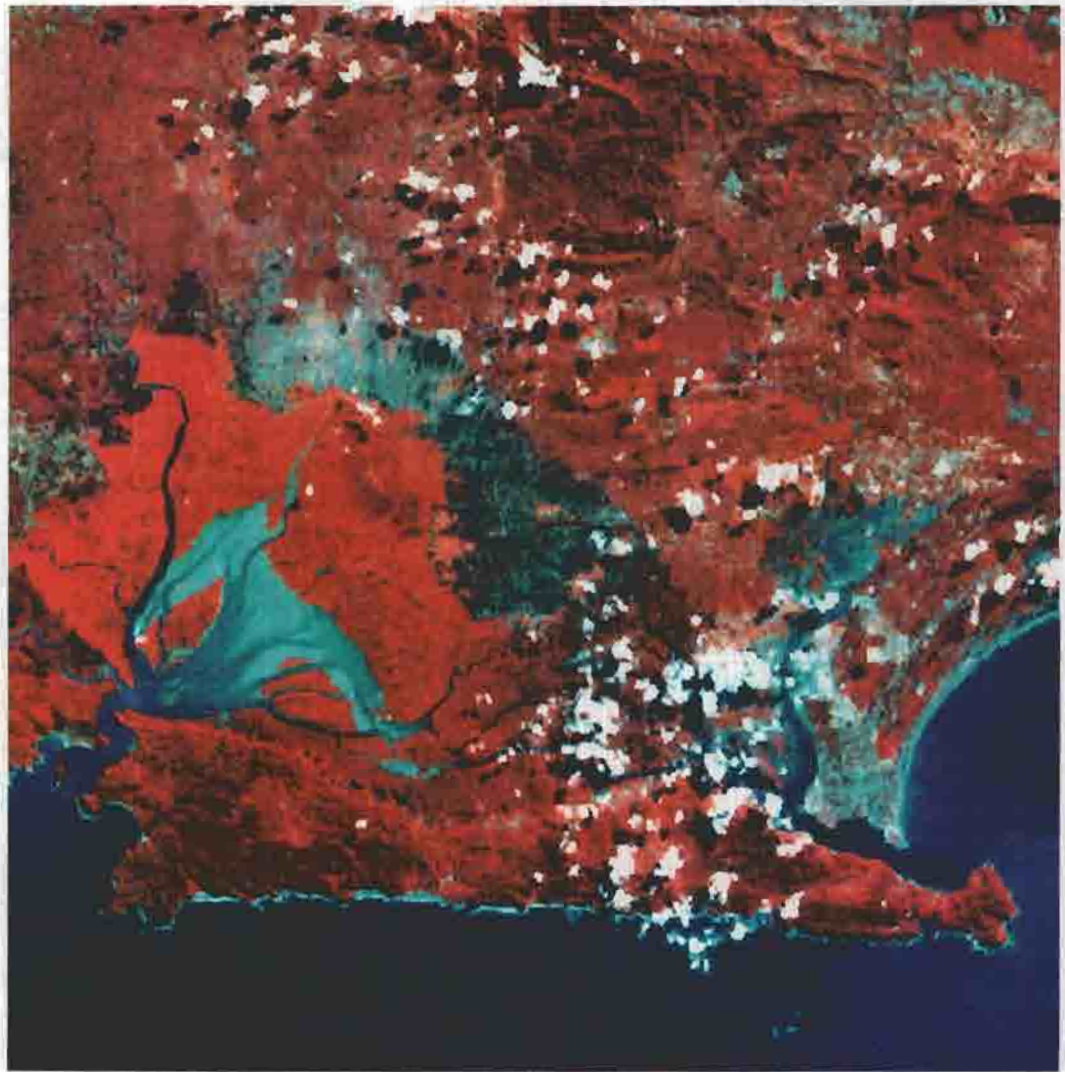


Fig. 2.1. Landsat TM imagery of Segara Anakan-Cilacap, south Central Java, Indonesia.

Table 2.1. Hydrology of rivers and their tributaries in Segara Anakan area.

Basin/river	Basin area (km ²)	Average flow (million m ³ /day)			Estimated silt transport into lagoon (million t/year)
		Dry season	Rainy season	Annual mean	
Citanduy Basin	3,500				
Citanduy River		14.77	24.45	19.61	3.04
Segara Anakan Basin	960				
Cibeureum River		0.05	0.17	0.11	0.01
Cihaur/Cikonde River		0.08	1.50	0.79	2.19
Total	4,460	14.90	26.12	20.51	5.24

Source: Ludwig (1985).

Chapter 2. Environment and Natural Resources

River thus plays an important role in transporting eroded soil into the management area (Table 2.1).

The two major erosive forces acting on the land are rainfall, which affects the entire management area, and wave action, which affects the Indian Ocean coastline. Weather patterns are dominated by the two distinct monsoonal seasons. Monthly rainfall at the Segara Anakan management area during the rainy season (November to April) ranges between 180 and 400 mm while dry season rainfall ranges from 100 to 180 mm (July to September). Mean annual rainfall is 2,907 mm (White et al. 1989). Waves up to 15 m high can be generated by Indian Ocean storms and these periodically batter the coastline during the dry season and prevent the formation of river deltas by resuspending sediment and transporting it to deeper water.

COASTAL RESOURCES

The southern coast is divided into three major ecosystems, the marine, the terrestrial (located above the influence of tides, henceforth called the upland ecosystem) and the estuarine. Although the marine and the upland ecosystems can significantly affect the management area and vice versa, they are not the primary focus of study and so their resources are briefly summarized, while the estuarine resources are considered in detail.

Marine Ecosystem

The marine ecosystem consists of the coastal waters bordering the management area. The coastal shelf is quite wide off Cilacap. The waters within 10 km offshore to the east of Cilacap are often quite turbid. More than 10 km offshore, the depth is less than 20 m. Off Nusa Kambangan, the 60 m-isobath is reached within 6 km offshore (Hadisumarno et al. 1982).

There is a seasonal alteration of coastal current; it flows towards the east from November to June and towards the west from July to October. These currents are important to the dispersal of planktonic larvae of fish and shrimp (Naamin 1991). Upwelling may occur during the southeast monsoon.

No data have been collected on benthic marine life in this area; however, it is known to be a soft bottom (sand and mud) community that is seasonally disturbed by wave action. A few rocky outcrops may harbor corals and other sessile benthic fauna, but no large coral reefs are found there. A few patches of coral reef are located along both the north and south sides of the east end of Nusa Kambangan and along Paninjoan Island, west of the management area.

The marine fish fauna consists of both pelagic species and those which migrate between the marine and estuarine systems such as anchovy (*Sardinella fimbriata*), mullet (*Mugil spp.*), ribbonfish (*Trichiurus sp.*), tuna and ponyfish (*Leiognathus spp.*). Squid (*Loligo spp.*) and penaeid shrimp are also abundant.

Upland Ecosystem

The upland area outside the management area has largely been converted from coastal forest to agriculture (30,836 ha). The distribution of land use is shown in Fig. 2.2. The ecology of the uplands is now affected by large numbers of livestock (Table 2.2). Terrestrial wildlife is scarce but small populations are still found there. Much of the 10,300 ha-Nusa Kambangan is an upland area that is largely covered with secondary rainforest.

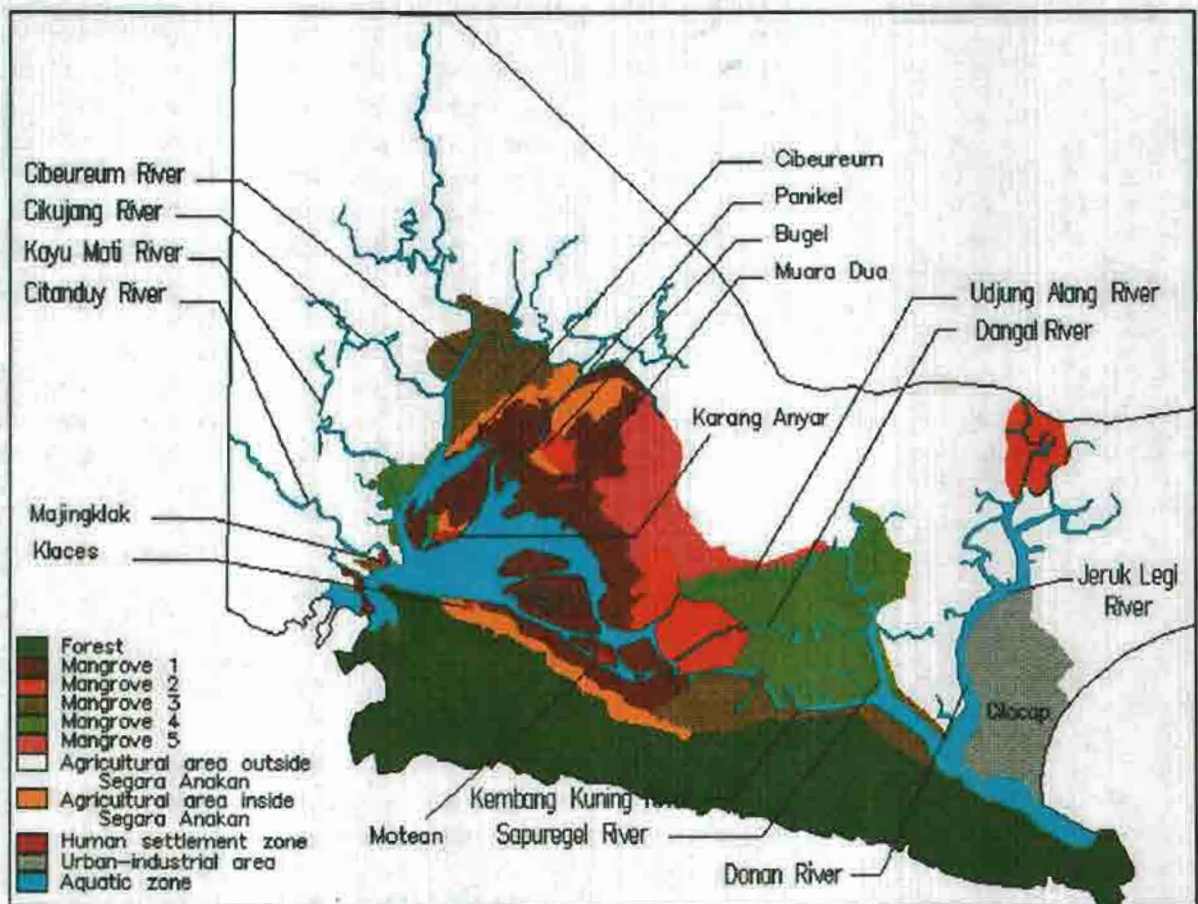


Fig. 2.2. Mangrove and land-use distribution map of Segara Anakan.

Table 2.2. Numbers of livestock in uplands surrounding the management area, 1990.

Livestock	Number
Horses	590
Cows	9,424
Water buffaloes	6,550
Sheep	87,715
Goats	17,156
Pigs	1,196
Chickens	1,409,736
Ducks	159,526

Source: SOC (1990).

Estuarine Ecosystem

Mangrove forest

Segara Anakan has the largest single stand of mangrove forest in Java. It covers an area of about 24,000 ha; 21,185 ha line the immediate shore surrounding the lagoon while an intertidal swampy forest covers about 14,100 ha (Figs. 2.2 and 2.3). A more recent survey indicates that the areal extent of mangroves is 12,227 ha (Soemodihardjo 1989). The mangrove ecosystem changes with differences in topography, tidal fluctuation and sediment transport patterns. Changes in the mangrove communities have been documented by the Ecology Team of Bogor Agricultural University (1984) and Soemodihardjo (1989). The forest has been classified into five categories, reflecting the condition of the mangrove stand (Soemodihardjo 1989). Table 2.3 gives a revised list of the categories. Details of the economic utilization of the mangroves are given in Chapter 3.

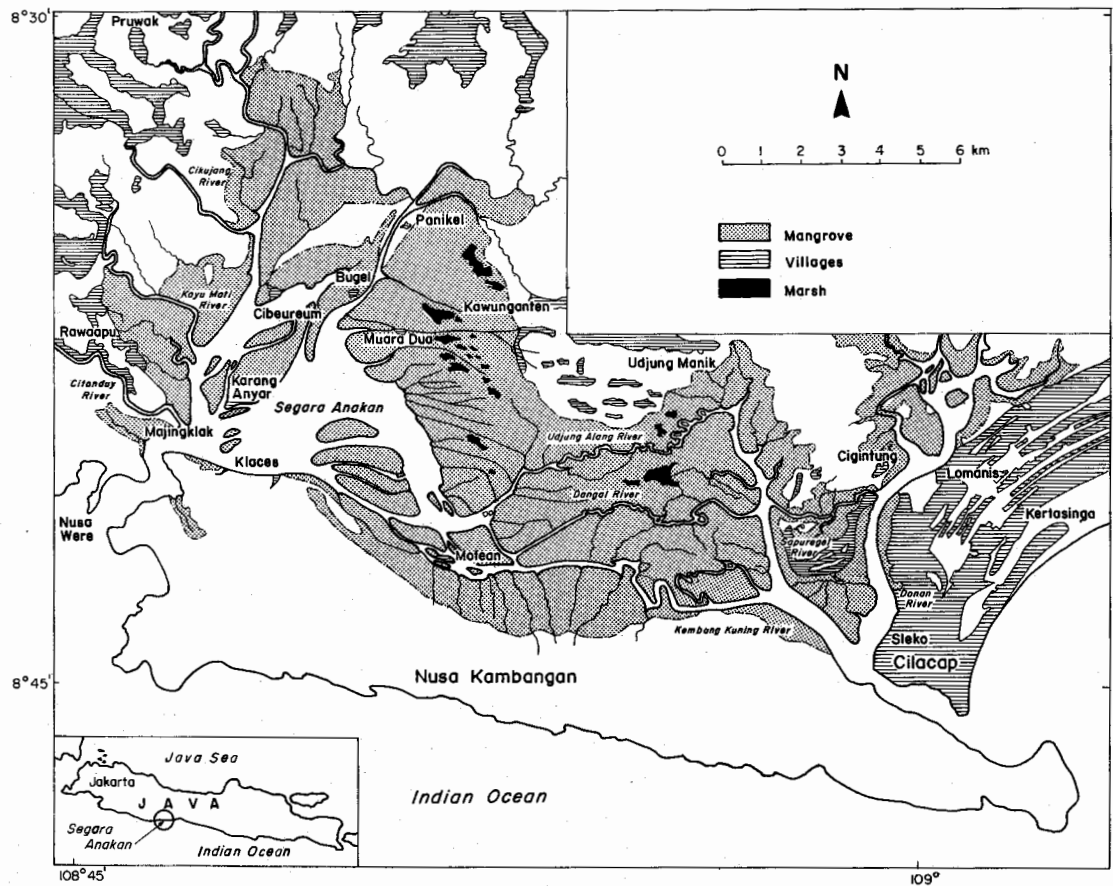


Fig. 2.3. Mangrove forest in Segara Anakan (Soemodihardjo 1989).

Chapter 2. Environment and Natural Resources

Table 2.3. Mangrove forest categories.

Category	Degree of disturbance	Description	Area (ha)	% of total
1	Undisturbed to slight	Insignificant human interference; includes mature trees; has a solid canopy	3,933	32
2	Mild	Abundant signs of human activities; forest canopy shows some gaps; a few tree stumps present; undergrowth and creepers cover open spaces	1,636	13
3	Disturbed	Pronounced evidence of human disturbance; tree stumps and open spaces common with sparse tree stands, predominantly covered with saplings and sprouts	2,069	17
4	Heavy	Much deterioration in evidence; most valuable trees cut; characterized by open land dotted with dumps of shrubs	3,038	25
5	Destroyed	Many mangrove species gone and replaced by marginal species	1,551	13
Total			12,227	100

Source: modified from Soemodihardjo (1989).

Some cutting of trees is evident in most areas of the mangrove forest and, except for new stands of mangrove that have colonized newly accreted land, there are no pristine stands left (Soemodihardjo 1989). Most of the undisturbed forest is located along the eastern and northern shores of the lagoon, on parts of newly accreted islands in the lagoon itself and on some small patches on the western edge of Nusa Kambangan (Fig. 2.2). A large area of mildly disturbed mangrove is located inland from the undisturbed mangrove and extends towards the east and north; additional patches are found north of Cilacap and across the inlet from Cilacap on Nusa Kambangan. Large tracts of disturbed mangrove are found along the northern shore of Nusa Kambangan and along Cibeureum River and on a portion of the western bank of Segara Anakan. The heavily disturbed mangrove is found in patches north of Cilacap along Jeruk Legi River, and on both banks of Sapuregel, Dangal and Kembang Kuning Rivers west of

Chapter 2. Environment and Natural Resources

Cilacap. The destroyed mangrove forest is found in the central area between the lagoon and Cilacap, abutting the agricultural area north of Ujung Alang River. Several small patches are located across the Jeruk Legi River from Cilacap.

The mangrove forest provides the estuarine ecosystem with large quantities of organic matter (ET 1984). Mangrove litter is broken down by bacteria and microalgae to form detritus that is a food source for fish, shrimp and crab. Mangrove branches and roots provide a habitat for several fish species.

The mangrove forest is an important habitat for numerous birds and mammals. The crab-eating macaque (*Macaca fascicularis*) and the silver-leaf monkey (*Presbytis cristatus*) reside in the denser mangrove areas (PHPA 1988). There are 85 species of birds dependent on the area: a nonbreeding population (160-180 individuals) of the endangered milky stork (*Mycteria cinerea*) and a smaller breeding population (there are only two breeding sites in Indonesia, one is in Segara Anakan); at least 25 lesser adjutants (*Leptoptilos javanicus*); and many herons and egrets. Migratory waders such as the sandpiper (*Actitis hypoleucos*) inhabit the area and forage at the intertidal mudflats. The wimbler (*Numenius phaeopus*) and golden plover (*Pluvialis fulva*) frequently roost in *Rhizophora* sp. trees along rivers and creeks (AWB 1988; Taufik 1988).

Lagoon

The lagoon waters have been studied extensively (White et al. 1989). The hydrological characteristics of Segara Anakan are mainly influenced by river runoff and tidal movement. The salinity of lagoon waters is affected by the ratio of seawater to freshwater inflows which varies on a daily and seasonal basis. Tides (mixed semi-diurnal) range between 0.4 and 1.9 m. At high tide, seawater enters the lagoon from two inlets located at its eastern and western ends. The western inlet provides most of the daily seawater inflow (26 million m³ during spring tides and 10 million m³ during neap tides). The tidal phase of the lagoon at the western entrance lags that of Cilacap by 1-2 hours. Since the drainage area is relatively flat, tidal influence extends up to 10 km inland at Panikel, depending on the tidal range and river discharge.

Freshwater inflow to the lagoon during the rainy season reduces the salinity of lagoon water. During the dry season, salinity ranges from 25-33 ppt while it usually drops to 13-19 ppt during the rainy season. The salinity pattern also varies spatially, with the central lagoon having higher salinities than peripheral areas. The main part of the lagoon appears to be vertically and horizontally mixed while partial stratification occurs within the vicinity of the river mouth.

Chapter 2. Environment and Natural Resources

Water circulation within Segara Anakan is primarily tidally driven because the lagoon is protected from wind-driven ocean currents by Nusa Kambangan, and the flow of river currents slows down upon entering the wide lagoon channel. Since sediment carried in water settles at a constant rate determined by physicochemical factors, much of the sediment transported to the lagoon by rivers settles inside the lagoon. By 1984, sediment deposition had reduced the depth of the lagoon to an average of 1.48 m (ET 1984).

Primary productivity of the lagoon (mean of four stations) varies between 210 and 267 mg C/m³/day (ET 1984). The lagoon supports a high abundance and diversity of phytoplankton and zooplankton that vary seasonally. Following freshwater influx, plankton populations are temporarily reduced (ECI 1987; ET et al. 1989; White et al. 1989). Dominated by diatoms (90% of total), the phytoplankton community has an estimated mean density of 3,900 individuals/l, which increases to 5,270 individuals/l in July and August. The zooplankton community consists of copepods (8 genera), rotifers (5 genera), ostracods (1 genus), rhizopods (4 genera), and crustacean and fish larvae.

The mud bottom of the lagoon supports 16 genera of macrobenthic invertebrates dominated by the gastropod genus *Thiara*. The highest densities (650-1,500 individuals/m²) were found near the Cibereum-Bugel area. Both the plankton and benthic organisms are a good food source for economically important fish and crustaceans.

The lagoon hosts 45 species of fish, with 17 migratory, 12 resident and 16 occasional visitor species (ET 1984). The larvae and postlarvae of shrimp and fish are abundant at the eastern and western entrances, demonstrating the interdependence between the offshore and lagoon areas (Naamin 1991).

All three ecosystems (upland, marine and estuarine) contribute to the rich natural resources of the management area and are linked to each other by rivers, weather patterns, the movement of animals and plants, and by the local inhabitants. The following chapter describes the people who live in the area and how they utilize the natural resources found there.

CHAPTER 3

DEMOGRAPHY AND ECONOMICS

HUMAN RESOURCES

Segara Anakan is thinly populated compared with other areas of Java. In 1988, the area's total population was 7,840 persons divided among 1,636 households (Table 3.1). About 41% of the population was under 15 years old. Mean family size was 5.1 members, and 60% of families had 5 to 7 children. The population is decreasing at a rate of about 0.9% per year. Between 1979 and 1983, a total of 1,889 people from Kampung Laut took part in the transmigration program and moved to Rimbo Bujang and Natuna Islands. Almost all of these people subsequently returned to Segara Anakan. Future moves of this type are not welcomed as the residents believe in a prophecy that life will become prosperous when Nusa Kambangan joins the mainland—a process that they believe is nearly complete.

In maps dating from 1944, the villages, which were on stilts, appeared to sit in the middle of the lagoon. Since then, the lagoon has filled in so some of these villages are now partially located on raised land.

The population is primarily concentrated along the shoreline of the lagoon and waterways. No settlement exists in the area between the eastern tip of the lagoon and Cilacap, except for the prison facilities at Nusa Kambangan and a forestry post.

Table 3.1. Population of Kampung Laut, 1975-1988.

Year	Udjung Gagak	Panikel	Udjung Alang	Majingklak ^a	Total
1975	3,058	1,585	3,274	351	8,268
1976	3,058	1,581	3,364	363	8,366
1977	3,083	1,595	3,396	371	8,445
1978	3,069	1,589	3,507	381	8,546
1979	3,092	1,602	3,570	389	8,653
1980	2,583	1,473	3,445	376	7,877
1981	2,552	1,396	3,229	350	7,527
1982	2,467	1,113	3,447	348	7,375
1983	2,499	1,079	3,606	392	7,576
1986	2,454	1,241	3,868	91	7,654
1987	2,596	1,311	3,905	50	7,862
1988	2,594	1,341	3,905	-	7,840 ^b

^aA village bordering the management area, but under the administration of Ciamis District, West Java Province.

^bExcluding population of Majingklak.

THE VILLAGES

Collectively, the three main villages of Segara Anakan are properly named "Kampung Laut" (Sea Village). Divided into eight subvillages (Fig. 3.1), these are under the administration of Kawanganten Subdistrict of Cilacap District, Central Java Province.

Udjung Alang

Udjung Alang consists of three subvillages, Klaces, Udjung Alang Bahru and Motean near the western end of Nusa Kambangan. They cover a combined territory of 6,300 ha and have a population of 3,905. Klaces is located on the north side of Nusa Kambangan itself while Motean is on a small island facing Kambangan. The land area, made up of the islands north of Motean and large sections of Nusa Kambangan, did not exist in 1944. The subvillage of Motean has now developed an extension across the channel on Nusa Kambangan called New Motean.

Agriculture has developed since 1987 in the area which stretches almost 10 km from Klaces in the west to past Motean in the east. The development of the northern shore of Nusa Kambangan is orderly. A dike was built as a roadway and to protect rice fields from high tide. The rice fields are on higher ground than the fishponds and houses. A water supply system provides water to Motean across the river.

A 1987 estimate of land use gives 1,250 ha of rice fields and 500 ha of fishponds divided among 400 households. This estimate of 4 ha/household appears very high as farming is done manually; 1 ha/household is probably more accurate. Analysis of 1989 aerial photos indicates that the rice fields and ponds cover 527 ha.

Udjung Gagak

Udjung Gagak which includes the subvillages Karang Anyar and Cibeureum, occupies the western side of Segara Anakan and covers about 2,500 ha consisting of several islands, most of which did not exist in 1944. The village does not actually include the land on the western shore of the lagoon because this belongs to the province of West Java. In 1987, there were 2,596 persons in 551 households in Udjung Gagak.

This village derives its primary income from fisheries as there is not enough land for development. Also, situated on the crossroad of boat traffic, it has developed some trading and transportation activities.

Of the total village land area, 645 ha are dry land and the rest is tidal mangrove forest. Residents are just beginning to convert the forest to agricultural land. In 1988, about 50 ha were converted. In 1989, 62 ha adjacent to the village were cleared for agriculture. However, most of this land is not suitable for agriculture because of a high silt content.

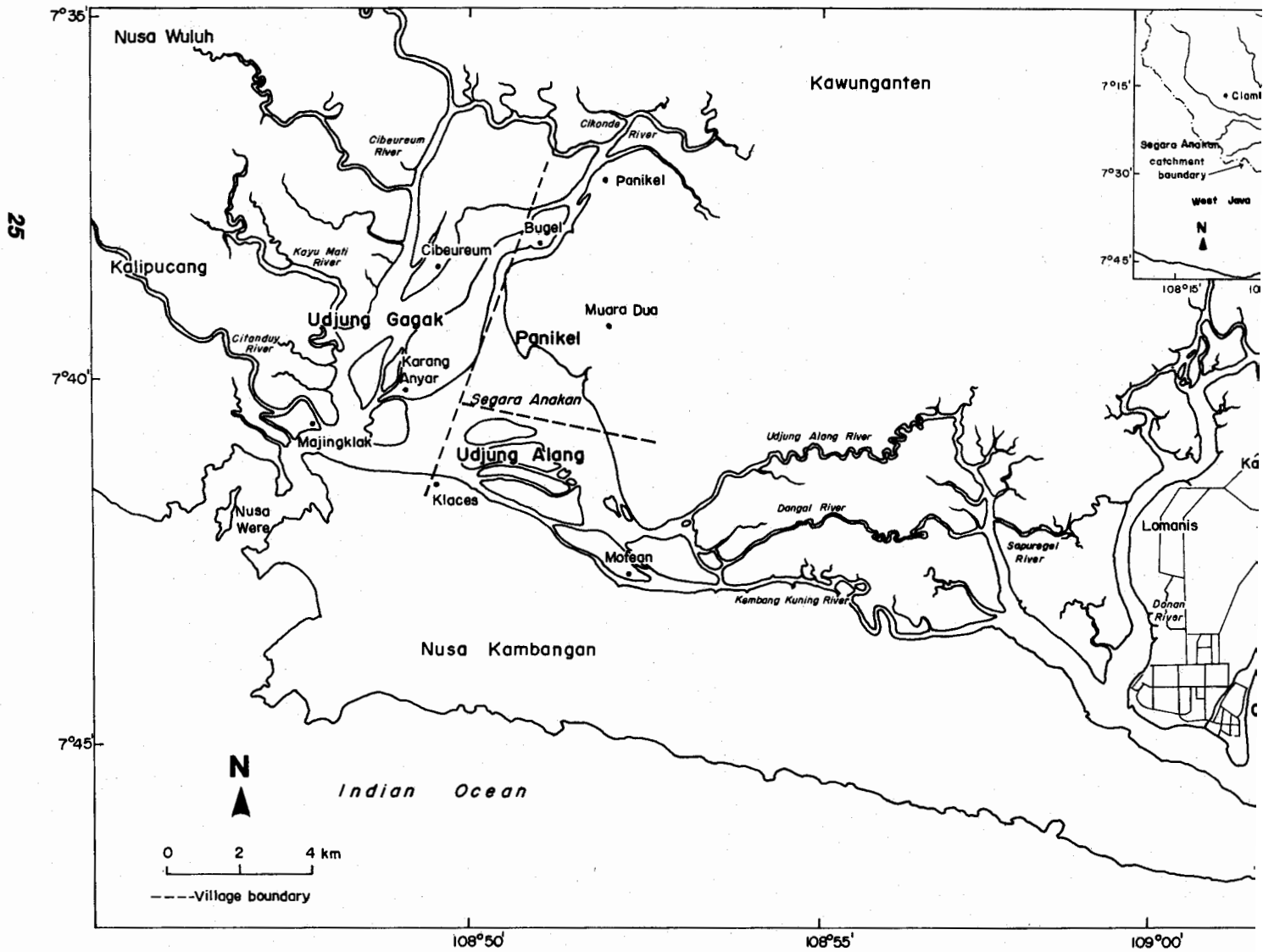


Fig. 3.1. Segara Anakan villages and subvillages collectively known as Kampung Laut (White et al. 1989).

The village of Majingklak, although physically located within Segara Anakan, is not officially included in the management area as it is under the administration of Ciamis District, West Java Province.

Panikel

Panikel consists of three subvillages, namely, Muara Dua (the largest), Bugel and Panikel located on the north side of Segara Anakan. In 1988, the total population was 1,341 persons in 300 households (LPM-ITB 1988).

Panikel is the smallest village, but because of its location on relatively stable fertile land, it has the highest potential for agricultural development.

As of late 1990, the area cleared for agriculture, ponds and settlements was more than 450 ha. Residents report that large tracts of mangrove forest between Muara Dua and Bugel are being converted into rice fields and fishponds by nonresidents.

SERVICES AND FACILITIES

Education

There are a total of seven schools located in Udjung Alang (three), Udjung Gagak (two) and Panikel (two). Many teachers commute from Cilacap, reducing the hours available for teaching. The illiteracy rate in these villages is about 10%.

Health

Sewage flows directly into the lagoon or in a few cases is collected in pour-flush toilets. There is poor sanitation and a lack of fresh water. Klaces and Udjung Alang Bahru have a polyvinyl chloride (PVC) pipe that supplies water from Nusa Kambangan, while Panikel and Udjung Gagak rely on rainfall or residents fetch water from Nusa Kambangan.

Power Supply

Electricity is supplied by small diesel generators which are not in good condition. In September 1990, an experimental unit of solar-powered generator was installed at Karang Anyar.

Transportation

The opening of land on the northern perimeter, and the construction of irrigation facilities and roads in the surrounding area will gradually break the isolation of Kampung Laut.

ECONOMIC UTILIZATION
OF COASTAL RESOURCES

Fisheries

Capture fisheries

Lagoon and offshore fisheries are economically important to the people residing in the management area. Fishing boats utilize an offshore fishing area that extends out to sea for about 50 km and along the coast for 180 km. Many of the species caught offshore are also caught in the lagoon and often depend on the lagoon environment during their larval and juvenile stages (Naamin 1991). The most important fisheries species are ten finfish, six shrimp, one crab and four mollusks (Table 3.2). The trend in offshore and lagoon fish and shrimp catch is shown in Figs. 3.2 and 3.3, respectively. Combined offshore fish and shrimp catch peaked between 1978 and 1980 at about 16,000 t and decreased to less than 4,000 t between 1981 and 1983. This decline is clearly linked to the banning of trawling in 1980.

Table 3.2. Main species of fish, shrimp, crab and mollusk in Segara Anakan and offshore area of Cilacap.

Common name	Genus/species	Local name
Fish		
Anchovy	<i>Stolephorus</i> spp.	<i>Ikan teri</i>
Sardine	<i>Sardinella fimbriata</i>	<i>Tembang</i>
Ponyfish	<i>Leiognathus</i> spp.	<i>Petek</i>
Mullet	<i>Mugil</i> spp.	<i>Belanak</i>
Croaker	<i>Johnius</i> spp.	<i>Gulamah</i>
Hairtail	<i>Trichiurus</i> spp.	<i>Layur</i>
Sole	<i>Cynoglossus</i> spp.	<i>Ikan lidah</i>
Lizardfish	<i>Saurida</i> spp.	<i>Bloso</i>
Wolf herring	<i>Chirocentrus</i> spp.	<i>Parang-parang</i>
Bombay duck fish	<i>Harpodon nechereus</i>	<i>Lomei</i>
Shrimp		
White shrimp	<i>Penaeus merguensis</i>	<i>Udang jerbung</i>
White shrimp	<i>P. chinensis</i>	<i>Udang jerbung</i>
Tiger shrimp	<i>P. monodon</i>	<i>Udang windu</i>
Endeavor shrimp	<i>Metapenaeus ensis</i>	<i>Udang dogol</i>
Endeavor shrimp	<i>M. elegans</i>	<i>Udang dogol</i>
Western shrimp	<i>M. dobsoni</i>	<i>Udang krosok</i>
Crab		
Mangrove/mudcrab	<i>Scylla serrata</i>	<i>Kepiting</i>
Mollusk		
Squid	<i>Loligo</i> spp.	<i>Cumi-cumi</i>
Cuttlefish	<i>Sepia</i> spp.	<i>Sontong</i>
Cockle	<i>Anadara granosa</i>	<i>Kerang darah</i>
Cockle	<i>A. antiquata</i>	<i>Kerang bulu</i>

Source: Naamin (1991).

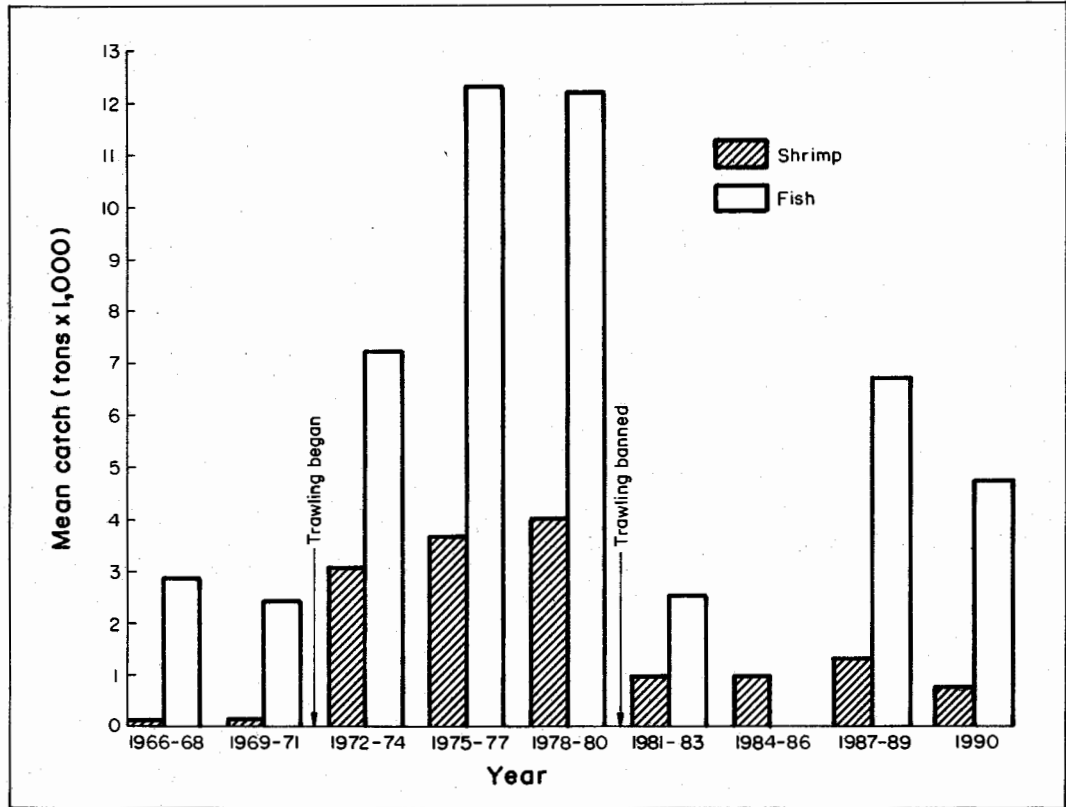


Fig. 3.2. Three-year average offshore shrimp and fish catch in Cilacap (FSC 1967-1991).

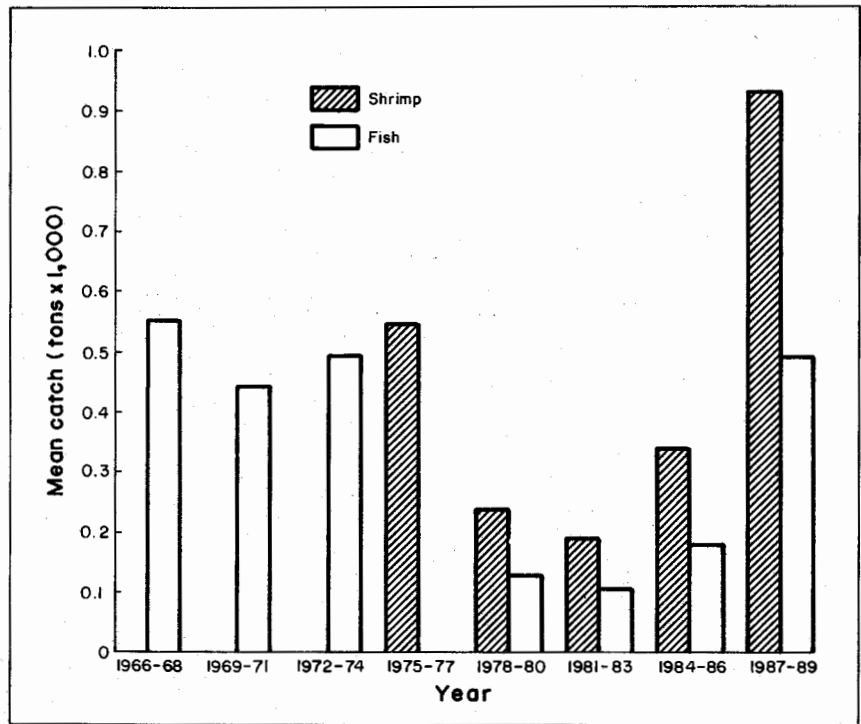


Fig. 3.3. Three-year average lagoon catch of shrimp and fish in Segara Anakan (FSC 1967-1990).

Chapter 3. Demography and Economics

In 1987-1989, offshore fish catch was about 14 times greater than lagoon fish catch. For offshore fisheries, MSY has been estimated to be 25,300 t (based on trawl data); 19,500 t of finfish and 5,800 t of penaeid shrimp. The value of this potential catch is more than Rp 38.9 billion annually.

Before trawling began in 1972, offshore shrimp catch ranged from 80 to 200 t/year. From a low of 2,911 t caught in 1974, shrimp catch increased during the trawling era to 5,242 t (near MSY) by 1980. The offshore shrimp fishery has maintained a level of around 1,000 t/year since 1980 when trawling was banned. Based on these numbers, the offshore stocks are underexploited. For the period July 1987-July 1988, the offshore shrimp catch earned about Rp 20 billion for Cilacap, while the lagoonal catch was worth Rp 627 million (Naamin 1991). This forms a significant portion of the revenue of Kampung Laut where 90% of the people depend on fisheries.

Since 1984, lagoon fish and shrimp catches have recovered from eight years of poor yield. Small-scale fishing is an important activity in Kampung Laut and Cilacap. The fishing area extends from both ends of the passages that connect the lagoon to the Indian Ocean. In Cilacap, the bulk of the demersal catch is shrimp (penaeids and metapenaeids), while that of the pelagic catch is fish, particularly anchovies, ribbonfish (*Trichiurus*) and tuna.

Four types of fishing gear are now commonly used in the lagoon (Table 3.3). Tidal traps (*apong* and *wide tadahan*) are the dominant gear in terms of catch, but other traps like *wadong* and *pintur* are very numerous with over 6,000 units being operated (Amin et al. 1988). Other gear are trammel and push nets (*waring surungan*). The monthly average catch in 1987 ranged from 4.99 t for *pintur* to 86.75 t for *apong*. The CPUE for *apong* and *wide tadahan* was over 10 kg/trip while for the rest of the gear types, it was 4-7 kg/trip (Table 3.3).

Table 3.3. Monthly average catch, effort and CPUE of fisheries in Segara Anakan, 1987.

Gear	Catch (t/month)	Value (million Rp)	Effort (trips/month)	CPUE (kg/trip)
Trammel net	14.94	13.16	2,535.00	5.89
Tidal trap				
<i>apong</i>	86.75	38.89	5,760.00	15.06
<i>wide tadahan</i>	80.20	35.65	7,999.00	10.03
Push net				
<i>waring surungan</i>	22.84	12.19	3,212.00	7.11
Trap				
<i>wadong</i>	16.05	14.13	3,682.00	4.36
<i>pintur</i>	4.99	4.28	1,117.00	3.97
Total	225.77	118.30		

Source: Amin et al. (1988).

Chapter 3. Demography and Economics

The annual lagoon fisheries catch in 1987 using the traditional gear was about 2,700 t worth Rp 1,419 million (Amin et al. 1988). Of this, 74% was caught with tidal traps. Note that this estimate is significantly higher than that made by Naamin (1991).

Shrimp account for about 60% of the total catch in Segara Anakan. *Penaeus indicus* and *P. merguensis* are the most valuable. On the average, the shrimp catch consists of juvenile metapenaeids (50%) and penaeids (33%). During a 12-month period in 1987-1988 and using the same four types of gear described above, Amin et al. (1988) reported that 1,483 t of shrimp were caught from the lagoon. From July 1987 to July 1988, Naamin (1991) reported 932 t of shrimp caught from the lagoon. According to Naamin (1991), MSY for the lagoon shrimp population is 605 t/year; therefore MSY had been exceeded.

Crabs, especially the mudcrab, *Scylla serrata*, are also caught in the lagoon. The mudcrab is caught using bamboo traps and lift nets, and their respective mean catch rates are 4.5 and 3.2 kg/trip/day. Seasonal fluctuations in catch using these gear are attributed to the prevailing monsoon.

The peak fishing season in the lagoon occurs from July to December; the other months are used for gear-repairing and farming. Income depends on the type of gear used. The annual average catch using the trammel net was 179.28 t valued at Rp 157.92 million (Rp 880.86/kg) while for the tidal trap (*apong*), it was 1,041 t valued at Rp 466.68 million (Rp 448.30/kg).

When the number of units operating during peak season is considered, the value of the catch is even less (Rp 4.5/kg/unit for trammel net and Rp 1.40 kg/unit for *apong*). In 1987, there were 964 fishermen in Segara Anakan with an average monthly catch of 225.77 t valued at Rp 118.30 million (Amin et al. 1988). Budihardjo (1988) reported that in 1987, the fishermen's monthly income per household ranged from Rp 75,000-Rp 150,000 or an average of about Rp 10,000/capita/month. It was not sufficient to support a family and was below the national poverty level of Rp 14,600/capita/month. Incomes from other activities were also below the national poverty level.

Aquaculture

The government has encouraged aquaculture development to compensate for the decrease in shrimp production from the offshore trawling ban. A trial project in Kampung Laut was set up in 1983 by the Fisheries Service of Cilacap (FSC) to provide assistance in design, construction and management of brackishwater ponds (*tambak*) by cooperative (*kelompok*) or individual (*rakyat*) management. The areas designated were near Muara Dua, Karang Anyar, Klaces and Motean (ECI 1987). In Klaces, there are 7 ha of *kelompok*

Chapter 3. Demography and Economics

ponds and 17 ha of *rakyat* ponds; some of the latter are not in use. In Nusa Kambangan, there are 9 ha of *kelompok* ponds and 20 ha of *rakyat* ponds. About 4 ha of the former were abandoned, being unsuccessful, due to lack of community spirit.

The ponds at Klaces have proven successful for production of tilapia (*mujair*) and *Puntius* (*tawes*). Ponds with an average size of 5,000 m² were stocked at a density of 5 fish/m². After six months, about 400-500 kg/ha of tilapia weighing about 200 g each were harvested and sold for Rp 500/kg in Pangandaran and Rp 1,000/kg in Cilacap (ECI 1987).

The area between Klaces and Motean has been recommended for aquaculture development (White et al. 1989). Aquaculture failures were due to a variety of reasons including acid soils, high silt content of the lagoon water, highly variable environmental conditions (e.g., fluctuating salinity regimes due to freshwater influx) and sociocultural factors (ECI 1987).

Farmers in search of better living through acquisition of land and working opportunity move to Udjung Alang Bahru as they are attracted to the relative success of integrated rice-fish culture there (ECI 1987; ET and Sujastani 1989).

Integrated fish culture using red and Nile tilapia is being developed by Perhutani in Jojak, Cilacap. Tilapia is cultured along the periphery of the pond, which is about 40% of the total pond area, at a density of 5 fish/m². Perhutani provides the capital for pond construction and fish seed while the fishfarmers manage the ponds and receive 50% of the fish produced.

Although shrimp larvae are abundant in the lagoon, pond culture is constrained by acid soils (pH 3), siltation and predation. Other species considered to have aquaculture potential are mullets and mudcrabs which can tolerate the conditions of the lagoon area. But the fry of these species must be caught from the wild. Few larvae are found in the lagoon (Amin et al. 1988).

Mudcrabs (*Scylla serrata*) live in mangrove areas of Segara Anakan and are extensively exploited. No attempt has been made to manage the mudcrab fishery, but some cage culture is being done. Amin et al. (1988) recommended the culture of these crabs because they are plentiful in the lagoon and are well adapted to the environmental conditions. In addition, the economics of raising them in cages or ponds is favorable since their natural food is readily available. Crab culture could relieve fishing pressure on the wild fishery.

The oyster (*Crassostrea* sp.), although indigenous, is not abundant and not well adapted to the high silt content of the water and its culture is not considered economical.

Chapter 3. Demography and Economics

Water fowl, such as a local species of duck (*bebek*) and Manila duck (*mentok*), are beginning to be raised in the area for extra income. Species that are well adapted to the estuarine environment hold some potential for propagation, particularly with fish culture as an integrated system.

Forestry

Mangrove trees are exploited to provide wood for construction of houses and fish traps and for firewood, causing forest denudation. No accurate data are available for mangrove wood utilization. Assuming that half the residents (4,000) harvest 4 kg of wood daily, the annual harvest would amount to 5,840 t of mangrove wood. Firewood sells in Cilacap for Rp 15.00/kg, making this industry worth Rp 87.6 million/year. However, the conversion of mangrove areas to rice farms and agriculture is the largest single factor in reducing the size of the forest. Some conversion to aquaculture has also taken place (Fig. 3.4).

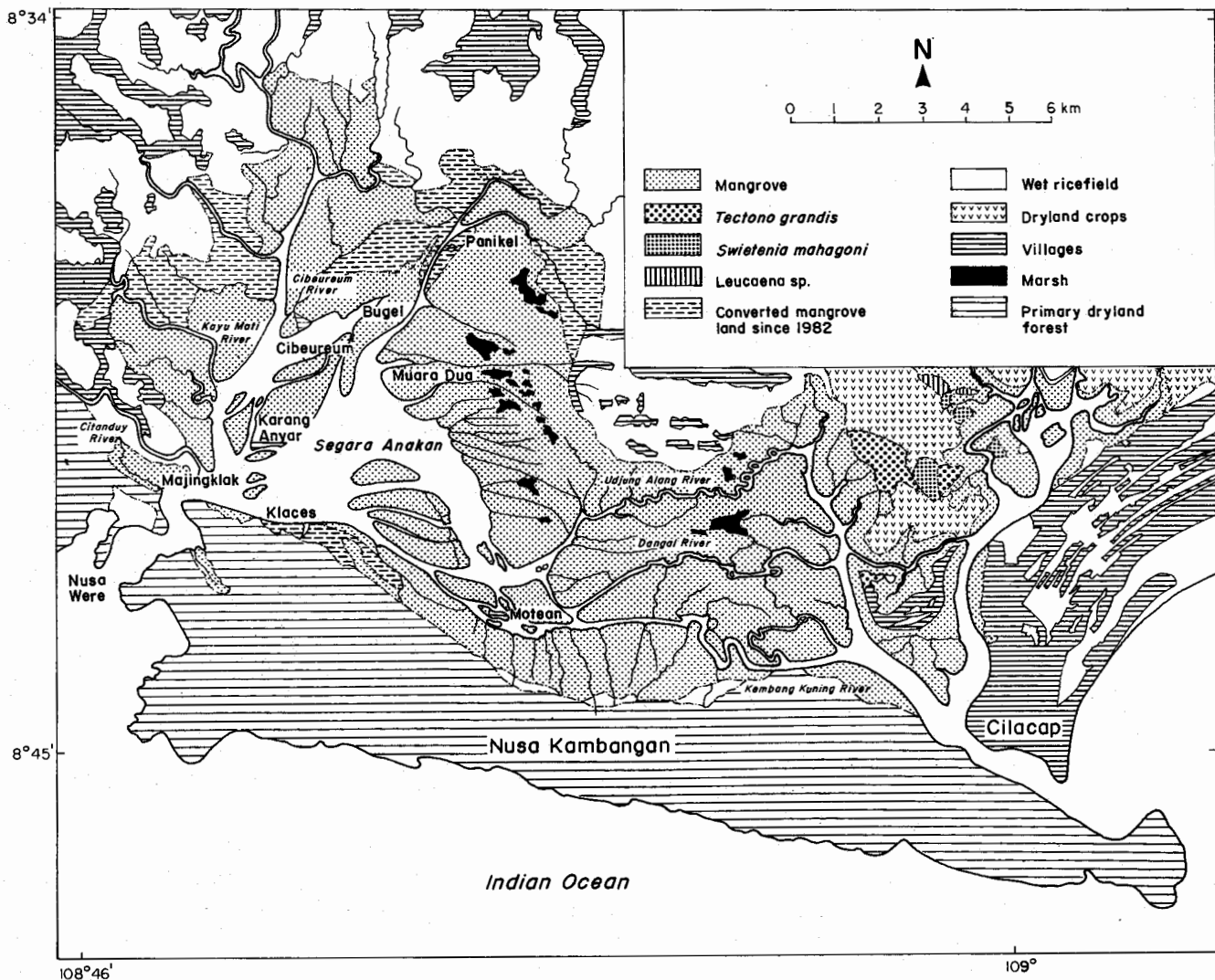


Fig. 3.4. Land use in Segara Anakan according to Perhutani (Soemodihardjo 1989).

Chapter 3. Demography and Economics

Mangroves show a trend of increasing degradation away from the lagoon and towards the inhabited areas along the outside perimeter of Segara Anakan mangrove forest. This may indicate that fisherfolk have less impact on the mangrove conditions than those living outside the lagoon.

Agriculture

As of 1989, about 51% of the management area was devoted to agriculture. Most residents of Kampung Laut participate in this industry. The major crop is rice. Although no total rice production data have been collected, an estimate can be made of production potential based on mean production of 5 t of rice/ha multiplied by 150,000 ha of rice fields. This yields 750,000 t of rice worth Rp 225 billion (at an average price of Rp 300,000/t). Nonrice agricultural production is listed in Table 3.4. Small rubber plantations provide an additional source of income.

Table 3.4. Agricultural production in Segara Anakan.

Crop	t/year	Value (Rp)
Rice	750,000	225,000,000,000
Banana	5.16	1,549,230
Corn	0.30	8,512,950
Cassava	96.93	9,693,000
Peanut	2.00	1,500,000
Soy bean	26.00	19,500,000

Source: CPB (1989).

Each year, more mangrove forest and newly formed land are converted to agriculture. Most of the conversion to paddy fields is done outside the perimeter of the mangrove forest. Some conversion was started along the northern edge of Nusa Kambangan and the western half of Karang Anyar. Significant paddy conversion has also occurred along the western edge of the lagoon, an area primarily populated by migrants from West Java.

SOCIOECONOMICS

In 1835, the Dutch government built custody stations in Segara Anakan to protect navigational channels. The first dwellings were established then and later developed into villages. The village is considered the smallest unit of government (Sujastani 1989).

Fishing is the dominant source of income. The others are rice farming, aquaculture, services and harvesting of mangroves. In 1982, 67% of the households earned less than Rp 31,000/month while 35% earned less than Rp 17,000/month. About 50% of the fishermen earned less than

Chapter 3. Demography and Economics

Rp 180,000/year which was not sufficient to meet basic needs (Hardoyo 1982). This situation improved by 1987 when most workers earned between Rp 45,000 and 150,000/month (Table 3.5). However, taking into account inflation, the improvement was not much.

Table 3.5. Returns from day-labor and other livelihood activities of people in Kampung Laut, 1987.

Activity/labor	Potential earning (Rp)
Extractive	
water carrier	5,000/day
mangrove cutter	5,000/day
frog keeper	4,000-4,500/night
bird keeper	3,500/day
nipa collector	3,000/day
firewood collector	3,000/day
eel (for bait) collector	2,500-3,000/day
shell collector	2,500/day
sand collector	2,000-2,500/day
limestone collector	1,500/day
Service	
building laborer	3,500-4,000/day
casual worker	2,000/day
tailor	1,500-2,000/day
fishpond laborer	1,500-1,750/day
farm laborer	1,500/day
fishing laborer	1,500/day
massage woman	1,000-2,000/day
barber	500-1,000/day
housekeeper	15,000-20,000/month

Source: Budihardjo (1988).

Land Use and Ownership

Segara Anakan area covers 96,000 ha, composed of 32,500 ha of the total lagoon environs and surrounding land, and 63,500 ha of the eastern and northern areas of Sidareja. Land ownership in some areas of Segara Anakan is not clearly defined.

Four areas on Nusa Kambangan are gazetted as strict nature reserves under the future control of the Directorate General of Forest Protection and Nature Conservation (PHPA). There are six prison camps on the island.

Land-use patterns are constantly changing (Napitupulu and Ramu 1982). Land use in 1972 and 1975 is shown in Fig. 3.5. By 1986, land in Citanduy Basin was primarily used for agriculture (57%) and forestry and plantation (33%) (RMI 1986).

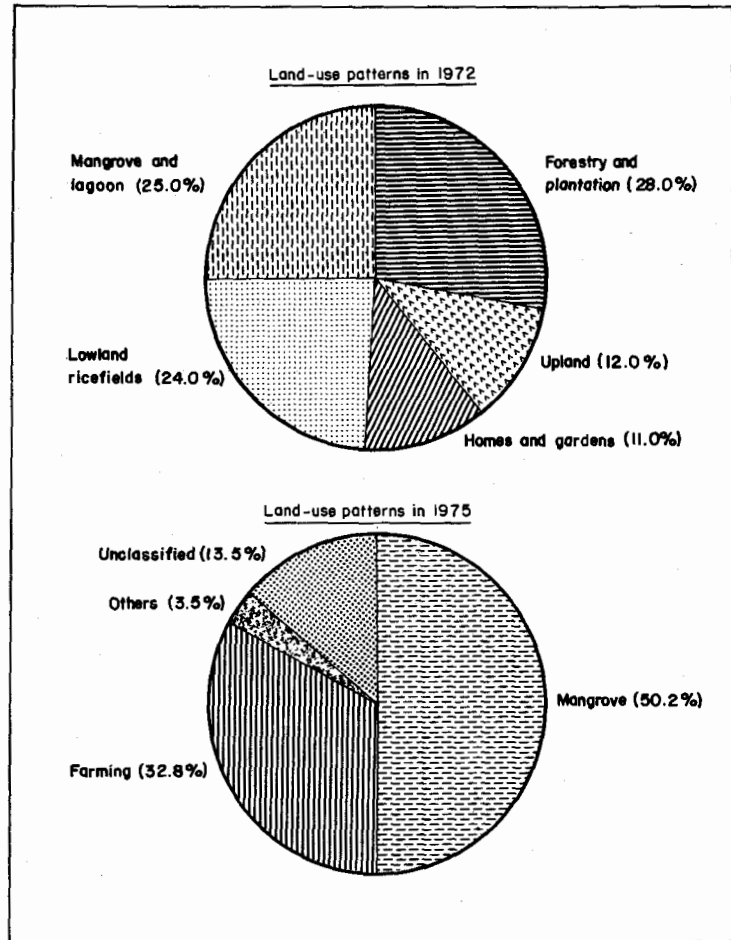


Fig. 3.5. Land-use patterns in Segara Anakan.

The residents of Kampung Laut are closely tied to their environment. Although still primarily dependent on fishing, an ever increasing number are turning to farming. This transition is placing a heavy burden on the mangrove forest which is being exploited and converted at an unsustainable rate. In Chapter 4, details of the management issues facing the region are presented.

CHAPTER 4

COASTAL AREA MANAGEMENT ISSUES

The management issues affecting Segara Anakan can be divided into three broad classes: environmental quality, resource exploitation and institutional concerns (Table 4.1). Environmental quality issues involve anthropogenic changes to the natural state of ecosystems in the management area such as pollution and sediment infilling of the lagoon. Resource exploitation issues deal with the rate and manner of utilization of natural resources such as fish and mangroves. Institutional issues pertain to the operation of government agencies, particularly their interaction, and implementation of government policies. Commonly, a particular issue, such as poor health, will involve aspects of more than one class of issues.

ENVIRONMENTAL QUALITY

Water Pollution

The water quality of Segara Anakan has been studied extensively; biological and chemical characteristics are listed in Table 4.2. Based on these data, the water is classified as turbid, and mesotrophic to eutrophic (Birowo and Uktolseya 1982). Eutrophication caused by an oversupply of nutrients, primarily phosphorus and nitrogen, can reduce the productivity of the lagoon fishery. The sources of these nutrients are probably sewage and agricultural fertilizer.

Table 4.1. Coastal area management issues.

Environmental quality
Water pollution
Sedimentation (lagoon infilling)
Rare and endangered species
Resource exploitation
Forestry (mangroves)
Fisheries (lagoon and offshore)
Institutional concerns
(jurisdiction, integration, implementation)
Support for the management plan
Landownership
Infrastructure development
Transportation, health and education
Livelihood
Tourism and credit facilities

Chapter 4. Coastal Area Management Issues

Both inorganic and organic pollutants were found in Segara Anakan waters, but their concentrations were well below the levels considered to be dangerous for inland waters, even in Cilacap Harbor, which generally showed the highest level of pollutants (Table 4.2). Indonesia currently has water quality standards only for inland waters used for fisheries and animal husbandry. No standards have been adopted for coastal waters or brackishwater but a number of standards have been proposed by the Bureau for Population and the Environment (KLH), and the Centre for Oceanological Research and Development (CORD). The standard referred to in Table 4.2 is proposed by CORD.

Table 4.2. Pollution in Segara Anakan and Cilacap.

Water quality parameter	Mean	Maximum value	Standard deviation	Station	Standard limit ^a
Inorganic (ppb)					
Lead	13.9	32.4	4.2	CI	75
Iron	536.0	746.2	308.4	CI	5,000
Cadmium	1.4	3.5	0.8	CI	10
Nickel	8.4	20.8	5.4	CI	100
Organic (ppb)					
Aldrin	0.01-0.019				10
Diazinon	0.067-0.36				20
Hydrocarbon	0.12-1.05				5,000
Bacteria (MPN/100 ml)					
Fecal coliform	43	200	52	SA	1,000
Total coliform	319	2,150	445	SA	20,000
Fecal streptococci	147	600	118	SA	none

^aStandard limit for proposed water quality criteria for marine and estuarine ecology in Indonesia as proposed by CORD (Workshop on Marine Environmental Quality, Bogor, February 1984).

ppb - parts per billion

MPN - most probable number

CI - Cilacap

SA - Segara Anakan

Sources: Romimohtarto (1989); Thayib et al. (1991).

The primary sources of heavy metal pollution are believed to be industries and ships in the vicinity of Cilacap. Segara Anakan is naturally protected from the effects of much pollution originating in Cilacap because local circulation patterns limit the amount of water exchange between Cilacap Harbor and Segara Anakan. This is because relatively little water flows into Segara Anakan from the eastern entrance; most water exchange occurs at the western inlet. For all practical purposes, water originating in Cilacap Harbor will not pass west of Motean. Pesticide residues detected in the lagoon are

Chapter 4. Coastal Area Management Issues

believed to be left over from previous years when farmers used organochlorines; they have now switched to degradable organophosphate pesticides (White et al. 1989).

Microbial analysis of Segara Anakan waters collected from ten stations revealed that human and animal wastes are polluting the lagoon to a minor degree, but may exceed acceptable limits in some locations; levels vary seasonally and are higher during the wet season (Thayib et al. 1991). Bacterial counts are high near river outlets and in densely populated areas, where sanitary facilities are inadequate and wastes are directly discharged into lagoon waters.

Additional specific sources of industrial pollution include: Nusantara Cement Factory and limestone mining sites; Pertamina Refinery (crude oil); Sriwijaya Fertilizer Co.; Sentolo Kawat Fish Market; tankers in the Indian Ocean; and dredging of lagoon channels for maintenance of navigation.

There is an institutional aspect of the water quality issue. The KLH and the Ministry of Health (MH) are the only national agencies responsible for water quality control. Although they can set water quality standards and make recommendations, they have no mandate to implement pollution control programs.

Sedimentation

Accelerated sediment deposition in Segara Anakan reduces its area available for fisheries and impairs its nursery and feeding functions for many commercially important aquatic species, notably shrimp. A consequent decline in the valuable offshore shrimp catch is the most serious economic threat to the region.

Accelerated sediment deposition is the major environmental problem affecting Segara Anakan. Although no studies have documented changes in land use in Citanduy Basin, increasing soil erosion due to poorly planned land use is believed to be causing increased sediment delivery to river basins. Suspended sediment is carried from Citanduy and the upper watershed to the lagoon by Citanduy, Cibeureum and Cikonde Rivers. The Citanduy River alone carries an estimated 9 million t/year of sediment load (Ludwig 1985). Some of this reaches the lagoon, reducing transparency to as little as 20 cm. Five to 10 million t of sediment enter the lagoon from all sources each year; about 2.63 million t/year are deposited (ECI 1975; 1987).

Sediment deposited in the lagoon has decreased the surface area of lagoon waters from 6,400 ha in 1903 to 2,700 ha in 1986 (Fig.4.1). On the newly accreted land, mangrove growth is prolific (Fig. 4.2). Further sedimentation is predicted to completely fill in the lagoon, leaving only narrow channels (Fig. 4.3) within a period of 4.5 to 31 years (ECI 1987).

Although sediment deposition in an estuary is a natural process, accelerated sedimentation caused by man's activities in the watershed is threatening to decrease the socioeconomic value of the lagoon by reducing its area available for fisheries. About 90% of the inhabitants of Kampung Laut are engaged in fishing. Ecologically, the lagoon is an important nursery and feeding grounds for many commercially important aquatic species, especially

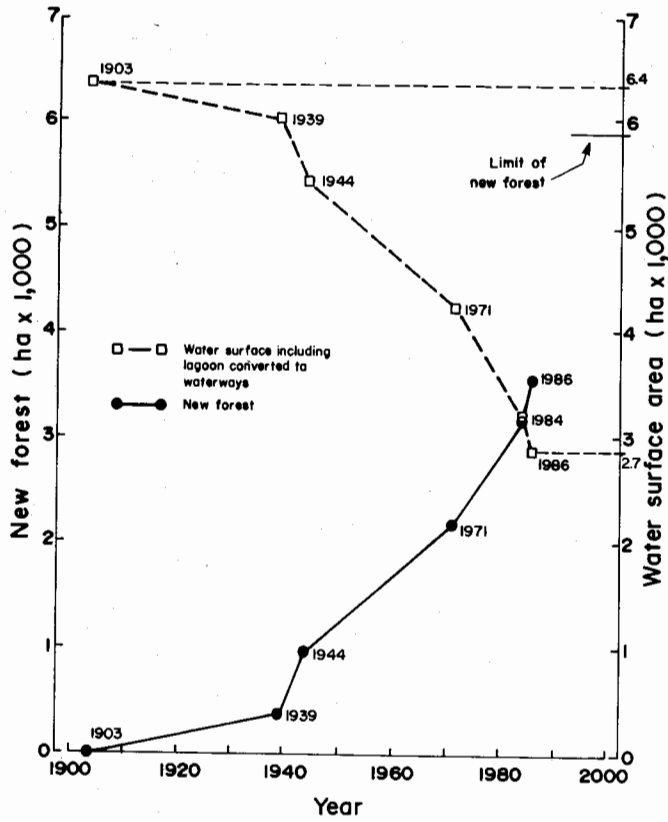
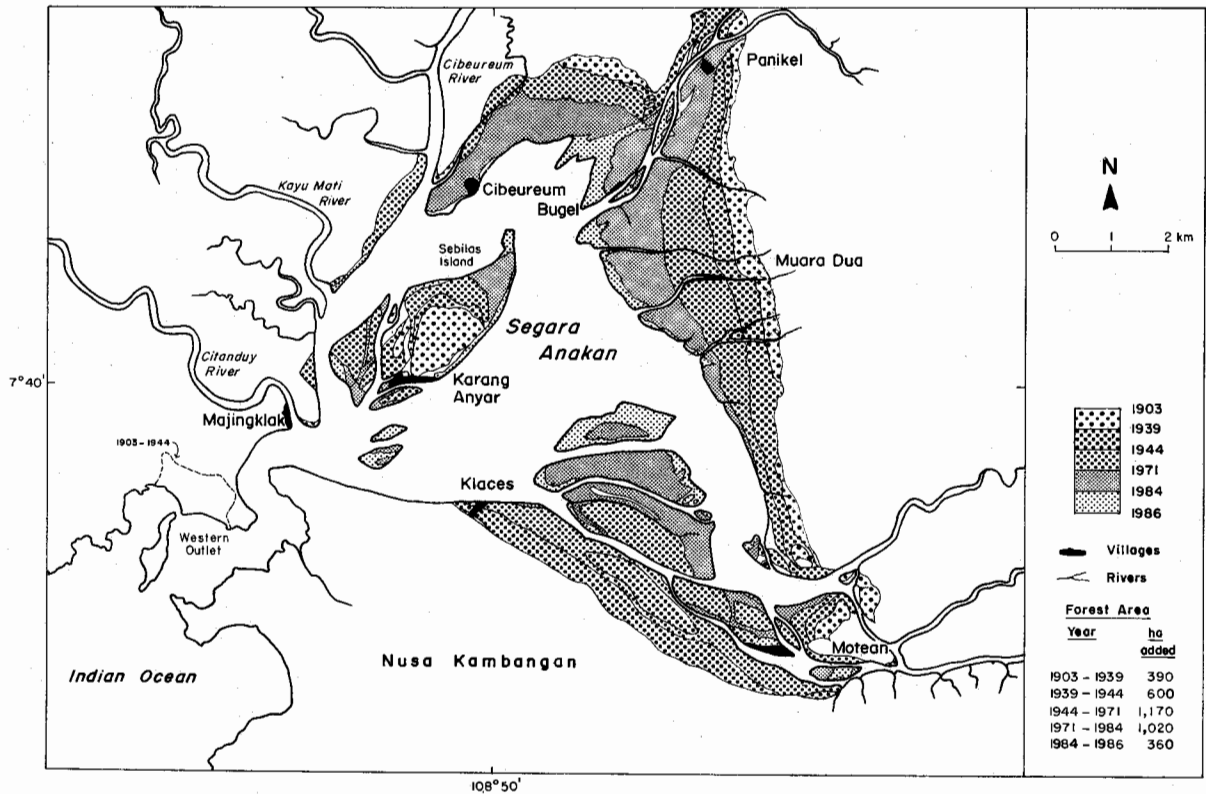


Fig. 4.1. Changes in mangrove forest and water surface area since 1903 (high tide) (ECI 1987).

Fig. 4.2. Land accretion and mangrove forest area from 1903 to 1986 (ECI 1987).



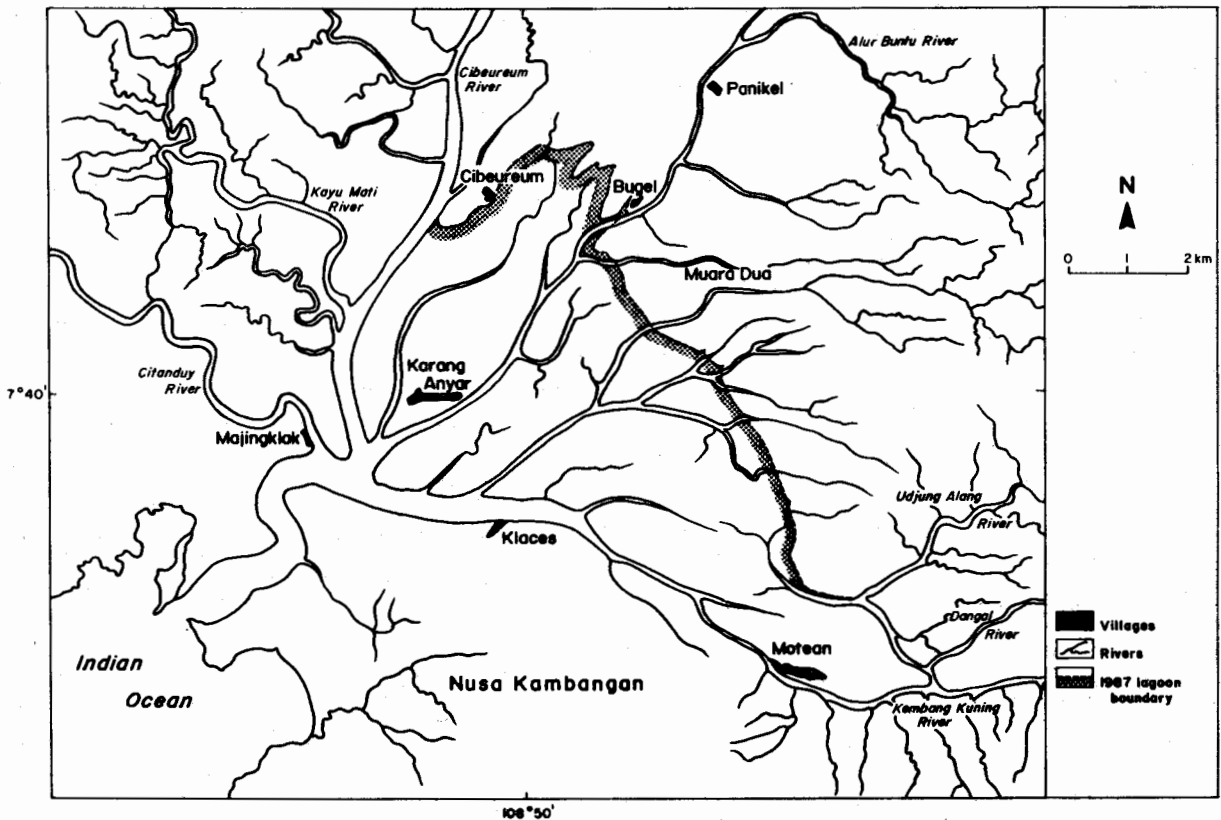


Fig. 4.3. Projected shape of Segara Anakan following complete sediment infilling (ECI 1987).

shrimp. Hence, damage to the lagoon fishery itself is a potential problem, but the most serious threat to the economic future of the region is a decline in the valuable offshore shrimp catch if the lagoon's nursery function is impaired by sediment infilling.

Rare and Endangered Species

As a result of the deterioration in the quality of the mangrove forest and the decrease in the area of lagoon waters, the habitat of several rare and endangered species has been reduced. Habitat reduction is a primary threat to the ability of these species to maintain viable populations. Of particular concern is the milky stork which uses Segara Anakan as one of only two breeding sites in the country. Other species of wading birds, which spend the summer in temperate habitats, migrate to Indonesia to use the lagoon as an overwintering site. A reduction in the size of the lagoon is not expected to affect mammalian species, however.

One successful mode of sustainable development for mangrove areas is ecotourism. If ecotourism is going to be developed in this area, it will be particularly important to maintain populations of rare and endangered species.

RESOURCE EXPLOITATION

Mangrove Forest

As discussed in previous chapters, the mangrove forest of Segara Anakan is the largest in Java and is an important resource for both local residents and all Indonesians. This is because of the forest's role in providing nutrients for the lagoon that in turn functions as a nursery for valuable offshore fisheries and as a habitat for rare and endangered species.

The mangrove forest is constantly changing in size, character and shape. Some of these changes are caused by natural processes while others are the result of man's activities. Due to siltation of the lagoon, new land is building up along its shoreline. This land is constantly subject to colonization by the floating seeds of mangrove trees. This has resulted in new mangrove forest being added, especially at the inner margins of the lagoon. At the same time, human activities are damaging and reducing the area of existing mangrove stands. Mangrove branches are cut and used directly as a source of building material and as fuel; some areas of the mangrove forest are also being converted to agriculture and aquaculture.

The net size of the mangrove area is believed to have decreased from 15,554 ha in 1974 to 14,100 in 1987 (ECI 1975; 1987). Of this total, 55% is classified as disturbed (Categories 3, 4 and 5 in Table 2.3) principally through forest cutting and trimming. Few mature mangrove trees, i.e., with trunk diameters greater than 10 cm, are found in Segara Anakan. The average number of cut tree-stumps is 718/ha with a range of 27-4,517/ha (Soemodihardjo 1989).

By 1980, about 11% of the mangrove forest in 1974 had been converted to agriculture and aquaculture. Mangrove habitat converted to agricultural land totalled about 1,050 ha (800 ha in Ujung Alang, 200 ha in Panikel and 50 ha in Ujung Gagak) (Ludwig 1985). By 1989, conversion of mangrove land to agriculture had increased to 300 ha in Panikel (Soemodihardjo 1989). Conversion to brackishwater aquaculture ponds consumed only 16.5 ha. Land use and vegetative cover categories of Segara Anakan are shown in Fig. 3.4.

Several resource-use conflicts affect the sustainable development of the Segara Anakan mangrove forest. Although no figures are available, local residents harvest mangrove wood for use as fuel (*Rhizophora* spp.) and as building material (*Bruguiera* spp.) to be marketed both inside and outside the community. There is preferential harvesting of the two genera noted above for the given uses. Because forestry laws specifically prohibit mangrove cutting, villagers have developed tactics to disguise their activities, such as cutting mangroves inside the forest, while leaving the outer forest margins pristine (Soemodihardjo 1989). Enforcement of forestry laws is limited by lack of motivation, personnel and equipment.

Given this situation, one area of resource-use conflict is between the state-sponsored forestry concessionaire (Perhutani) and the villagers. Another is between DGF, which would like to develop more aquaculture ponds, some potentially by converting mangrove lands, and Perhutani. Additional tensions are created by the desire of both local villagers and outsiders to develop new agricultural lands from the mangrove forest.

Although the mangrove forest is a renewable resource, the fact that there is little forest untouched by harvesting, and the absence of trees larger than 10 cm in diameter suggest that harvesting may be occurring at an unsustainable rate. More information is needed on the economic value of the forest to the local residents and what level of harvesting is considered sustainable.

Fisheries

In contrast to the assumptions of many observers that fisheries production is declining due to the reduction in area of Segara Anakan waters, fish and shrimp catch has increased in Segara Anakan over the past several years. It is not clear how much of this increase may be attributed to greater fishing effort. Theoretically, as the lagoon size continues to decrease, a point will be reached where fish and shrimp catch will decline if the same effort is maintained--but this has not yet happened.

It is also not known what effect, if any, the harvest of primarily juvenile shrimp inside the lagoon (Naamin 1991) may have on the offshore shrimp fishery. If, for example, food is limited in the lagoon, then harvesting a certain number of juvenile shrimp would be beneficial because it would allow those that remain to have adequate nutrition for grow-out. On the other hand, if food is not limited, then the harvest of low-value juveniles rather than high-value adults (following migration offshore) would be a poor economic decision from the standpoint of offshore fishermen and the national government. Of course, the need of the local people to have a source of livelihood must outweigh purely economic decisions.

The banning of trawling in 1980 removed the major direct fisheries conflict in the management area between commercial and artisanal fishermen. Since current catch figures are lower than those during the trawling era (due to the reduction in effort), and the latter figures were less than the estimated MSY for the Cilacap fisheries, it appears that some trawling could be allowed to return. Although the opposite is more likely to occur, the danger that overfishing offshore may reduce lagoon catch needs to be evaluated. So far, available data indicate that during the trawling era, there was not a close relationship between trawl and lagoon catch, even when considering various lag periods to account for maturation of juveniles (Naamin 1991).

The primary fisheries problem appears to be the threat to lagoon fisheries posed by sediment infilling. This would be expected to reduce the value of both offshore and lagoonal fisheries. This is an indirect resource-use conflict

between upland farmers and fishermen who utilize Segara Anakan and associated offshore fisheries. This relationship exists because it appears likely that upland farming practices are the primary cause of accelerated soil erosion, sediment transport and deposition in the lagoon. The time it would take for complete infilling of the lagoon would depend on upland land use.

It should be noted that only 3% of fishermen in Kampung Laut reported that they fish outside the lagoon. Offshore fisheries are currently underexploited. This suggests that the nearshore fishery off Nusa Kambangan could be exploited, at least seasonally, by these fishermen provided they have access to appropriate boats and fishing gear.

INSTITUTIONAL CONCERNS

Support for the Management Plan

The agencies which will be involved in the implementation of the management plan do not communicate regularly. These are the Ministry of Public Works (MPW), MT, MTPPT, Perhutani, PHPA, BAPPENAS, BAPPEDA and DGF, as well as the *Bupati* (Cilacap). There has also been a lack of coordination on foreign-assisted projects, and this has made some government ministries competitive and secretive in their negotiations, undermining cooperation and integration in planning and implementation.

Furthermore, the current IMPSA was not included in Indonesia's Five-year Plan (*Repelita*) for 1989-1994 or in BAPPENAS's annual *Blue book* (list of approved development projects for which the government of Indonesia is seeking foreign financing). This situation compounds the difficulty in enlisting the cooperation of different agencies in the final implementation of the plan.

At present, the *Bupati* (Cilacap) is enthusiastic about IMPSA, but has not been given support in implementation by national agency offices. The Department of Home Affairs (DHA), although a potential source of support to provincial and local governments in regional planning and development, has not yet been fully involved in the planning process. The issue of support has not been properly presented at the national level. A lack of coordination especially regarding implementation of the land-use plan and enforcement of environmental laws (Statute No. 4/1982) under the office of SMPE has led to confusion among the general public.

One reason for the difficulty in arranging for participation of national agencies is that personnel at the offices of the *Bupati*, BAPPEDA and other line agencies at Cilacap have little experience in planning and management of natural resources, especially in using an integrated approach and in EIA. These personnel need more training in these areas.

Landownership

Landownership issues are complex and involve traditions, ecological and socioeconomic conditions, and institutional and legal aspects. An equitable resolution of conflicts is necessary for the government to effectively implement its management plans.

Landownership in some areas of Segara Anakan is not clearly defined. The parties involved are Perhutani, NLUB, the local residents represented by the *Bupati* and NKPA under MJ (Sujastani 1989). Issues concerning landownership are complex and involve traditions, ecological and socioeconomic conditions, and institutional and legal aspects. Despite years of discussion, there are still serious conflicts among several government agencies regarding control over land due to inconsistent laws and regulations (Table 4.3). An equitable resolution of these conflicts is long overdue and is necessary for the government to effectively implement its management plans.

The ability of a given area to support people is directly tied to population density and available resources. Compared to the fast-growing population in other parts of Java, the population of Kampung Laut has remained relatively stable at about 8,000 since 1975, even showing a decrease in some years. Despite this trend, increased demands on natural resources have come from greater utilization of arable lands and from growing fishing effort by both local residents and nonresidents.

Table 4.3. Institutions and laws affecting land use in Segara Anakan area.

Law	Policy	Objective	Institution/head
Agrarian Act No. 5/1960	Land, water, air resources are under the state's authority. All rights over the land have social functions.	Control and manage the use of land, water, air resources. Regulate all rights over and designate titles of land.	Local government, e.g., NLUB through the <i>Bupati</i> , Cilacap
Local Government Act No. 5/1974	Decentralize central government's authority.	Regulate local government's authority.	Ministry of Home Affairs (MHA), Government of Central Java and the <i>Bupati</i> , Cilacap
Government Decree No. 11/1988	Cocordinate national development.	Coordinate national development in the provincial levels.	Government of Central Java and the <i>Bupati</i> , Cilacap
Environment Act No. 4/1982	Harmonize development of the environment.	Control and manage the national environment.	SMPE
Forestry Act No. 5/1967	Use forestry for the welfare of the people.	Explore, exploit, manage and conserve the forest.	Ministry of Forestry (MF), Perhutani
<i>Hukum adat</i>	Recognize the existing unwritten law of the local people.	Regulate the relationships between the local people and land, water and air resources.	Village head and local community

Changes in livelihood are creating more demands for land. Although the lagoon continues to provide a productive fishery, there appears to have been a significant shift in livelihood of residents from fishing to farming. As of 1990, about 50% of heads of households considered themselves fishermen, a

Chapter 4. Coastal Area Management Issues

decrease of about 25% since 1987. During the same period, those who considered themselves farmers increased dramatically from 17.3 to 46%. Since many men participate seasonally in both activities, part of this shift may be an artifact of the research questionnaire. But the general trend seems to be that the demands for arable land will increase in the future, exacerbating land-use conflicts.

Kampung Laut residents claim ownership of land through *hukum adat* or *hak ulayat* (the right upon an area). Under this system, the person who first clears a section of forest or settles on a piece of land is entitled to it. The inhabitants of Segara Anakan claim that their ancestors were among the first settlers, and their descendants have been living there for more than three generations. Some residents of Motean claim that their ancestors were landowners of at least some parts of Nusa Kambangan before 1900; that is, before the Dutch government converted it into a penal colony and forced residents to migrate to Kampung Laut (Sujastani 1989).

An agreement between MJ and the *Bupati* allows 160 families to reside, farm and use the freshwater resource on the northern, accreted shore of Nusa Kambangan, but they will not be given titles to the land.

A special conflict has developed over who has the rights to new lands created by sediment deposition in the lagoon and by landslides that have enlarged the northern shore of Nusa Kambangan. Segara Anakan is within the boundary of the state-owned forest (Sujastani 1989), and according to the Forestry Act, newly formed lands that are forested are designated as tidal forests and reserves under the jurisdiction of Perhutani.

The NKPA argues that disputed land on the northern shore of Nusa Kambangan is part of the island, and therefore under its jurisdiction, since the land was formed due to landslides from slopes along the shore. In contrast, residents of Ujung Alang say that the natural boundary of the island is the old rocky shore, and that the newly formed lands have filled in the lagoon, an area where they previously fished. They claim all newly formed lands on the northern coast, and have already distributed about 400 ha among themselves.

The Office of Agrarian Affairs (OAA) believes that the Agrarian Reform Law (1960) gives it authority over all newly formed lands. A basic principle regarding agricultural land is that it must be cultivated by the owner.

According to the interpretation of Brotosusilo (1988) and Koesoebiono et al. (1989), the Local Government Act (1974) states that the *Bupati* as head of a *kabupaten* (district) has the highest authority and legal standing to manage all state lands in the *kabupaten* and to coordinate the activities of all vertical and horizontal offices. However, it is OAA which is the executor. Article 33 of the Constitution of Indonesia and Article 2 of the Basic Agrarian Law stress that

Designating one government agency to take responsibility for the development of Segara Anakan will reduce interagency conflicts and allow implementation of policies that strike a balance between the needs of the local residents and all Indonesians.

Chapter 4. Coastal Area Management Issues

land should be used for the greatest attainable welfare of the people. The OAA, the *Bupati* and BAPPEDA are in agreement that this means they should have authority over new lands while MJ and Perhutani have a different interpretation.

The SMPE also has an interest in this situation. The Environment Act of 1982 gives it the authority to conserve the environment when land is being developed such that the impact on adjacent areas will be minimized.

Clearly, one of the greatest challenges facing the government is to designate one agency to take responsibility for the development of the Segara Anakan area. This will reduce interagency conflicts and allow implementation of policies that provide a balance between the needs of the local people and all Indonesians. For example, although the mangrove forest is technically under the jurisdiction of Perhutani, it is not managed in a manner consistent with the needs of the local communities. Although Perhutani's social forestry program involves the leasing of land for conversion to other uses, adequate land is not made available to the local community in areas where the mangrove habitat is already damaged beyond rehabilitation.

Some agencies have not realized that the existing guidelines for jurisdictional control are no longer appropriate, given the changes in the area. Inaction only encourages local residents to break the law and do what is practical for their economic survival.

Infrastructure Development

Infrastructure development in the Segara Anakan management area is poor. Roads, markets, schools and medical facilities are lacking.

Transportation

The transportation issue has two sides. Currently, access to much of Kampung Laut is only via boat. There are four ferryboats to Kalipucang and two to Sidareja; Panikel, Bugel and Muara Dua have no ferry service. Some waterways are so narrow and shallow, only canoes are able to pass. This limits the attractiveness of the area to potential settlers. If new roads are built that open up more of the area to outsiders, it is to be expected that migration to the relatively productive area will increase. At the same time, lack of access to good roads is a hardship for the original inhabitants. This factor deleteriously affects the ability of the government to provide quality health care and educational services.

Health

The quality of health in the area is generally poor. There are no health care facilities or doctors. Malaria, malnutrition and skin diseases exist in some areas. Anecdotal reports suggest that death due to malaria is common, especially among new immigrants who lack resistance to the local strains of the disease. There is a lack of potable water, housing and sanitary facilities.

Chapter 4. Coastal Area Management Issues

Except for Klaces and Udjung Alang Bahru, the villages have no source of fresh groundwater. Rainwater is normally the source during the wet season, or at Nusa Kambangan, from wells; otherwise, water is purchased.

Education

There is a low level of formal education in the area. About 10% of the residents are illiterate and in 1984, 67% of the population had had no schooling. This improved to 50% by 1988 (Budihardjo 1988). Each village has an elementary school but the facilities are poorly maintained. A new government program called *Bebas Buta Huruf* (i.e., free from illiteracy) was launched to eliminate illiteracy and is now improving education among the general population. There are no secondary schools, so some parents send their children outside of Kampung Laut to study in Cilacap or Kawunganten at a cost of up to Rp 60,000 per month. One of the reasons why the educational system is not fully operational is that teachers, many of whom live in Cilacap, find it difficult to commute to schools in Kampung Laut.

One of the constraints to effective conservation and management of the natural resources of Segara Anakan is the low appreciation of their value by local inhabitants and government officials. Understandably, the poverty of the local inhabitants causes them to focus on the potential for short-term economic gain when considering various options for resource utilization. Resource management should be incorporated into the school curricula and other public awareness programs.

The local communities are reluctant to participate in planning and management of their resources for several reasons. First, the government agencies controlling land use have not been responsive to their needs. Second, the potential benefits from CRM are not clear to local communities. Incentives, such as fishing cooperatives, are lacking for local residents who participate in offshore fisheries on a part- or full-time basis. Third, community-based planning and management models have not yet been effectively tried in the area; so far, efforts have been made by national agencies and consultants who are seen as "outsiders". On only a few occasions has the *Bupati* worked directly with village heads on socioeconomic programs.

Livelihood

Tourism

Tourism development has been overlooked by both the government and private groups in the search for alternative livelihood sources for Segara Anakan residents and new business opportunities. Given proper government support, there is good potential for both domestic and international tourism development. The evidence is found in Pangandaran, a small resort area located on a peninsula 10 km west of Segara Anakan. Due to poor overland transport to Pangandaran, ferries are used to bring most

Chapter 4. Coastal Area Management Issues

tourists from Cilacap through Segara Anakan. In 1989, 13,987 foreign and 63,457 domestic tourists visited the area, but apparently, very limited attempts have been made to tap this market for handicrafts and services.

Although some income can be derived from tourists transiting the lagoon on their way to Pangandaran, there is greater profit in making Segara Anakan a tourist destination in itself. Given the low annual earnings of residents, a small tourist industry could provide a significant additional source of income. As is always the case, care must be taken to limit cultural conflicts between native inhabitants and foreign visitors.

Credit facilities

Respondents to socioeconomic questionnaires consistently point to a lack of credit as a primary constraint in their attempts to improve their standard of living. Since most villagers do not hold titles to their land, they do not have a collateral for obtaining credit.

Alternative economic opportunities

Although some fishermen have already switched to full-time farming out of necessity, many are reluctant to change. Attempts by the government to train these fishermen to become full-time farmers are restricted by traditional barriers. Fishermen believe that they are not capable of learning a new trade. They find it difficult to change from the relative freedom of their lifestyle, including flexible daily work schedules and the ability to fish seasonally, to full-time farming. A fisherman can choose whether to go out fishing on a particular day. If the weather is bad, he may opt to stay home. A farmer must work on certain days, such as when the crop is ready to be harvested, regardless of weather conditions. The same barriers exist, but to a lesser extent, in promoting aquaculture as an alternative livelihood.

Based on analysis of 1989 aerial photographs, it is possible to estimate the extent of increase in farming since 1986. Assuming 1 ha per household, 1,750 households have switched to farming.

Newly opened land in Cibeureum amounts to about 350 ha. An equal number of full- or part-time farming households is assumed. The land opened adjacent to Karang Anyar is about 400 ha. A large number of fishermen are concentrated in this subvillage; however, due to its strategic location in terms of transportation, many are also engaged in trade.

Since 1986, the fishing population of Segara Anakan may have declined. During the reconnaissance survey in August 1990, only 20 fishing boats were observed in the lagoon area and the major rivers. If the land use and socioeconomic estimates are accurate, then the potential for overfishing may be low and the depletion of the lagoon may be much less advanced than has been assumed by others.

Chapter 4. Coastal Area Management Issues

Sociocultural factors must be taken into account when considering alternative livelihood opportunities to ensure a high degree of success.

There is a general lack of alternative livelihood opportunities in Segara Anakan. This lack pushes fishermen to increase fishing efforts to secure more income. One obvious alternative occupation, cutting mangroves for firewood, is illegal. Illegal land clearing and conversion of mangrove habitat will continue until a proper zoning scheme is enforced. There is a lack of practical information on the development of a viable aquaculture industry which uses local agencies, skills, protected waters and existing habitat. Pond and cage culture have not been adequately explored and tested. However, the recent introduction of crab culture was very successful.

There remains the problem of proper marketing channels between the fishing communities of Kampung Laut and Cilacap. The more expensive transportation system and pre-purchase market arrangements bring low prices to the local sellers.

Certain social aspects of life in Segara Anakan affect the ability of residents to make a living. Residents do not utilize their time effectively and productively, especially during off-fishing periods (LPM-ITB 1988). Saving for future use is uncommon, except in Cibeureum where a cooperative exists. Thus, people often lack funds to buy food and other necessities, especially during off-fishing season. They become dependent on middlemen-traders (*bakul*) who lend money at a usurious interest rate of 5% per week (LPM-ITB 1988). Thus, sociocultural factors must be taken into account when considering alternative economic opportunities for the villages to ensure a high degree of success of the programs.

Most of the management issues affecting Segara Anakan involve aspects of other management issues. Therefore, their successful resolution depends on using an integrated approach; e.g., the environmental quality problems cannot be solved without also resolving institutional questions regarding which agency has the authority to implement regulations. This strategy is discussed in Chapter 5.

CHAPTER 5

INTEGRATED MANAGEMENT PLAN

INTRODUCTION

The process of IMP involves analyzing various options for sustainable development in the context of the total environment, and recommending those that will benefit the most people. The bottom line is to maintain and improve the environmental quality of the lagoon and enhance the residents' quality of life.

Segara Anakan is important as an area of great biodiversity; as nursery grounds for commercially important marine species, particularly shrimp; and as a source of livelihood for residents. Development issues facing the government and residents of Kampung Laut were discussed in detail in the previous chapter. The most serious problem identified by the government is infilling of the lagoon by sedimentation, which has been accelerating due to the development in the Citanduy watershed, and is considered a threat to the lagoon's existence. Thus, the land area is expanding while the lagoon and associated fishing grounds are getting smaller.

To determine the most practical strategies for solving the sedimentation problem, the cost of maintaining the lagoon through artificial means must be weighed against its ecological and socioeconomic value. A decision must be made regarding the minimum size and volume of the lagoon that will be necessary to achieve the management goals.

The location and needs of the human population are a primary consideration in the formulation of the management plan. The major socioeconomic change since population data were collected in 1986 has been a shift in employment from fishing to agriculture. The population growth of Segara Anakan has been relatively low because of the transmigration program and the migration of some adults to Cilacap and other urban centers for employment. On the other hand, some agricultural development by new immigrants is creating conflicts between them and the original residents.

In addition, conflicting claims on the land of Segara Anakan have resulted in the unplanned use of the mangrove forest and conversion of newly formed land to agriculture. The mangrove forest is being overexploited due to demand for forestry products and agricultural development.

Major institutional issues involving several government agencies remain unresolved, particularly regarding landownership. These conflicting policies and claims of landownership have to be considered by SATF. Composed of representatives from FSC, Perhutani, NLUB, PHPA, Ministry of Education

Chapter 5. Integrated Management Plan

and Culture (MEC), MH and Kampung Laut and including the *Bupati* and BAPPEDA in Cilacap, the task force will undertake all aspects of planning a comprehensive management strategy for the sustainable development of Segara Anakan. The SATF is expected to coordinate and implement the projects and recommendations of this plan (see Chapter 6).

The process of IMP involves analyzing various options for sustainable development in the context of the total environment, and recommending those that will benefit the most people. In general, the welfare of the local residents should have first priority, but there may be situations where the welfare of all Indonesians may take precedence. The ultimate goal of the plan is to maintain and improve the environmental quality of the lagoon while raising the quality of life of the residents.

ZONATION

After identifying the issues affecting Segara Anakan, the next step in the planning process is to designate land-use zones. The formal process of zoning is valuable for two reasons. First, it forces planners, in consultation with regulators and the public, to catalogue available resources. Second, it allows for an orderly, planned utilization of those resources so that potential resource-use conflicts can be minimized. The zonation scheme is described below. A discussion of potential solutions to management issues follows. Finally, specific projects designed to address those issues are proposed in Chapter 6.

Zoning is valuable because it compels planners to catalogue available resources and makes possible their orderly, planned utilization that should minimize potential resource-use conflicts.

The zonation scheme applies to the management area as defined in Chapter 1. The plan has been developed and refined over several years in consultation with all concerned government agencies, representatives of the villages and NGOs. It attempts to reach a compromise among the conflicting claims of the various government agencies that were discussed in the previous chapter.

Because the goals of the management plan are both environmental protection and social upliftment, the zonation scheme was first designated based on ecological suitability for the use indicated, and then adjusted as necessary to mesh with socioeconomic requirements and government policy. In general, zonal boundaries were made without respect to landownership. In the future, as the complex questions regarding landownership are resolved, adjustments to the location of boundaries can be made.

One of the major goals of the zonation scheme is to preserve a healthy mangrove forest in Segara Anakan. Guidelines for zoning the mangrove forest are as follows. Since certain types of mangrove require an intertidal habitat, mangrove areas located in the intertidal zone should be preserved. At the same time, newly accreted land which has dried out and will soon be

Chapter 5. Integrated Management Plan

unable to support a mangrove ecosystem should be allocated for agriculture or aquaculture. The same is true for seriously damaged mangrove areas which do not warrant rehabilitation due to expense and greater demands for other resources. Buffer zones should always be established between conservation zones and areas to be developed for alternative uses. The size of the buffer zone will depend on the particular use.

Zoning should also be applied to the lagoon and rivers to secure a sustainable fish catch and a passage for marine species which use the mangrove areas as feeding and nursery grounds.

One aquatic and six land-based zones have been designated in this plan (Fig. 5.1). Two special zones have also been identified--the Ministry of Justice zone, which covers much of Nusa Kambangan, and the marine zone, which covers the coastal fishery out to the 60-m isobath. Management and

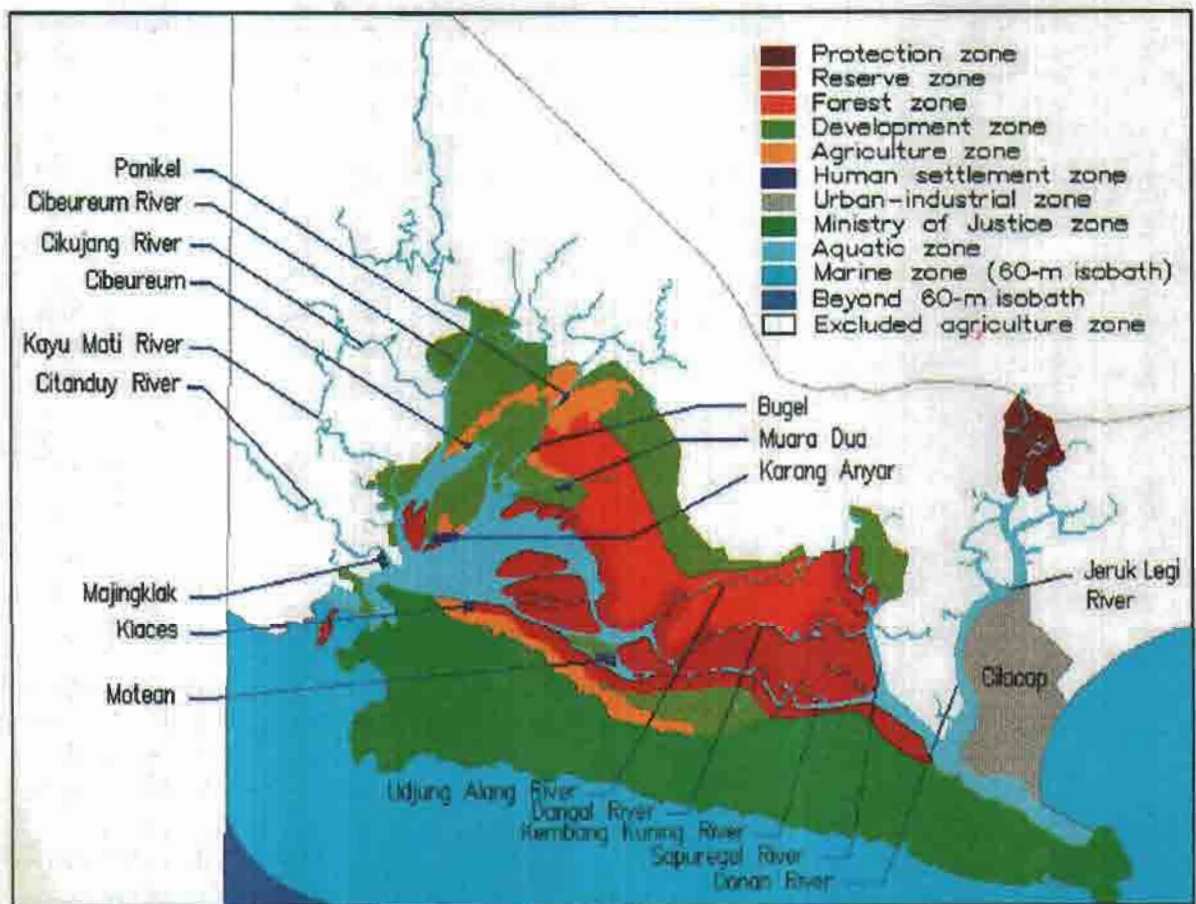


Fig. 5.1. Recommended zonation map for Segara Anakan.

Chapter 5. *Integrated Management Plan*

development of these two zones, however, are not considered in this plan in any detail because of legal and institutional constraints to be dealt with by SATF. The urban-industrial zone should be considered individually because the complexity of the development issues facing Cilacap warrants the development of a management plan specifically for this zone.

Land-based Zones

Protection zone

In this zone, no human interference with the environment is permitted. The usage regulations for this zone are the most strict and should be the most tightly enforced. This area is important as a sanctuary for species of migrating birds.

The 480-ha zone is situated about 5 km north of Cilacap proper in Cigintung. Earlier studies in this area showed that its benthic faunal species diversity index was high (1.48 as against 0.75 of lower Donan River) (Djohan 1982). The 1989 aerial photo interpretation showed that this mangrove forest is one of the few still in a relatively pristine state in the Segara Anakan basin.

Reserve zone

The purpose of this zone is to totally protect a core area of the mangrove forest from exploitation and degradation. The health of this zone will determine the long-term ecological viability of the Segara Anakan ecosystems. The ecological functions of this zone include providing detritus for fish and shrimp larvae that use the lagoon as nursery grounds, and acting as a biological bank to supply neighboring areas where exploitation is allowed.

The zonal boundary should lie 500 m landwards of the eastern shore of the lagoon and cover most of the newly accreted islands. The mangroves between Kembang Kuñing and Sapuregel Rivers can be rehabilitated and included within the zone.

The reserve zone comprises only about 4,122 ha (Table 5.1) or 21.12% of the management area and about half of the area considered adequate by Ludwig (1988) to maintain the biological integrity of the mangrove forest. Socioeconomic considerations are the basis for limiting the reserve zone to this size. In addition to mangrove forest in the buffer areas, more mangrove forest will continue to flourish in some of the other areas not specifically designated for mangrove conservation, especially the forest zone.

Chapter 5. Integrated Management Plan

Table 5.1. Area of Segara Anakan zones.

Zone	Area (ha)	% of total area
Management area		
Protection	480	2.46
Reserve	4,122	21.12
Forest	2,809	14.40
Development	4,779	24.50
Agriculture	1,199	6.14
Human settlements	95	0.48
Aquatic	6,029	30.90
Total	19,513	100.00
Special zones		
Ministry of Justice	10,258	
Marine	22,000	
Recommended for separate plan		
Urban-industrial	2,032	

Forest zone

The forest zone will be located west and north of the reserve zone. Its purpose is to form a buffer between the reserve zone and agriculture development to the north and to maintain a productive mangrove forest managed by Perhutani. The forest zone covers 2,809 ha, and in combination with the protection and reserve zones, gives a forested area of 7,411 ha (38% of the management area). Small portions of this area may be used for agriculture, agroforestry and aquaculture development. For example, Perhutani has started a small teak farm which it may want to expand.

As discussed in the previous chapter, there are conflicting government policies regarding forest lands in Segara Anakan. In this case, it is recommended that Perhutani be given full control only of the area designated as forest zone. For example, although the reserve zone includes mangrove forest, it should not come under the control of Perhutani, but rather under the aegis of SATF. This is because the primary role of Perhutani is to manage commercial forest—a conflict of interest with the goal of strict conservation.

Development zone

The purpose of the 4,779-ha development zone is to have an area close to current population centers that can be used by residents to pursue a variety of income-producing activities such as agriculture, horticulture, agroforestry, livestock raising, aquaculture and eventually manufacturing and other light industries. To be of practical use, its location is therefore mandated by existing land-use patterns.

Chapter 5. Integrated Management Plan

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Urban-industrial	2,032	

Forest zone

The forest zone will be located west and north of the reserve zone. Its purpose is to form a buffer between the reserve zone and agriculture development to the north and to maintain a productive mangrove forest managed by Perhutani. The forest zone covers 2,809 ha, and in combination with the protection and reserve zones, gives a forested area of 7,411 ha (38% of the management area). Small portions of this area may be used for agriculture, agroforestry and aquaculture development. For example, Perhutani has started a small teak farm which it may want to expand.

As discussed in the previous chapter, there are conflicting government policies regarding forest lands in Segara Anakan. In this case, it is recommended that Perhutani be given full control only of the area designated as forest zone. For example, although the reserve zone includes mangrove forest, it should not come under the control of Perhutani, but rather under the aegis of SATF. This is because the primary role of Perhutani is to manage commercial forest—a conflict of interest with the goal of strict conservation.

Development zone

The purpose of the 4,779-ha development zone is to have an area close to current population centers that can be used by residents to pursue a variety of income-producing activities such as agriculture, horticulture, agroforestry, livestock raising, aquaculture and eventually manufacturing and other light industries. To be of practical use, its location is therefore mandated by existing land-use patterns.

Chapter 5. Integrated Management Plan

A small and separate portion of the development zone is located east of the forest zone (Fig. 5.1). It includes some sections of destroyed mangrove forest that could potentially be converted to either agriculture or aquaculture. The main criterion for determining usage is location and the elevation of the land above the high tide. Land remaining within the reach of the tides is not suitable for agriculture. Perhutani is planning to develop a social forestry program in forested areas within the development zone.

Agriculture zone

The purpose of designating an agriculture zone is to set aside an area that will be suitable for development of a variety of farming activities, especially rice growing, and to limit the unplanned conversion of mangrove forest to agricultural lands. Agricultural activities are concentrated close to existing settlements. The area surrounding the subvillages, except Karang Anyar which is in the middle of the lagoon and thus has less room for expansion, is being developed for agriculture. The zone consists of five different sections that total almost 1,200 ha.

A large area to the east of the forestry zone under the jurisdiction of Perhutani could be used for agroforestry under the social forestry program, as the land has become too elevated to revert to mangrove forest. Perhutani is embarking on a reforestation program of several denuded areas.

Some of the land to the west and across Donan River from Cilacap has also been converted to agriculture. Further conversion of this land may occur as lack of land in the city causes people to migrate across the river.

Human settlement zone

The purpose of designating a human settlement zone is to limit the unplanned growth of *kampung*. Human settlements are now found in three villages which can be divided into eight subvillages. The natural tendency of settlement along a far-flung network of roadways and canals makes it difficult for the government to provide adequate services. One goal of zoning is to provide a framework for the government to plan improvements of roads, schools and health services. The SATF should undertake to develop a detailed plan for the allocation of new infrastructure within the human settlement zone.

Man-made canals, which constitute the major transportation network, are dug to provide fill upon which tracks and houses can be constructed. Ponds resulting from this excavation can easily be converted to fishponds with the aid of fisheries extension work.

An urban-industrial zone is centered in the town of Cilacap and has not been included in this plan. A separate plan should be made for Cilacap and consideration given to expansion of the town, particularly across the river. Suitable buffer zones should be designated.

Aquatic Zone

In the Segara Anakan area, waterways function not only as fishing areas but also as a major transportation system. The channels also provide the main routes for marine species to enter the lagoon to breed and to feed. Based on the analysis of Naamin (1991), shrimp catch from the lagoon exceeds MSY by about 1.5 times. The SATF should consider setting up rotational zones--designating sections of the lagoon which could be completely closed to fishing for a specified period of time to allow shrimp stocks to be replenished naturally. For example, a section of the reserve zone could be closed to fishing.

Although there is little reliable data, some villagers have suggested that the decreasing size of crabs caught in recent years indicates that the catch level is now over MSY. If this proves to be true, then strict enforcement of current regulations and the possibility of introducing size limits should be pursued.

The aquatic zone is subdivided into two categories: lagoon and aquaculture area.

Lagoon fishing

Many of the villagers living along the lagoon have shifted from fishing to agriculture because of the newly available land; however, the two villages (Udjung Gagak and Panikel) located within the lagoon will continue to rely on fishing. The decreasing number of fishermen in Kampung Laut should have a beneficial effect on lagoon fish stocks.

The lagoon fishing area shall be subdivided based on the type of fishing gear to be used or the target species:

1. *jaring apung* - requires a strong current to function, thus, the area it covers includes the main rivers; placement of the net should allow a 10-m clearance for river transport;
2. trammel net - set up in the deepest area of the lagoon to catch large shrimp;
3. *wide gear* - used in places which run dry during low tide; and
4. crab fishing - allowed in all areas of the mangrove forest except during the spawning season from May to July.

Chapter 5. Integrated Management Plan

The exact boundaries of these fishing areas are not yet marked pending consideration by the government agencies involved. To help delineate the zones, the following data will be useful:

1. upper limits of the tidal waters - to determine what land can be converted to agricultural use;
2. soil chemistry - to determine which areas are suitable for agriculture or aquaculture without additional inputs; and
3. quality of the mangrove forest - so that it can be divided into zones for conservation, rehabilitation or conversion. The goal is to preserve the highest-quality areas and to convert the damaged ones.

The mapping of tidal boundaries and assessment of the mangrove forest have already been completed. Some soil chemistry analysis has been done but a complete soil map has yet to be made.

Aquaculture

Aquaculture development holds a lot of potential for livelihood opportunities for Segara Anakan villagers. Aquaculture pond areas can be located within the aquatic zone as well as within the development and agriculture zones.

Special Zones

Ministry of Justice zone (Nusa Kambangan)

The importance of Nusa Kambangan to Segara Anakan cannot be overstated. The rocky coast of the island protects it from seasonally stormy seas and high waves from the Indian Ocean, creating a low-energy environment favorable to mangrove colonization. Thus, without the island, Segara Anakan would not exist as it is today. The island also provides the major source of fresh water for most of the inhabitants of Kampung Laut. Because of its "off-limits" status as prison land, most of the natural resources found there have been preserved to a greater degree than in the surrounding area. Therefore, the island has acted as a refuge for many species of plants and animals.

For the future, the beautiful rocky coastline of the island holds much promise as a tourist attraction, as do some of the prison facilities themselves. Tourism development could be one of the biggest sources of new revenue for Kampung Laut residents. Although MJ and NKPA have not previously been involved with such activities, the revenue-producing aspect of this type of development should be an attractive incentive. The SATF should look into the economic potential of Nusa Kambangan for sustainable development and include full and continued participation of MJ and NKPA representatives at all planning meetings for the management area.

Chapter 5. *Integrated Management Plan*

Already, MJ and NKPA have demonstrated their skills in solving management problems through their negotiations with villagers who have settled on land along the north shore of the island. However, it is expected that more and more settlement will occur in this area. By formally including all of Nusa Kambangan in the management area and plan, and by sub-zoning the island into, e.g. human settlement, tourism development and restricted access zones, these and other development issues can be resolved to the satisfaction of all concerned agencies. Lack of participation by these agencies in the planning and management process will adversely affect both the development process in Segara Anakan as well as the integrity of the Ministry of Justice zone.

Marine zone

The marine zone is of overwhelming importance to the people of Kampung Laut, even those who do not participate directly in marine fisheries. The links are both biological and socioeconomic. Shrimp and fish species that are the basis for the offshore fisheries spawn offshore and their larvae migrate into the lagoon for maturation. The lagoon shrimp fishery harvests juvenile shrimp that have not yet migrated back to sea. Clearly, neither the lagoon nor the offshore fisheries can exist without the other. Therefore, the socioeconomic benefits of the lagoon fishery are also dependent on the marine zone.

Since fisheries are currently the only industry operating in the marine zone, specific recommendations for this zone are included in the fisheries section in this chapter. In general, it appears that an expansion of coastal artisanal fishing as well as offshore fishing could be justified based on fish catch statistics and the MSY estimate. Such an expansion would provide increased livelihood opportunities for residents of Kampung Laut.

Urban-industrial zone

The future development of the Cilacap urban-industrial zone will have a major impact on the sustainable development of the Segara Anakan management area. Because of the complexities involved in urban development issues and the differences with those affecting a primarily rural area, a separate management plan should be designed specifically for Cilacap. As Cilacap grows, there will be both positive and negative effects on Segara Anakan. On the negative side, the potential for pollution problems and increasing conflicts between "outsiders" and local residents can be expected. Therefore, pollution monitoring and control, and a design for the spread of residential and industrial buildings should have priority. On the positive side, increased growth of Cilacap should promote more opportunities for better transportation links, power supply, and educational, health care and marketing facilities (both physical infrastructure and financial development). The Cilacap management plan must include strategies for dealing with these aspects of growth.

PLAN IMPLEMENTATION

To implement IMPSA, the first activity is to formally adopt the zonation scheme and assign responsibility for the necessary government functions relating to education and enforcement.

To implement IMPSA, the first activity is to execute the zonation scheme—that is, to formally adopt it and to assign responsibility for the necessary government functions relating to education and enforcement. Some changes may be needed as the work progresses and new data become available. The government agencies will need to agree on their respective responsibilities in the management of the land-based zones. The zonation map (Fig. 5.1) gives a general guideline for zonal boundaries; final boundaries can be formally agreed upon and drawn up in a new map. In the field, boundary markers or signs can be installed that indicate the type of zone and pertinent rules.

Sediment Infilling

All available evidence supports the idea that sediment deposition is filling up Segara Anakan. What is not clear is how fast and to what extent it will continue, and what deleterious socioeconomic effects this will cause. The estimated time for complete infilling of the lagoon covers a range of several years to decades (Ludwig 1985), reflecting the uncertainty of predicting such a complex process based on fragmentary data. Sediment infilling is dependent upon erosion of upland soil and sediment transport to the lagoon. Various factors could affect this process in the future. For example, it is possible that the upland erosion rate could decline in the future due to natural soil surface hardening and agricultural extension work that trains farmers in soil conservation practices. In addition, it is possible that a long period of low-intensity rainfall could create high-volume water flows in Segara Anakan rivers that would clear some of the waterways of silt deposits. Taking these possibilities into account, it becomes clear that complete filling of the lagoon with sediment is not a certain end point. Therefore, government contingency plans should consider a number of future outcomes.

At present, the government is primarily concerned with stopping or slowing down sediment infilling. This focus may be too narrow. A better investment of time and money might be to devise methods of adapting to the new conditions rather than trying to prevent them. There are two reasons why the government would like to preserve the lagoon. The first is to maintain an adequate drainage area for upland irrigation schemes, while the second is to preserve the lagoon fisheries for Segara Anakan residents. As long as the lagoon channels remain clear, there should not be any threat to the irrigation drainage. Although fish catch declined for a few years in the 1980s, the latest figures show an increase. Multiyear data on CPUE are not available. Evidence collected by Amin et al. (1988) indicates CPUE may be decreasing, but this could be due to a variety of factors.

At the current rate of sediment infilling, the effects on lagoon fisheries are unclear. Although there will certainly be a size threshold for the lagoon below which fish catch must decrease, it has apparently not yet been reached. If the government decides that some remedial measures are needed to slow down the process of sediment infilling, the social, environmental and economic costs and benefits should be considered. Typical remedies for preventing sedimentation from completely filling up the lagoon include some type of dredging and/or channelization (Ludwig 1985). Eight engineering measures were initially evaluated by Engineering Consultants, Inc. (ECI 1987) and four were considered economically feasible based on present net value analysis. Of the four, a combination of two, agitation dredging and enhanced flushing, was recommended to MPW as the most appropriate.

It should be noted that dredging, in addition to being extremely time-consuming and expensive, could create more damage than it was designed to alleviate. This is because dredging will release large amounts of anoxic sediments into the water column along with various pollutants such as sulfur compounds that may be stored in the sediment. The sediment itself as well as the pollutants could seriously endanger Segara Anakan biota, particularly larval fish and shrimp. At the minimum, a careful EIA should be made of the effects of dredging based on analysis of water currents and amount of sediment to be dredged. Tolerance tests should be done of the effects of Segara Anakan sediments on shrimp and fish larvae. Until the bioassays are completed, it is not possible to make a recommendation regarding the best course of action.

Partial solutions to the sediment infilling problem can be implemented at the source. A variety of upland farming techniques do not cause erosion and can even reverse it. A genuine effort should be exerted to educate upland farmers regarding these sustainable farming methods, concentrating on those areas believed to be contributing the greatest amounts of eroded material. Given the value the government places on Segara Anakan, it will be necessary to use extreme caution when pursuing engineering solutions to the lagoon infilling problem.

Mangrove Forest

According to the zonation plan, the total area of mangrove forest available for conservation is 4,602 ha (protection and reserve zones); this does not consider rehabilitation of damaged portions. The forest zone can provide an additional 2,809 ha which can also be used as a conservation area on a rotational basis, i.e., with periodic harvest of mangroves. This will bring the total mangrove forest area to 7,411 ha. With the estimated reduced population of fishermen, this area of mangrove forest should be adequate to provide lagoon fish species with the needed feeding and nursery grounds.

The 1,551 ha of severely damaged mangrove forest (Category 5) is adequate to supply the fuel needs of about 1,000 households, although the proximity of this zone to the present highly developed agricultural land in the north is likely to invite further immigration.

Fisheries

Fisheries management for Segara Anakan and its vicinity should address the intensity of exploitation and the various fishing methods used. The eventual transfer of more fishermen from the lagoon to offshore areas and the control of the use of fine-meshed nets must also be considered. Fishing activities, especially those operating permanently set gear such as *apong*, *wide tadahan* and trammel nets, should be zoned. Entry to the zones should be limited. Some measures (e.g., limiting fishing effort and number of fishermen) should complement Governor's Regulation (GR) No. 6/1978, which regulates and enforces the permissible use of nets with mesh size larger than 25 mm for fishing activities within the Segara Anakan area. Fishing along Kembang Kuning River should also be limited in order not to interfere with the shipping lanes and to provide marine species free access to feeding and breeding grounds.

Effective extension work can introduce fishermen to new livelihood opportunities. For instance, a training conducted in crab aquaculture in 1990 by ASEAN/US CRMP was well received. To ensure that the villagers have support for pursuing crab culture, an aquaculture extension worker should be assigned to Kampung Laut.

It should be noted that allowances for participants at training courses run by NGOs should not be too large so that they do not jeopardize future government training courses which cannot provide such high budgets. Therefore, training courses should be conducted by extension service workers in each village on a rotational basis, ensuring that the participants have sites for developing aquaculture. Thus, the program should be a long-term operation run by one agency.

There is a need for stocking of ponds with crab seed. A pilot program should be set up for the fishermen to catch crab seed in the lagoon. Similar aquaculture projects should be undertaken to provide the market with a variety of products. Several aquaculture experiments failed because of unsuitable environmental conditions. The pilot projects should take these into consideration.

Another alternative for displaced fishermen is offshore fishing. The viability of setting up fishermen's cooperatives to provide technical and financial assistance should be considered, especially for exploiting the coastal fisheries off Nusa Kambangan. Marketing facilities and access to them also need improvement.

Tourism

A number of opportunities for tourism development in the Segara Anakan area can do a great deal to raise the villagers' standard of living. Once the zonation plan has been implemented, the reserve zone can be designated as a local park and advertised as such. Both domestic and foreign visitors would be interested to see native species of plants, birds and other animals. Native guides can be employed to give informative tours of this area. For a small investment, observation "blinds" can be built so that visitors have a chance to watch wildlife, e.g., the milky stork, from a safe distance.

The people involved in tourism development should tap the resources at the disposal of SATF, particularly academic experts on the ecology and biology of particular groups of organisms, in developing handouts, so that tourists can get an educational presentation, not just a Disneyland type of experience. To make this most effective, a strong component should be devoted to the people and customs of Segara Anakan. Special legends and stories can be told and the local villagers' way of life can be explained or shown. Religious or nonreligious customs such as dances endemic to the area can be used as the basis of a cultural show. Activities such as catching shrimp fry or frogs are familiar to Indonesians but fascinating to foreigners who have never had such experiences. A local handicraft industry can be developed with either indigenous or imported ideas for items. Even a few sales of handicrafts could significantly increase the income of the villagers.

The natural beauty of Nusa Kambangan's southern coast and its historic prison are also potential tourist options. An example of the latter is Iwahig, a prison in the Philippine town of Puerto Princesa on Palawan Island, which has been bringing in tourist dollars for many years. Visitors pay to enter the prison grounds and after a tour, are offered a wide variety of handicrafts for sale.

In order to pursue tourism development in Segara Anakan, the *Bupati* should coordinate with both MJ and the national tourism authorities to set up a plan of action.

Landownership

The act of zonation will not solve questions of ownership. Therefore, it is very important for all parties to make an effort to resolve the land allocation and ownership issues as soon as the physical plan is in place. This will help the government to improve its relationship with the people. The SATF, consisting of representatives from all the concerned agencies and institutions, is tasked to evaluate the different conflicting landownership policies and laws and to develop uniform landownership and tenants' agreements. The task force should make sure that the residents of Segara Anakan receive priority in allocation of land.

Land Development

The government should aim to develop subvillage centers rather than allow linear development along transport routes in order to supply infrastructure such as schools, water supply, health and sanitation facilities and a central market, among others. A centralized plan would allow the building of a central open space for community activities, which could be surrounded by government facilities and stores. The dwellings, in turn, could be built around the area. The aquaculture ponds or facilities could surround the dwellings or be positioned linearly along the subdivisions of agricultural land. Each household should be allocated approximately 1 ha of land to produce at least 2 t of rice and 0.5 ha of pond site for aquaculture to produce about 500-1,000 kg of fish or other aquatic species. These allocations would provide the new farmers an income above the present poverty line, and probably higher, if they obtain better technical training, credit facilities and other assistance.

Water, Health and Pollution

Many of the health problems in the Kampung Laut area are related to the poor environmental conditions. The lack of drinking water and sanitation facilities is a health hazard. It may not be possible to provide piped water in the villages, at the moment, except in Nusa Kambangan. Therefore, storage tanks should be set up to provide adequate drinking water. Using the springs in Nusa Kambangan, the subvillages of Motean and Klaces can have a more permanent water supply.

Efforts must also be made to improve the waste disposal system by preventing the use of waterways as open sewers. A system of latrines should be built, such as is commonly used in the floodplains of Thailand or over the fishponds as commonly practised in the villages elsewhere in Java.

Although pollution levels are generally within the acceptable limits, monitoring should be continued to safeguard public health. Both local and national government agencies should be concerned with the issue of improving domestic sanitation and sewage disposal. Appropriate waste management programs should be instituted to minimize pollution as population and economic activities increase in nearby Cilacap. Since there is a vacuum in the government regarding water quality implementation and enforcement, an agency with implementing power has to be designated. For example, KLH or CORD has to take a more active role in this area.

Transportation

Because it is relatively inconvenient, limiting access to Kampung Laut to boat traffic reduces the tendency for immigration. Restricting immigration is considered helpful in minimizing conflicts between new settlers and the original inhabitants. However, lack of roads makes it difficult for villagers to conduct business with outside areas. It should be up to the villagers to decide what is the proper balance between these factors, and thus how quickly new land routes should be made available.

Chapter 5. Integrated Management Plan

Coordination of Government Agencies

To provide services, it will be necessary to evaluate the bureaucratic system and to designate a coordinating body. The BAPPEDA is best suited for this role, as its charter states that its function is to plan and execute programs. The SATF should assist BAPPEDA with coordination to avoid overlaps in activities and roles of different agencies.

The agencies' limited technical capability in planning and implementation must be strengthened to avoid complete reliance on commissioned consultants.

Information Services

There is a need for information dissemination on the benefits of preserving and conserving Segara Anakan's environment and its resources. Written and audiovisual materials on this should be prepared and presented directly and through radio, TV and newspapers. Media representatives should be invited to attend workshops and training sessions to familiarize them with the philosophy of integrated management.

Education and Extension Services

The present educational system of Kampung Laut is below standard. The location of the schools causes the staff to commute a long distance, resulting in short teaching hours. The possibility of providing local housing for teachers and building a middle school which could serve all the surrounding villages should be looked into. More attention could be given to teacher training within the framework of the management plan although changes in the curriculum may take some time. In the meantime, extension services could be provided immediately. These include the development and maintenance of aquaculture facilities; selection and acquisition of better aquaculture stock and farm inputs; training in improved farming methods; and tourism development, among others. Extension workers should be assigned to Segara Anakan on a permanent basis and have basic training in the philosophy and implementation of integrated management. Coordination with the local media to promote workshops and seminars and disseminate the progress of extension work could also prove useful.

This chapter has provided overall recommendations and guidelines for resolving the management issues affecting Segara Anakan. A zonation scheme has also been proposed that should serve as a physical framework for the implementation of the management plan. Specific projects designed to solve particular management problems are detailed in Chapter 6.

CHAPTER 6

PROJECTS TO IMPLEMENT MANAGEMENT STRATEGIES

INTRODUCTION

Nine high-priority projects have been proposed to implement the objectives, recommendations and strategies of the management plan over a five-year period.

Nine projects have been proposed for implementation as part of IMPSA. These have been developed to address the objectives of the management plan as well as some of its recommendations and strategies. Fig. 6.1 illustrates the complementarity of the objectives of IMPSA with the proposed projects and their objectives. Details of the nine projects include the objectives and benefits, background, description, phasing of activities, agencies and administration, and budget.

Table 6.1 shows which projects cover particular strategies and actions of IMPSA. Table 6.2 summarizes the projects and the priorities for implementation as decided by SATF in February 1990.

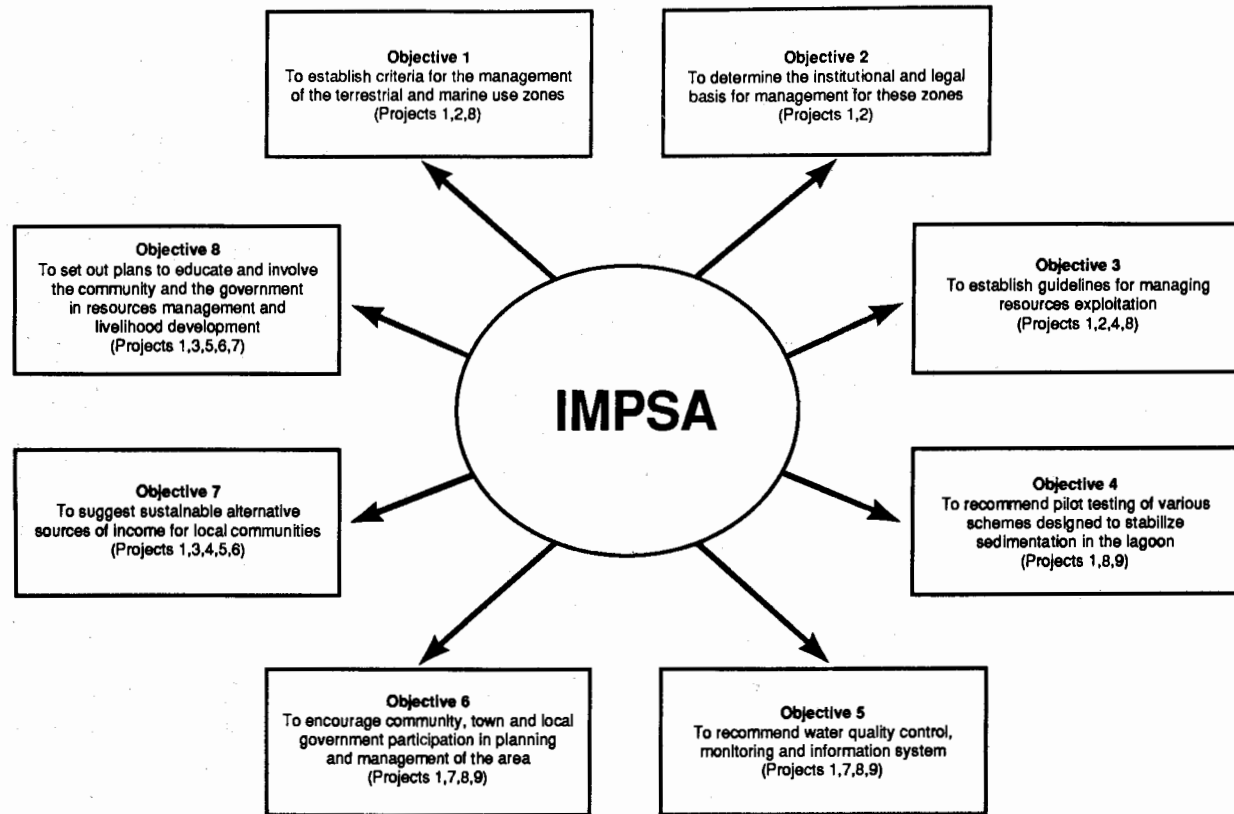
The time frame for implementing all nine projects is five years. International funding sources should be tapped for the first three years and then Indonesian funding should be used.

PROJECTS FOR IMPLEMENTATION

Objectives and benefits

1. Formation of SATF and Coordination of Activities In Cilacap

The objective of this project is to initiate the administrative and coordination apparatus for implementation of the overall management plan. In fact, it has set up SATF as proposed in the plan and approved by the *Bupati* of Cilacap in late 1989. The formation of SATF is a prerequisite for successful plan integration and implementation which involves all the agencies working at present in the Segara Anakan area. The task force will help prevent conflicts of interest among the agencies involved. Project 1 will refine the



Projects and their Objectives

1. **Formation of SATF and coordination of activities in Cilacap**
This project aims to initiate the administrative and coordination apparatus for implementation of the overall management plan.
2. **Delineation of the zonation boundaries for Segara Anakan mangroves and land area**
This project aims to clarify the boundaries of the land-based zones approved in the management plan including the administrative boundaries of the villages in Kampung Laut.
3. **Training of Kampung Laut residents in the culture of crab, fish and related aquatic species**
The project aims to provide an alternative source of income for fishermen of Kampung Laut and to relieve fishing pressure in the lagoon.
4. **Reduction of fishing pressure in the lagoon**
This project attempts to relieve fishing pressure in the lagoon by eliminating the use of fine-meshed nets and other destructive gear and by transferring some fishermen to offshore fisheries.
5. **Improvement of crab and fishery commodity marketing channels, and training in marketing cooperatives**
The project intends to develop marketing channels for fishery products, especially the mudcrab, and enhance the revenue to the dealers and fishermen of Kampung Laut.
6. **Involvement of women in alternative income-generating activities**
This project aims to organize women's groups in new economic activities and to encourage them to use their extra time effectively.
7. **Education and public awareness on environment and ecology in Kampung Laut**
This project's goal is to increase the awareness of Kampung Laut residents on the means of implementation of IMPSA and its associated activities.
8. **Improvement of wetland management in Segara Anakan**
The project aims to formulate and implement the management of the reserve and periodically check to establish criteria for their management.
9. **Monitoring of water quality in Segara Anakan**
This project aims to periodically check the water quality in the lagoon and incoming rivers regarding the types of pollutants as well as recommend measures to reduce the pollution.

Fig. 6.1. The complementarity of the IMPSA objectives with the proposed projects and their objectives.

Chapter 6. Projects to Implement Management Strategies

Table 6.1. Summary of management issues/problems, strategies and actions, and pilot projects for implementation.

Issues/problems	Strategies (S) and actions (A)	Projects
Resource degradation Coastal forest depletion and land-use conflicts	S1 Set up SATF and implement zonation scheme	1,2,7,8
	A1 Form SATF	1
	A2 Establish management criteria for seven zones	1,2,8
	A3 Mark and map exact zonation boundaries through SATF	1,2
	A4 Establish management guidelines for zones under PHPA and Perhutani	1,2,8
	A5 Mobilize Kampung Laut residents to participate through field workers	4,7,8
	A6 Work through existing organizations	4,7,8
	A7 Increase forest production output	7,8
	A8 Monitor management and refine plan	1
Declining fisheries and catching large amounts of juvenile shrimps	S2 Reduce fishing effort in lagoon, eliminate fine-meshed nets and transfer some fishermen offshore	1,3,4,8
	A1 Draft and approve regulations to support plan recommendations	4
	A2 Communicate new regulations to villages through field workers	4,7
	A3 Identify village management committees	4
	A4 Transfer some fishermen offshore	4
	A5 Set up pilot aquaculture projects	3
	A6 Protect the nursery function of the lagoon	4,8
Water quality degradation	S3 Establish permanent monitoring stations and determine sources of pollution through local agencies	9
	A1 Establish subcommittee of SATF to coordinate water quality control	1,9
	A2 Identify monitoring/research agency and laboratory	9
	A3 Establish monitoring stations	9
	A4 Refine data on point sources	9
	A5 Encourage self-enforcement among large companies near Cilacap	9
	A6 Use village management committees to regulate local domestic waste and improve drinking water supply	4,9
Sedimentation of the lagoon	S4 Implement pilot projects for agitation dredging proposals or variations thereof as soon as possible through MPW	8,9
	A1 Refine terms of reference for testing operations to be complementary with IMPSA	1
	A2 Include studies to monitor impact of dredging on lagoonal fishery system and on water quality	8,9
	A3 Coordinate implementation through SATF	1
	A4 Establish long-term costs/benefits	8,9

Continued

Chapter 6. Projects to Implement Management Strategies

Table 6.1. (continued)

Issues/problems	Strategies (S) and actions (A)	Projects
Socioeconomics and livelihood Poverty, poor health and lack of livelihood options	S5 Expand and support the existing socioeconomic program of the <i>Bupati</i> ; further develop viable alternative livelihood options in offshore fishing, marketing, aquaculture, agriculture and women's projects	3,5,6,7
	A1 Find support for alternative livelihood projects through MHA and other aid projects	3,4,6
	A2 Place permanent community development workers in Kampung Laut	3,4,5
	A3 Improve and expand mudcrab rearing	5
	A4 Transfer some fishermen offshore	4
	A5 Construct mooring area in Karang Anyar	4
	A6 Provide agricultural extension	7
	A7 Improve basic education	7
	A8 Improve drinking water quality	9
	A9 Test feasibility of tourism and handicrafts	6
	A10 Improve marketing arrangements	5,6
	A11 Establish fish and produce market	5
A12 Encourage family planning	7	
Legal, institutional and administrative framework Inadequate clear jurisdictions of land control No clear institutional mandates No cross-sectoral cooperation	S6 Clarify jurisdiction over land and management roles in Segara Anakan	1,2,8
	A1 Form SATF of Strategy 1	1
	A2 Hold regular meetings among SATF members	1
	A3 Mark field boundaries and establish map	1,2
	A4 Draft agreements and/or changes in policy about management of land and resources; endorse plan	1,2
Inadequate planning and management skills	S7 Provide training for local and regional government personnel	1,8,9
	A1 Conduct training courses every six months for three years	1
	A2 Provide information and consultation to agencies through SATF as needed	1
	A3 Train two government personnel in EIA	1,9
Education and public awareness Poor formal education for communities Low public appreciation of resources Poor local participation in resources management	S8 Conduct seminars and nonformal education on resources management and conservation in Kampung Laut	7,8
	A1 Conduct four training and education programs per year in Kampung Laut	7
	A2 Conduct two public seminars per year in Cilacap	7
	A3 Incorporate resources management into the formal school curricula of Kampung Laut	7
	A4 Highlight economic role of resources	7
	A5 Encourage local management committees to take responsibility	4,7,8

Chapter 6. Projects to Implement Management Strategies

Table 6.2. Summary of projects to implement the plan, their priorities and estimated budgets.

Project title	Priority	Budget (US\$)
First		
1. Formation of SATF and coordination of plan activities in Cilacap.	needed to implement other projects	161,000
2. Delineation of the zonation boundaries for Segara Anakan mangroves and land area	needed to begin land use management	75,000
3. Training of Kampung Laut residents in the culture of crab, fish and related aquatic species	needed to begin income generation and relieve fishing pressure	82,000
4. Reduction of fishing pressure in the lagoon	will provide fishery management	163,000
5. Improvement of crab and fishery commodity marketing channels, and training in marketing cooperatives	will enhance income as crab production increases	26,000
Second		
6. Involvement of women in alternative income-generating activities	will enhance income by introducing new activities	43,000
7. Education and public awareness on resources management and ecology in Kampung Laut	will support total plan implementation and project success	40,000
8. Improvement of wetland management and conservation in Segara Anakan	will begin management of core zone	82,000
Third		
9. Monitoring of water quality in Segara Anakan for long-term management, and training of local personnel	will begin long-term monitoring of environment	74,000
Total		746,000

management criteria for the land-use zones and train two local officials in EIA.

The expected benefits from this project are the:

1. formation of a formal and recognized body to implement the management plan;
2. setting up of an office where meetings can take place;
3. representation in the plan activities by BAPPEDA, the *Bupati*, Perhutani, PHPA, FSC, MEC, MH and NLUB, two villagers and NGOs working in the area;
4. full-time presence of the coordinator-resource management specialist in Cilacap who can oversee all plans and project implementation activities;
5. scheduling of regular meetings of SATF to discuss issues of implementation and to decide on matters which affect more than one agency in relation to the management of Segara Anakan;
6. synchronization and coordination of resource management objectives of each group and government agency;

Chapter 6. Projects to Implement Management Strategies

7. clarification of institutional mandates of each agency;
8. refinement of management criteria for the land-use zones;
9. training of two officials from the office of the *Bupati* in EIA to be responsible for valuation and execution; and
10. establishment of a resource center for coastal management in Cilacap District.

Background

The successful implementation of IMPSA depends on the coordination among various agencies. A prerequisite to this coordination is the formation of an autonomous and objective task force which represents all interested and participatory agencies.

Coastal management issues are of increasing concern in Indonesia as many areas are being degraded through habitat destruction and overexploitation of the resources. Until now, most solutions have used a sectoral management approach with one agency responsible for a particular resource. However, effective resource/area management requires the coordinated efforts of several national and/or local government agencies.

The management of resources in Segara Anakan involves the use of land and water areas; the protection of vulnerable environments; and the production of food, timber and other commodities. The resources are regulated by laws of various government agencies, each of which has its own purpose and goal. Thus, there is little real coordination among the agencies in managing the area. In some cases, the development goals are in contrast with those of sustainable use upon which the newly formed plan is based. Thus, an ongoing dialogue among the principal parties is necessary for plan implementation to proceed.

The IMPSA is predicated on the coordination among various agencies for its successful implementation. A prerequisite to this coordination is the formation of a body which represents all the interested and participatory agencies, including the villages of Kampung Laut, in plan implementation. Such a body should not be based in any of the agencies involved. Rather, it should be autonomous and objective.

Description

This project organized and initiated the operation of SATF, whose office is in Cilacap. A full-time coordinator will be hired. The project will support SATF, the full-time coordinator and the activities. It will also support the meetings of SATF for one year as a means of resolving all management issues as they arise and will coordinate the pilot projects as they are funded.

The project coordinator will undertake the refinement of management criteria for the seven zones as part of the ongoing project activities through close interaction with the respective agencies. The project will select two individuals from KLH under the *Bupati* to participate in an EIA training through an accredited course recognized by KLH with a 'Certificate B' rating. These participants will be asked to get involved in future project implementation as needed.

2. improved knowledge and ability of at least 10% of the fishermen on the rearing of mudcrab from juvenile stage to marketable size;
3. enhanced production of tilapia from existing ponds and an increased number of ponds producing this fish in areas which have appropriate space and habitat;
4. improved mangrove silviculture-cum-aquaculture;
5. establishment of a pilot site for duck raising which is compatible with aquaculture;
6. increase in income of communities from nonfishing activities;
7. decrease in the average fishing effort exerted on the lagoon fishery; and
8. increase in the daily protein intake among fishermen and their families from the supply of tilapia.

Background

Historically, aquaculture in Segara Anakan has not been very successful. Several fish and shrimp aquaculture projects were initiated in the past, but most ended in failure. Reasons for the failure were inappropriate species, silt-filled ponds, acidic soil or consumption of the fish by a predator otter common in some areas.

Tradition has also inhibited the introduction of aquaculture. Several ponds set up in Karang Anyar were abandoned shortly after construction because of the reluctance of fishermen to engage in aquaculture as opposed to lagoon fishing.

Moreover, aquaculture ponds had often not been well managed. The potential problems had not been considered before construction, resulting in a high incidence of failure. On Nusa Kambangan, at Motean and Klaces, there is some development of rice-fish culture. Once again, management has been poor and yields are low.

Integrated culture of mangrove and fish (red and Nile tilapia) is being developed by Perhutani in the Jojok area behind the main lagoon. This is working well under a system whereby Perhutani provides the capital for pond construction and fish seed. Fishfarmers take care of the fish during the rearing period and receive 50% of the produce. This system or variations thereof merit further development because the species used seem to do well in the local environment and fishfarmers are happy with the arrangement.

Culture possibilities besides the more common ones already tried in the area include mullet and mudcrab. The mullet can tolerate the conditions of the lagoon area but fry are not available and must be brought from other areas. Few larvae are found in the lagoon.

Mudcrabs (*Scylla serrata*) are native to the mangroves of Segara Anakan. They are extensively exploited in the lagoon and have not been managed as a fishery but are being raised in cages. Catches are dominated by small adult

Chapter 6. Projects to Implement Management Strategies

and juvenile crabs. It is reasonable that these crabs be cultured in the area because they are totally adapted to the conditions and are still plentiful in the lagoon. Since continued exploitation as a capture fishery will eventually deplete the resource, a more active management strategy is needed for mudcrabs. Their favorable market value is also an incentive to promote them for culture.

Oysters, although native to the lagoon, are not well adapted to the high silt condition. Thus, they are not recommended for aquaculture.

One related aquatic species is a local duck which is popular for husbandry and can be cultured in a pond where it feeds on locally available foods.

Description

There are five project components: (1) extension and improvement of pond culture for tilapia; (2) development of mangrove silviculture with aquaculture; (3) promotion of cage rearing of mudcrab; (4) research on the propagation of mudcrab from post-megalopal stage for rearing and marketing; and (5) development of duck husbandry in association with pond culture.

This project will be implemented through the appropriate extension and education programs on tilapia and mudcrab culture to be conducted by two full-time aquaculturists. The extension agents also versed in community education and motivation techniques will work closely with existing community organizations concerned with fishing and/or alternative livelihood development. Thus, entry into the communities and education programs will be conducted through the structures set up by the fisheries project and in cooperation with other SATF projects.

The aquaculture project will work in areas where either tilapia culture or mudcrab cage culture is possible. Areas for silviculture with aquaculture will be decided in consultation with Perhutani, and duck raising will be in association with pond culture sites. These pilot plots will be managed by the community groups in conjunction with the extension person responsible for a plot. As the plots are developed, they will be used for demonstrations for other community members and those from other villages.

Production from each pilot plot will be carefully monitored to obtain exact information on the revenues generated. Documentation will be done with the community group so that members can evaluate the operation of the culture technique.

The project will design an experimental component for crab culture which will focus on techniques for collecting post-megalopae and allowing these to "mature" under controlled conditions. This will commence after the other components are underway.

Chapter 6. Projects to Implement Management Strategies

Phasing of activities

1. Set up administrative structure through FSC and SATF. One fishery department employee will be designated as full-time coordinator.
2. Hire two full-time aquaculture extension workers, one versed in tilapia culture and another in mudcrab culture.
3. Select feasible sites for pilot projects based on the recommended zonation, environmental conditions and preferences of the community participants.
4. Identify and train community members who will participate in the pilot projects.
5. Set up pilot projects for each culture technique with the assistance of the community participants.
6. Stock, raise and harvest the first production of fish/crab in a methodical and well-documented manner, such that records will show all costs, revenues and labor.
7. Conduct community-wide education programs which will use the pilot sites for demonstration.
8. Continue to stock, rear and harvest the fish/crab in each plot for the duration of the project while being careful to involve the community groups in all stages of the process.
9. Compile a general evaluation of the project.

Agencies and administration

The FSC will be the lead agency in this project in cooperation with SATF which handles overall coordination. The project under SATF will draw assistance from DGF. The FSC, through SATF, will cooperate in the other IMPSA projects implemented under SATF. Perhutani will also be a consulting member because of its role in silvi-aquaculture for tilapia which is already underway in parts of Kampung Laut.

Budget

A minimum of two years will be needed for the successful implementation of the project. It is possible that FSC of Cilacap can assume part of the cost of administration and coordination for this project. The budget for one year is:

Item	US\$
Personnel	
Project coordinator/director	6,000
Extension workers (2)	10,000
Logistics assistant	3,000
Consultant (3 man-months)	30,000
Travel and per diem	3,000
Education and training	10,000
Field operations	5,000
Equipment and supplies	10,000
Overhead (10%)	5,000
Total	82,000

4. Reduction of Fishing Pressure In the Lagoon

Objectives and benefits

This project will attempt to relieve fishing pressure in the lagoon by eliminating the use of fine-meshed nets and other destructive gear and by transferring some fishermen to offshore fisheries. The rationale is to bring the lagoon fishery back to a sustainable level of exploitation so that the nursery function of the lagoon for economically important shrimp and some fish is maintained and the quality of the lagoon catch is improved. This project will address Strategy 2 of IMPSA.

The expected benefits from this project are the:

1. sustainable use of resources to ensure long-term production of the lagoon fishery as well as the offshore fisheries, especially shrimp which depend to some degree on the lagoon as a nursery and feeding area;
2. improved quality (size of fish and shrimp) of catch for the lagoon fishermen as small-meshed nets, which are used to overexploit the juvenile shrimp and fish, are eliminated;
3. alternative sources of employment and income for some lagoon community fishermen who will fish offshore instead of in the lagoon;
4. decreased incidence of destructive fishing practices in the lagoon; and
5. increased awareness among fishing community members on how to manage the fishery resources in a sustainable manner.

Background

It is well known that Segara Anakan and the offshore waters of Cilacap are rich fishing grounds. Many people in the Cilacap area derive most of their income from fishing. The lagoon shrimp fishery is being overexploited and the catch quality has declined in recent years. Also, the offshore shrimp fishery dependent on the lagoon as nursery and feeding grounds is becoming vulnerable to destructive fishing practices.

The lagoon hosts at least 45 species of fish of which 17 are migratory, 12 are resident and 16 are occasional visitors. There is a similarity between species caught in the offshore areas and in the lagoon. Larvae and postlarvae of shrimp and fish found in samples taken from the entrances to the lagoon further indicate an interdependence between the offshore and lagoon areas.

Decreasing CPUE characterizes fish and shrimp production from the lagoon in recent years. On the one hand, this may reflect the decreasing size of the lagoon, but it is more likely a result of the use of fine-meshed nets in tidal traps which is depleting the lagoon stock of fish and shrimp.

The offshore fishery for shrimp and fish may be underexploited because of the 1980 ban on trawling. The offshore catch declined after 1980 and has not

Chapter 6. Projects to Implement Management Strategies

Phasing of activities

1. Select a full-time coordinator for SATF for one year.
2. Organize an office for the operation of SATF.
3. Formalize membership of SATF.
4. Call regular meetings to begin the functioning of SATF.
5. Initiate the first pilot project to delineate boundaries for the management plan zonation scheme.
6. Prioritize all pilot project activities as recommended in the management plan.
7. Initiate implementation of plan activities under the direction of one or more local government or national agency offices which do not require additional support.
8. Compile new information on land-use management criteria and refine existing guidelines.
9. Select two individuals for EIA training.
10. Review the management plan and its objectives in relation to activities and projects achieved.
11. Review and evaluate project activities to determine accomplishments and to suggest activities for the next year.

Agencies and administration

This project was initiated in 1991 by ASEAN/US CRMP through DGF in Jakarta in coordination with the *Bupati* and BAPPEDA in Cilacap. Membership in SATF includes FSC, Perhutani, NLUB, PHPA, MEC, MH and two village representatives. The SATF coordinator shall consult with DGF and SATF as required.

Budget

The following budget was used to implement Project 1 for one year as provided for and administered by ASEAN/US CRMP through DGF. Two years will be needed to stabilize SATF.

Item	US\$
Personnel	
One full-time coordinator	12,000
Consultants	3,000
Technical advisor	100,000
Travel and per diem	
Coordinator	3,000
Meetings of SATF	10,000
Training of two officials in EIA	3,000
Office and equipment	5,000
Operation cost of coordinator	5,000
Overhead and miscellaneous	20,000
Total	161,000

2. Delineation of the Zonation Boundaries for Segara Anakan Mangroves and Land Area

Objectives and benefits

This project will clarify the boundaries of the land-use zones approved in the management plan, including the administrative boundaries of the villages in Kampung Laut. Boundary markers and/or signs will be placed in the field as needed and ground checks will be made. Project 2 will address strategies 1 and 6 of IMPSA.

The expected benefits from this project are the:

1. resolution of the land jurisdiction and boundary discrepancies between the *Bupati* and villages, on one hand, and Perhutani and NLUB on the other;
2. designation of a final policy on who controls the newly accreted land;
3. clarification of boundaries for management purposes;
4. designation of land at the disposal of Kampung Laut villagers and for other uses;
5. production of an up-to-date map which indicates the environmental conditions in all the zones that will be used to refine the management criteria for each zone; and
6. field involvement of SATF so that the members can see the conditions on the ground.

Background

Land-use conflicts in the Segara Anakan area have a long history. The root cause of the conflicts is the dynamic nature of the lagoon and changes in the shoreline due to increasing sedimentation. As new land is formed, mangroves tend to colonize it rapidly while the land at the back of the mangrove forest becomes drier. Thus, there is a constant shifting of potential land uses in some areas. Government agency jurisdictions over the area have not been able to accommodate these changes and hence, conflicts have arisen.

The use of mangrove areas by local communities of Segara Anakan stimulates the main conflict between the local government, which represents the local inhabitants, and Perhutani because of different perceptions about the laws and their respective rights. Since Perhutani is responsible for all mangrove lands, it assumes rights over the newly accreted land. But in conformity with *hukum adat*, the villages assume the right to clear and use parts of the mangrove forest, especially the newly accreted land.

The *Bupati* of Cilacap, who supports the villagers' view, said that based on the Local Government Act of 1974, he, as head of the local government, has the highest authority and legal power to develop and use land (including

Chapter 6. Projects to Implement Management Strategies

inland water bodies and swampy land under mangrove cover) in the administrative area. This interpretation is in direct conflict with that of Perhutani.

Another aspect of land use in the area is that although Perhutani has introduced social forestry on a small scale, it has not set up any strict nature conservation areas in the mangrove forest. Thus, PHPA has recommended part of the mangrove forest as a protected area because it represents the last intact mangrove habitat for several rare species of birds and mammals.

These issues of jurisdiction over the land were discussed in the CRMP Steering Committee meeting in October 1989 in Cilacap. The draft of IMPSA was presented at that time to all the participating agencies in the area and was approved in principle. The boundaries for the management zones were estimated and each agency agreed to assume responsibility for its zone(s). This agreement, in essence, solves the long-standing conflicts of jurisdiction in the area. Needed now are an official map showing the precise boundaries of each management zone and actual boundary markers in the field.

Description

This project will be implemented under the coordination of SATF so that each agency with an interest in the area to be surveyed will be represented in the team to be formed. The survey team will be fielded to mark the exact boundaries of the management zones. The team will document the condition of the environment in all boundary areas and produce an official map with the boundaries clearly indicated. When some disagreement arises among agencies, it will be resolved in a regular meeting of SATF.

The fieldwork of the survey team will take into consideration the needs of the villages, and consultation will be made in case of potential conflict. This process will allow the residents, through the village head, to express their concern before boundaries are fixed and thus, avoid disagreements later.

Phasing of activities

1. Set up a survey team of four members with appropriate representation of agencies under SATF.
2. Formulate survey methods and schedules so that all work can be completed in one year.
3. Organize necessary equipment from local sources.
4. Make survey trips to mark all boundaries (if possible over a six-month period) and draw up the map.
5. Resolve any disputes of boundaries through SATF and in consultation with the village heads.
6. Finalize maps and reports which document the area.
7. Evaluate the results of the project in relation to further implementation of IMPSA through SATF.

Chapter 6. Projects to Implement Management Strategies

Agencies and administration

The SATF will coordinate the project. The main participants will be Perhutani, NLUB, the *Bupati* of Cilacap and the village governments. The project will have a coordinator based in Cilacap while the field personnel and equipment will be on loan from the respective agencies.

Budget

This project may require more than one year to adequately mark all the boundaries in the area. It is assumed that some inputs in the form of salaries and equipment will come from the participating agencies. The budget shown here should be provided by external sources administered by SATF and the participating agencies.

Item	US\$
Personnel	
Project coordinator/director	12,000 ^a
Field surveyors (4)	16,000
Field assistants (2)	4,000
Cartographer	3,000
Travel and per diem	15,000
Field operations	10,000
Equipment and supplies	20,000
Overhead (10%)	7,000
Total	<u>75,000</u>

^aNot included in total cost; covered in Project 1.

3. Training of Kampung Laut Residents in the Culture of Crab, Fish and Related Aquatic Species

Objectives and benefits

The objectives of this project are to provide an alternative source of income for fishermen of Kampung Laut and to relieve fishing pressure on the lagoon. The project will involve setting up several demonstration sites for culture of mudcrab and pond culture for red and Nile tilapia, and will combine mangrove silviculture with aquaculture and the propagation of a local duck species. The project will develop rearing techniques for mudcrab. Selected groups of fishermen from each of the communities will participate. This project will address Strategies 2 and 5 of IMPSA.

The expected benefits from this project are the:

1. establishment of locally applicable rearing techniques for mudcrab and decreased collecting in the wild;

Chapter 6. Projects to Implement Management Strategies

come back to the level when trawling was allowed. Thus, it is rational to allow a further increase in effort in the offshore areas using traditional and noncommercial techniques and boats.

Since the offshore catch is valuable, generating about Rp 20 billion in revenue in July 1987-July 1988 for shrimp alone, it is important that this fishery not be damaged by further degradation of the lagoon, use of fine-meshed nets or overfishing in the offshore waters.

A management strategy which lowers the fishing effort in the lagoon and eliminates the use of fine-meshed nets can potentially benefit the offshore catch. A result of this reduction is that some fishermen will need to find new sources of income such as offshore fishing if a means of transferring them is available.

Description

This project will focus its activities on the communities of Kampung Laut. It will have two components: decreasing the incidence of fishing using fine-meshed nets, and training some fishermen for offshore fishing and having them employed on offshore fishing vessels.

Project 4 will be carried out by two full-time community development workers who are trained in the problems of fishery management in the lagoon. The fieldworkers will reside in the villages of Kampung Laut and will be responsible for implementing the zonation scheme of Strategy 2 of IMPSA which controls the areas where fishing will be allowed. Over a two-year period, the fieldworkers will organize the communities concerned in sustainable fishing in the lagoon. The outcome of this organization will be the phasing out of *apong*, *wide tadahan* and fine-meshed nets. These activities will also be supported by new fishery regulations which make these gear illegal in the area.

The community workers, in addition to educating fishermen, will set up community-based management groups capable of controlling the practices of the fishermen. The incentives for making these changes in fishing practices will come from ongoing education in the community, an awareness that the fish catch will improve after destructive techniques are discontinued; and the transfer of some fishermen to offshore fishery or to newly formed aquaculture activities for crab and tilapia.

Phasing of activities

1. Set up administrative arrangements with SATF and FSC with a full-time project coordinator in place.
2. Hire and train two community fieldworkers to be stationed in Kampung Laut communities.

Chapter 6. Projects to Implement Management Strategies

3. Draft and approve regulations to phase out or limit gear use (through FSC and the *Bupati*) consistent with the policy recommendations of IMPSA and the policy of DGF.
4. Conduct education programs in the communities on fishing regulations and implications for the fishery vis-à-vis the continued use of destructive methods.
5. Organize community-based management groups which will take responsibility for the policing of fishing practices in the lagoon.
6. Design and implement, through community members, data collection on fish catch in the lagoon to involve fishermen in the monitoring of fishing over a two-year period.
7. Incorporate a fishing zonation scheme into the community patterns through education and management groups.
8. Make a fair selection of who will fish in the offshore waters through a community process.
9. Train selected fishermen in offshore fishing techniques and facilitate their working on boats operating out of Cilacap.
10. Assist in the purchase of gear and two small fishing vessels for fishermen who will fish in offshore waters but continue to reside in Kampung Laut.
11. Circulate fish yield research data and project progress results through the community.
12. Establish links with other ongoing projects to develop alternative livelihood.

Agencies and administration

This project will be implemented jointly by FSC and SATF with a full-time project coordinator/director based in both offices. The project will be recognized at the village level by formally involving the village leaders. The community management groups will eventually become part of the hierarchy of project implementation. All the activities will be under the *Bupati* of Cilacap through SATF.

Budget

The estimated total cost will vary significantly, depending on the amount of equipment purchased as part of the transfer of fishermen to offshore areas. This one-year project can at least be partly supported by DGF but will require additional assistance, if it is to be implemented as planned. The budget for one year is:

Chapter 6. Projects to Implement Management Strategies

Item	US\$
Personnel	
Project coordinator/director	6,000
Field development workers (2)	8,000
Secretary/accountant	4,000
Logistics assistant	3,000
Travel and per diem	20,000
Education and training	30,000
Field operations	10,000
Equipment (2 boats and gear)	66,000
Overhead (10%)	16,000
Total	163,000

5. Improvement of Crab and Fishery Commodity Marketing Channels, and Training in Marketing Cooperatives

Objectives and benefits

The objective of this project is to develop marketing channels for fishery products, especially the mudcrab which is currently being caught in large numbers and, to a lesser extent, cultured in cages. The improvement of current marketing techniques and channels will enhance the revenue to the dealers and fishermen of Kampung Laut from the sale of fishery products and crab. This project will address Strategy 5 of IMPSA which suggests alternative livelihood for fishermen.

The expected benefits from this project are the:

1. stabilization of price and a higher average revenue to producers throughout the year;
2. formation of fishery product marketing cooperatives which will equalize the revenue to producers; and
3. increased production of crab as the revenues increase and the potential benefits become known to more fishermen.

Background

The income of the residents of Kampung Laut from fishing and other activities is well below the poverty level by Indonesian standards. People are not able to buy enough food and other necessities.

In recent years, the fishery for mudcrabs in the lagoon and mangrove areas has expanded significantly. Now, many fishermen are rearing crabs from juvenile to adult stages in cages and selling them when they reach a marketable size. The price received for the crabs is directly proportional to their size and they are more valuable in cities away from Segara Anakan.

Chapter 6. Projects to Implement Management Strategies

Since the development of crab culture is considered one of the prime alternatives to capture fisheries in the lagoon, the improvement in marketing and price of the crab will encourage culture activities. This will, in turn, increase the general revenues to the people involved.

Since fish (e.g., tilapia) and other fishery products (e.g., shrimp paste) are also economically important, any marketing improvements should also address these products.

Description

This project will be implemented by SATF through a full-time fieldworker knowledgeable in marketing and working with rural fishermen. This person will plan and conduct the project so that it targets the middlemen for crab in Kampung Laut. He/she will initially make a survey to determine exactly the problems in the present marketing system for mudcrab. A scheme will be designed to enhance marketing through the participation of the marketing middlemen and key fishermen in a series of seminars to adjust their marketing system. In the process, an organization(s) will be formed among those concerned with marketing so that cooperation is assured for the benefit of the communities.

Initially, ten middlemen will be made to attend the seminars and training will be conducted by the fieldworker. Later, more individuals will be included as the initial trainees can extend their knowledge. An evaluation of project effectiveness will be conducted after one year of implementation.

Phasing of activities

1. Hire a marketing extension worker, and organize and plan the project in coordination with SATF in Cilacap.
2. Survey the villages and the middlemen concerned with crab and fish marketing to determine the exact problems in their marketing practices. Make a similar survey of the marketing potential for crab in the nearby market outlets and analyze the current and potential channels.
3. Design a training module and means to transfer the necessary skills to the middlemen for crab and fishery products.
4. Conduct field seminars and one-on-one informal sessions with the targeted participants for marketing.
5. Organize the middlemen and key fishermen into a cooperative for marketing.
6. Develop a market information system of the crab's market potential and price for the crab producers in the villages.
7. Facilitate business relationships between merchants and fishermen.
8. Monitor and evaluate the project by measuring changes in revenue to the fishermen as well as the volume and prices of crab and other products bought and sold. Participation of the fishermen in the program will also be monitored.

Agencies and administration

This project will be coordinated by SATF with the involvement of the Departments of Commerce and Cooperatives. It will be managed closely with aquaculture development for crab and tilapia and the other livelihood projects which may involve aspects of marketing. It will also fit in with the other activities of IMPSA handled by SATF.

Budget

The estimated budget for this one-year project is as follows:

Item	US\$
Personnel	
Coordinator/director/fieldworker	12,000
Field assistant	4,000
Travel and per diem	4,000
Field operations	2,000
Supplies	2,000
Overhead (10%)	2,000
Total	<u>26,000</u>

6. Involvement of Women In Alternative Income-Generating Activities

Objectives and benefits

The main objective is to organize women's groups in income-generating activities aside from the traditional dependence on fisheries, and to encourage them to use their extra time effectively. The project will involve at least 10% of the women in Kampung Laut communities and is estimated to increase the average income per family by at least 10% also.

This project is intended to enhance the socioeconomic program implemented through the *Bupati* of Cilacap. It will address aspects of Strategy 5 of IMPSA which can be achieved at the community level.

The expected benefits from this project are:

1. Women will learn to organize themselves into working groups for particular economic activities.
2. The three target villages will each have at least one working group of women engaging in one or more new economic projects.
3. At least 10% of the women in the three villages will be trained in value-added processing using native materials available from the mangrove forest (e.g., *Nypa* for roofing or housing material, fiber plants for floor mats, plant extracts for medicine) and fishery products (e.g., fish paste), and in other potential livelihood projects.
4. Each family participating in the project will increase its average income by at least 10% over a one- to two-year period.

Background

Kampung Laut communities have low per capita incomes. In 1982, 67% of the households earned less than Rp 31,000/month and 35%, less than Rp 17,000. In 1987, the situation somewhat improved when most workers earned between Rp 45,000 and 150,000/month, although with inflation, these figures were not significantly higher than those in 1982. Monthly incomes this low cannot feed a family of five or six, except with minimal subsistence.

In general, nutrition and health are poor in the communities. Malaria, skin diseases and malnutrition are present. Poverty exacerbates these conditions.

In recent years, men and women in Kampung Laut have been forced to explore alternative sources of income. Some fishermen have become farmers of rice and vegetables, and a few have ventured into aquaculture. Training in these activities, as alternatives to capture fisheries, is the focus of other projects by the *Bupati* of Cilacap. But new income-generating activities for women have not been addressed systematically.

If women are organized into working groups and trained in some skills, then these will translate into new viable sources of income. Since many people in Segara Anakan derive their main earnings from the collection and sale of natural resources, it is reasonable to propose training in value-added activities. *Nypa* palm, for example, is collected and sold, but not processed. Shells are collected and sold very cheaply. Export of plants with medicinal uses is not yet explored.

Description

At least 10% of the women in the three villages will be selected to participate in training programs. Community development workers who will stay in Kampung Laut will organize the women into groups to engage in particular income-generating activities. The fieldworkers will rotate from one village to another so that periodic support is available to each of the three organized women's groups.

After training, a women's group will then begin to implement what it has learned with the help of the fieldworkers. A product will be refined, and marketing channels set up with assistance from the project. Small amounts of capital investment, in the form of no-interest loans, will be made available to the groups.

Each women's group will receive a special training at least once every three months, during which problems will be discussed and a mini-evaluation of the work made. Eventually, women from the groups will serve as nuclei for new groups.

Chapter 6. Projects to Implement Management Strategies

Phasing of activities

1. Form a community development project team composed of two workers and a coordinator/director.
2. Introduce the project to each village and make a preliminary selection of the participants.
3. Design training courses appropriate to the needs of each village.
4. Conduct a series of trainings in the three villages over a three-month period.
5. Rotate the trainings among the villages to assist their groups in actual project implementation.
6. Continue to assist all the groups as needed and provide the inputs which will guarantee their success without making them dependent on the project.
7. Evaluate and improve each working group on a case-to-case basis.
8. Select women who can venture into forming new working groups for income-generating activities.

Agencies and administration

This project will be based in the office of SATF under the authority of the *Bupati* of Cilacap. As part of IMPSA, the project will be coordinated with other government agencies activities in Kampung Laut concerned with the development of the communities—FSC and its alternative livelihood development projects; the Department of Industries for possible links in technology relevant to income generation; the Department of Social Affairs; and the State Ministry of Women's Roles and Affairs on other women's projects in Indonesia.

Budget

Two years may be required for project operation during which external funding through SATF will be needed. The estimated budget for a one-year operation is as follows:

Item	US\$
Personnel	
Project coordinator/director	6,000
Community workers/trainers (2)	10,000
Field assistant, secretary (1)	3,000
Travel and per diem	6,000
Field operations	4,000
Equipment and supplies	5,000
Seed capital	5,000
Overhead (10%)	4,000
Total	43,000

7. Education and Public Awareness on Resources Management and Ecology in Kampung Laut

Objectives and benefits

The main objective of this project is to increase the general knowledge of the Kampung Laut residents on the means of and rationale for the implementation of IMPSA and its associated projects. It will provide background information on the environmental and ecological relationships upon which the functioning of the lagoon, its fisheries and the mangrove ecosystem depends. It will highlight the implications of continued and unmanaged exploitation of the resources on the environment. This project will also provide information on possible alternatives for income generation aside from fisheries and mangrove harvesting.

The socioeconomic development program being implemented by the *Bupati* of Cilacap is also expected to be enhanced. The project will generate educational materials for general dissemination and use in local schools. It will fulfill Strategies 1, 5 and 8 of IMPSA and support all the strategies which depend on community participation and awareness.

The expected benefits of the project are the:

1. improved appreciation and understanding of marine resources management and underlying ecological processes of Segara Anakan by the people of Kampung Laut;
2. enhanced openness of the village residents to the necessary changes to successfully implement the management plan;
3. decreased incidence of illegal and destructive activities such as the use of fine-meshed nets and the harvesting of mangroves in the wrong areas;
4. better knowledge among the Kampung Laut residents about the new zonation scheme for the whole Segara Anakan area and the criteria for management of each zone; and
5. greater participation in and knowledge about the other projects set up to facilitate plan implementation.

Background

The general level of education in the Kampung Laut communities is very low by Indonesian standards. The illiteracy rate is 10%. About 67% of the population had no schooling in 1984; this improved to 50% in 1988.

The low level of education contributes to the lack of understanding among the local residents on resources management issues in the area. They are poor, live on a day-to-day basis and have little foresight regarding the implications of their actions on the environment. Furthermore, they are pushed by declining fish yields to resort to ever more efficient methods of fishing. Without education, the chances of the people seeing the impact of their actions are small.

Chapter 6. Projects to Implement Management Strategies

The various projects to be implemented in Segara Anakan will depend to a large extent on the participation of its residents. Their participation will be enhanced if they can understand the reasons behind their current situation. Since the plight of the people in Kampung Laut is dependent on the condition of the environment and natural resources, knowledge about this is essential for them to take action for improved resources management.

Description

Two full-time community educators will organize and implement education courses for this two-year project. They will recruit personnel (consultants) from various agencies who are knowledgeable in relevant subjects to assist in each of the education sessions.

The education programs will target the local schools and their teachers, and the community at large. One-day programs will be conducted on a regular rotation basis among the various villages. Special three-day seminars will be held every three months for a selected group in each village to address particular needs. An underlying theme in all the education programs/seminars is resources management in Segara Anakan as proposed by IMPSA.

Nonformal education methods will be employed. Audiovisuals, skits, plays, poster shows and the like which attract attention will be used whenever possible.

Phasing of activities

1. Form a team of two full-time community educators and select line agency resource persons to assist in education programs in coordination with SATF. Design baseline knowledge questionnaire to be used as an evaluation tool before and three months after each education program and seminar.
2. Prepare education modules and materials to be used for the courses.
3. Schedule the education sessions in the villages, and select participants for each at least one month in advance.
4. Conduct baseline knowledge interview with the selected participants prior to the education programs/seminars.
5. Carry out 2-3 one-day programs and at least 1 three-day seminar in each of the villages over a 12-month period.
6. Make follow-up intensive programs with evaluations after three months and new inputs as required to enhance information retention among the participants.
7. Use the results of the baseline-knowledge interview as an evaluation tool and suggest other programs to increase the awareness of the local people.

Chapter 6. Projects to Implement Management Strategies

Agencies and administration

This project will be conducted by SATF through a full-time coordinator/director and two community educators in cooperation with resource persons from the key line agencies concerned with the social welfare and education of the communities of Kampung Laut. Although an autonomous project, it will be coordinated closely with the socioeconomic programs of the *Bupati* of Cilacap and the other agencies involved. The education programs/seminars will be planned with the village governments and the leaders as appropriate.

Budget

The estimated budget for one year is as follows:

Item	US\$
Personnel	
Project coordinator/director	6,000
Community educators (2)	10,000
Resource consultants	10,000
Travel and per diem	3,000
Field operations	2,000
Equipment and supplies	5,000
Overhead (10%)	4,000
Total	40,000

8. Improvement of Wetland Management and Conservation In Segara Anakan

Objectives and benefits

The objective of this project is to formulate and implement activities for the management of the nature reserves and core area of IMPSA. It will establish criteria for the management of the protected areas and implement these through the participation of the local government and PHPA personnel. It will promote wetland conservation and improve the quality of wetland habitats within the management area. It aims to update the status of the protected and reserve areas in terms of current use and degradation. This project will address Strategies 1, 2, 4, 6, 7 and 8 of IMPSA.

The expected benefits from the project are the:

1. implementation of the management guidelines for the nature reserves and protected areas within IMPSA;
2. implementation of wetland conservation through the participation and education of the local residents;
3. improved quality of the mangrove habitat in the protection and reserve zones of IMPSA;

Chapter 6. Projects to Implement Management Strategies

4. protection of important bird and mammal habitats in the management zone;
5. new information on the status of the area so that the management guidelines can be refined and made more appropriate for the local situation;
6. increased awareness among villagers, local government agencies, line agencies and planners on the benefits to be derived from proper management of the mangrove area; and
7. training of three PHPA officers in mangrove evaluation and management techniques.

Background

Segara Anakan and its surrounding area have received much attention in recent years. Research surveys in 1987 and 1988 of ASEAN/US CRMP and the Asian Wetland Bureau in association with PHPA determined that the lagoon area, although deteriorating rapidly, is rich in natural resources. It contains the largest remaining mangrove stand in Java and an estuarine lagoon which is an important nursery, breeding and feeding area for offshore and lagoon fisheries and a habitat for rare bird and mammal species.

The most common arguments for management stem from economic interest in the mangrove forest and fisheries resources of the area. From a conservation perspective, it is a unique habitat area in Java and deserves protection in its own right. Several rare or endangered species, whose populations have been severely reduced in other areas of Indonesia, are still found here. These include birds such as the lesser adjutant, milky stork, woolly-necked stork and the rare endemic sunda coucal. The lagoon and its associated mudflats also have an important role as a wintering and staging or feeding site for birds that migrate across many countries.

The IMPSA includes a zonation scheme which covers all the potential uses of the lagoon and its surrounding land area. The plan provides for protection and reserve zones with the purpose of protecting, in its natural state, a portion of the mangrove habitat of Segara Anakan. Since this is the last such area in Java, it is critical that such zones be strictly protected.

The mangrove ecosystem of Segara Anakan is getting more degraded yearly as local people harvest the trees. Many areas have already been converted for agriculture or aquaculture purposes. Other areas have been overharvested so that regrowth is not efficient and the ecosystem has been permanently changed.

Thus, as part of IMPSA, it is suggested that the nature reserve project be implemented for the benefit of Java and the conservation of mangrove ecosystems and bird habitats. Such implementation fits into the long-term planning of PHPA for wetland management for Indonesia as a whole.

Chapter 6. Projects to Implement Management Strategies

Description

The PHPA will assign three full-time field personnel to work on the project. They will be based in Cilacap and the villages of Segara Anakan.

The PHPA team will survey the reserve and protection zones and formulate criteria for management in conjunction with SATF and the local communities. It will involve local residents in promoting conservation of the zones and important species through a series of education programs and by bringing key individuals into the management committees to be formed under the fisheries project (see Project 4). The committees will communicate with the larger population of the villages for resources management in Segara Anakan.

The team will verify the reserve and protection zones and place signs in strategic areas. It will produce educational materials on the role of the zones and will engage in rehabilitation through replanting and prevention of harvesting within the area. The team will also monitor the status of important species.

Phasing of activities

1. Organize the project team and prepare the workplan and specific activities with SATF.
2. Conduct initial field surveys in the reserve and protection zones to update data on the site and its management needs.
3. Refine the management plan for the zones with detailed guidelines for mangrove and wetland protection.
4. Hold meetings and seminars with local communities and government officials to present the management guidelines for reserve and protection zones and wetland conservation in general.
5. Verify boundary markings in the field and place signs in strategic areas.
6. Produce educational materials for local communities and the government offices in Cilacap on the management program and its objectives and benefits.
7. Involve local communities in actual management activities at the site whenever possible.
8. Conduct general education programs on a regular basis.
9. Evaluate the project and refine the management plan for the delineated zones.

Agencies and administration

This project will be the responsibility of PHPA and coordinated by SATF in conjunction with Perhutani, the Bupati of Cilacap, FSC and the local communities. A consultant will provide technical assistance to PHPA. The project office will be based at the SATF headquarters so that coordination is assured.

Budget

It is assumed that this project would need to run for three years. The estimated budget to support it for a year is as follows:

Item	US\$
Personnel	
Project coordinator/director	12,000
PHPA technical staff (3)	7,500
Field logistics assistant	2,500
Consultant (3 man-months)	30,000
Travel and per diem	5,000
Field operations	2,500
Education and training	7,500
Equipment and supplies	10,000
Overhead (10%)	5,000
Total	82,000

9. Monitoring of Water Quality In Segara Anakan for Long-Term Management, and Training of Local Personnel

Objectives and benefits

The main objective of this project is to periodically check the water quality of the lagoon and incoming rivers regarding any increase in particular types of pollutants. It will provide data on water quality in the lagoon, determine the sources of pollutants and recommend potential solutions. This project will undertake training of local government personnel in environmental monitoring and EIA. It will address Strategies 3, 4 and 7 of IMPSA.

The expected benefits from this project are:

1. periodic updates on water quality in the lagoon and its tributaries;
2. better information on the sources of pollution in the lagoon;
3. increased participation of the local government and line agencies in monitoring water quality which will translate into deeper awareness about the pollution problem;
4. training of at least two KLH officials in EIA and its execution, and in water quality monitoring; and
5. involvement of industries whose activities have an adverse effect on the water quality.

Background

Segara Anakan receives a large volume of water from its various tributaries. These rivers drain a watershed of approximately 960 km² and deliver an annual average of 20.5 million m³ of water/day. Essentially all the pollutants draining from this watershed flow into and/or through the lagoon. Because of the volume of water, the potential pollution is diluted.

Chapter 6. Projects to Implement Management Strategies

The presence of heavy metals and pesticides has been documented at levels not considered dangerous to the organisms in the lagoon. But large quantities of organic waste enter the lagoon from the rivers and to a lesser extent, from the villages. The concentration of microorganisms from organic sewage varies with the season, the area of the lagoon and current movements. Although not yet at harmful levels, organic waste inputs are increasing and require monitoring and eventual control.

Increasing industrialization near Cilacap requires monitoring of water quality in that area. Although the largest threat of pollution comes from domestic waste, river transportation is also a source.

The key parameters which require monitoring as listed in the Decree of the State Minister for Population and the Environment No. KEP-02/MENKLH/I/1988 in the Guide for Environmental Standards are:

1. physical qualities - turbidity, suspended matter and temperature; and
2. chemical and biological properties - various parameters including concentrations of heavy metals, hydrocarbons, pesticides and bacteria from waste.

As the demands on the environment increase in Cilacap, so does the need for personnel with knowledge of how to recognize problems and undertake EIA. The KLH has recently established a bureau within the *Bupati's* office to deal with environmental problems, but the staff lacks knowledge of water quality monitoring and EIA for the industrial sites being developed.

Description

The project will train a local agency to collect the water samples and when feasible, conduct the analysis in a local laboratory. The MH office or one of the industrial companies with a laboratory is being eyed to do this. Monitoring stations will be sampled on a quarterly basis for physicochemical parameters of importance to the lagoon and places prone to pollution as indicated in the previous baseline studies of ASEAN/US CRMP. Drinking water used in the villages of Kampung Laut will also be sampled regularly.

Training will be conducted on the site for general aspects of water quality monitoring. The personnel for specific training in EIA will be sent to one of several universities qualified to conduct the accredited course recognized by KLH.

Phasing of activities

1. Select the research institution appropriate to conduct the monitoring in cooperation with KLH, and locate a local laboratory which can be used for the analysis.
2. Finalize the terms of reference for a two-year implementation of the monitoring program.

Chapter 6. Projects to Implement Management Strategies

3. Finalize the workplan, sampling sites and personnel who will assist in the fieldwork.
4. Conduct local training in water quality monitoring.
5. Monitor the lagoon, rivers and drinking water of the village on a quarterly basis for two years.
6. Analyze periodically the water samples for trends in pollution.
7. Provide periodic feedback to SATF members on the status of water quality in the lagoon, and suggest remedial measures as needed.
8. Isolate local sources of pollutants and relay the appropriate information to persons responsible for the control of pollution in areas such as the industrial sites near the town of Cilacap.
9. Send at least two appropriate persons for a special course in EIA and evaluation.
10. Conduct a final evaluation of the monitoring project, and plan a means to transfer the activities to a local agency for further implementation.

Agencies and administration

This project will be coordinated by SATF under the direction of the *Bupati* of Cilacap and the local KLH. Candidate institutions for carrying out the actual field sampling are the Oil State Enterprise (Pertamina), University of Gadjah Mada, University of Sudirman and University of Diponegoro. The MH office in Cilacap can also assist in the monitoring of microbial levels in both the lagoon samples and the drinking water to minimize hazards to human health. The KLH will be consulted on the implementation of this project and the interpretation of the results.

Budget

The estimated budget for one year of operation of this two-year project is as follows:

Item	US\$
Personnel	
Coordinator/directors (2)	6,000
Fieldworkers (2), part-time	6,000
Consultant (2 man-months)	20,000
Travel and per diem	10,000
Water sample analysis	12,000
Local training courses	10,000
Training in EIA	5,000
Overhead and reporting	5,000
Total	<hr/> 74,000

**POLICY, COORDINATION,
TIMING AND
IMPLEMENTATION**

To succeed, IMPSA should be formally adopted by the government and included in the Five-year Plan, with the participation of all involved parties, particularly the public sector, through designated representatives and NGOs.

The overall policy objective of this plan is to promote sustainable development of Segara Anakan while raising the economic status of local residents. Sustainable development in this context means utilization of resources at a rate less than the rate of natural or assisted (as in plantation forestry) replenishment.

The idea of using an integrated plan for long-term management of natural resources is not a new process in Indonesia. Certain recommendations for a national planning policy made more than a decade ago by Hanson and Koesoebiono (1979), particularly the setting up of a specialized unit through BAPPEDA for resource management, have not yet been adopted, and many of the institutional problems highlighted at that time have not yet been solved. This situation should be rectified.

In past years, development of one sector, such as forestry, would proceed without the knowledge or assistance of other sectors, such as tourism. "Integrated" means that all affected parties should participate.

Regular meetings should be scheduled under the SATF umbrella in order to coordinate new developments with the plan. Because this is an integrated plan, it is particularly important that representatives of all pertinent agencies should attend.

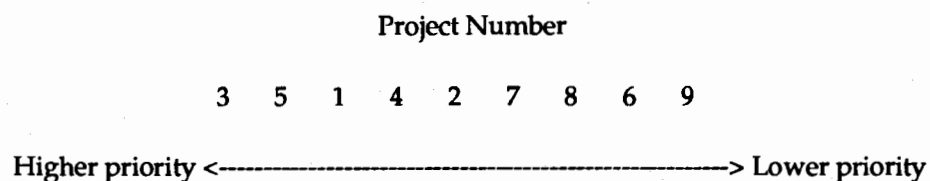
Some agencies were brought into the planning process later than others. These should be welcomed. For example, MJ and NKPA should be brought together to discuss the potential for tourism development on Nusa Kambangan with the tourism department.

In order for the current plan to succeed, certain procedures should be followed. Some of these have already been started. The IMPSA should be formally adopted by the government and included in the Five-year Plan. All parties involved should push to have this accomplished. It is of utmost importance that the public participate in this process through designated representatives and NGOs. Target constituencies, e.g., the tourism industry and fishermen's groups, need to be identified and tapped for this purpose.

A possible mechanism is suggested whereby the plan and its proposed projects can be included in the annual *Blue book* of BAPPENAS. Since BAPPEDA has been identified in this plan as the agency to coordinate government services in cooperation with SATF, it should officially submit this plan via the Central Java Planning Board to BAPPENAS for approval and inclusion in the annual *Blue book*. Simultaneously, DGF, the implementing agency of ASEAN/US CRMP, should send a copy of this plan to LIPI (the coordinating agency of the project) for official submission to BAPPENAS via the Directorate of Programme of DGF.

Chapter 6. Projects to Implement Management Strategies

One of the uses of the management plan will be as a framework for attracting domestic and international funding for development projects. Although many projects were proposed in this plan, only those considered essential have been included. This list of high-priority projects has a hierarchy to facilitate the funding process, as follows:



A schedule for plan implementation and estimated budgets will also be useful for all participants (Table 6.3).

Table 6.3. Implementation schedule and estimated budgets of projects.

Project	1	2	Year 3 Budget (US\$)	4	5	Total budget (US\$) ^a
1 ^b	161,000	161,000	56,000	56,000	56,000	490,000
2 ^c	75,000					75,000
3 ^c	82,000	82,000				164,000
4	163,000	163,000				326,000
5	26,000					26,000
6			43,000	43,000		86,000
7		40,000	40,000			80,000
8			82,000	82,000	82,000	246,000
9				74,000	74,000	148,000
Total (US\$)	507,000	446,000	221,000	255,000	212,000	1,641,000

^aInternational funding = US\$ 1,174,000 (1st 3 years).

Indonesian funding = US\$ 467,000 (last 2 years).

^bOngoing.

^cImplemented for one year under ASEAN/US CRMP to make an initial assessment of the need for and viability of the project.

PLAN MONITORING AND EVALUATION

The management plan should be periodically reevaluated and adjusted as necessary. The best way to do this is to monitor whether the implementation of the plan is running smoothly and its goals are being met. Remedies can be carried out to change unrealistic goals and/or reorient plan implementation

such that they match. An appropriate point in time to conduct an evaluation of the plan is two years.

The best way to periodically reevaluate and if necessary, adjust the management plan is to monitor whether it is being smoothly implemented and its goals are being met. Remedies should change unrealistic goals and/or reorient plan implementation such that they match.

The evaluation of project implementation can examine a variety of indicators including budget allocation; resource-use permits issued or denied; number of interagency agreements signed; availability of trained staff; and number of projects approved. Goal-oriented evaluation can examine such measures as extent of NGO and public participation in meetings; changes in environmental quality and the resource base; number of tourists; employment and income levels of residents; commodity sales; and number of new regulations.

The general requirements that should be examined when evaluating the management strategy include:

- clear and consistent guidelines
- adequate information and analytical tools
- sufficient jurisdiction and enforcement authority of implementing agency
- autonomous structure (control of staffing and budget)
- staff commitment
- legislative support
- good public relations

In this chapter, details of nine specific projects have been given that seek to address the most important management issues described in Chapter 5. These are designed to empower SATF, to improve livelihood opportunities, education, health care and public awareness of local residents while protecting and wisely managing valuable natural resources as well as reducing pollution. A schedule and prioritization scheme are also provided. For each project, guidelines are given for the implementation strategy, activity plan and budget. A scheme for monitoring and evaluating the progress of the project is furnished. The importance of the participation of the general public, target groups and NGOs is stressed.

It will be up to SATF to be the leader in all the above mentioned activities. The success of IMPSA can serve as a model for a national program.

REFERENCES

- Amin, E.M., T. Hariati, Wasilun, Suwarso and S.B. Atmadja. 1988. Lagoon and culture fisheries. Research Institute for Marine Fisheries, Jakarta. 22 p. (Unpublished).
- AWB (Asian Wetland Bureau). 1988. The importance of Segara Anakan for conservation, with special reference to its avifauna. Asian Wetland Bureau, Bogor. 50 p. (Unpublished).
- Birowo, S. and H. Uktolseya. 1982. The coastal and estuarine waters of the Cilacap region, p. 27-33. *In* E.C.F. Bird, A. Soegiarto, K.A. Soegiarto and N. Rosengen (eds.) Proceedings of the Workshop on Coastal Resources Management in Cilacap Region, 20-24 August 1980. Gadjah Mada University, Yogyakarta.
- Brotosusilo, A. 1988. Evaluation of perception and attitudes of public officials pertaining to environmental policy and coastal resources management implementation. *In* Proceedings of a Technical Workshop, ASEAN-US CRM Indonesia In-country Project, 7-9 March 1988. Semarang, Indonesia.
- Budihardjo. 1988. Socio-economic study in three fishing villages of Segara Anakan-Cilacap in relation to coastal resources management. Research Institute for Marine Fisheries, Jakarta. 19 p. (Unpublished).
- CPB (Cilacap Planning Board). 1989. Annual report for 1989. Cilacap Planning Board, Cilacap, Central Java, Indonesia.
- Djohan, T.S. 1982. Species diversity of mangrove forest floor fauna in Segara Anakan and the Donan River, p. 146-159. *In* E.C.F. Bird, A. Soegiarto, K.A. Soegiarto and N. Rosengen (eds.) Proceedings of the Workshop on Coastal Resources Management in Cilacap Region, 20-24 August 1980. Gadjah Mada University, Yogyakarta.
- ECI (PRC Engineering Consultants, Inc.). 1975. The Citanduy River Basin Development Project Master Plan. Prepared for the Directorate General of Water Resource Development, Ministry of Public Works. PRC Engineering Consultants, Inc., Jakarta. 100 p. (Unpublished).
- ECI (PRC Engineering Consultants, Inc.). 1987. Segara Anakan engineering measures study. Main Rep. Citanduy River Basin Development Project. PRC Engineering Consultants, Inc., Banjar, Indonesia. 351 p. (Unpublished).
- ET (Ecology Team-Bogor Agricultural University). 1984. Ecological aspects of Segara Anakan in relation to its future management. Institute of Hydraulic Engineering, Faculty of Fisheries, Bogor Agricultural University. 141 p. (Unpublished).
- ET (Ecology Team-Bogor Agricultural University) and T. Sujastani. 1989. Economic sector, p. 56-63. *In* A.T. White, P. Martosubroto and M.S.M. Sadorra (eds.) The coastal environmental profile of Segara Anakan-Cilacap, South Java, Indonesia. ICLARM Tech. Rep. 25, 82 p.
- ET (Ecology Team-Bogor Agricultural University), M. Purba and T. Sujastani. 1989. Geography and physical setting, p. 5-21. *In* A.T. White, P. Martosubroto and M.S.M. Sadorra (eds.) The coastal environmental profile of Segara Anakan-Cilacap, South Java, Indonesia. ICLARM Tech. Rep. 25, 82 p.
- FSC (Fisheries Service of Cilacap). 1967-1991. Annual report for various years. Fisheries Service of Cilacap, Cilacap.
- Hadisumarno, S., S. Murtopo and Sutanto. 1982. Remote sensing of geographical features of Cilacap Region, p. 17-22. *In* E.C.F. Bird, A. Soegiarto, K.A. Soegiarto and N. Rosengen (eds.) Proceedings of the Workshop on Coastal Resources Management in Cilacap Region, 20-24 August 1980. Gadjah Mada University, Yogyakarta.
- Hamidjojo, P. 1980. The geomorphology of Segara Anakan related to the tides and current. Seminar on Coastal Resources of Segara Anakan, Central Java, 18 August 1981. LIPI/UNU/UGM, Yogyakarta, Indonesia.
- Hanson, A. and Koesoebiono. 1979. Settling coastal swamplands in Sumatra: a case study for integrated resource management, p. 121-178. *In* C. MacAndrews and L.S. Chia (eds.) Developing economies and the environment: the Southeast Asia experience. McGraw-Hill International Co., Singapore.
- Hardoyo, S.R. 1982. The Kampung Laut of the Segara Anakan: a study of socio-economic problems. Paper presented at the MAB-LIPI-SII-ME Seminar on Mangrove Ecosystem, 3-5 August 1982. Baturraden.
- Koesoebiono, M. Purba, Hardjono and S. Rahardjo. 1989. General policy and guidelines for the management of zonation scheme of Segara Anakan. ASEAN/US CRMP Indonesia Subproject. (Unpublished).
- LPM-ITB (Lembaga Pengabdian Masyarakat-Institut Teknologi Bandung). 1988. Studi pengembangan wilayah Segara Anakan dan sekitarnya. Lembaga Pengabdian Masyarakat-Institut Teknologi Bandung, Indonesia.

References

- Ludwig, H.F. 1985. Segara Anakan environmental monitoring and optimal use planning projects: final reports. Institute of Hydraulic Engineering, Agency for Resource and Development, Department of Public Works, Bandung. 285 p. (Unpublished).
- Ludwig, H.F. 1988. Regional economic-cum-environmental development planning. Asian Development Bank, Philippines.
- Naamin, N. 1991. The ecological and economic roles of Segara Anakan, Indonesia, as a nursery ground of shrimp, p.119-130. *In* L.M. Chou, T.-E. Chua, H.M. 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.
- Napitupulu, M. and K.L.V. Ramu. 1982. Development of the Segara Anakan area of Central Java, p. 66-82. *In* E.C.F. Bird, A. Soegiarto, K.A. Soegiarto and N. Rosengen (eds.) Proceedings of the Workshop on Coastal Resources Management in Cilacap Region, 20-24 August 1980. Gadjah Mada University, Yogyakarta.
- PHPA (Directorate General of Forest Protection and Nature Conservation). 1988. Field survey report of Segara Anakan, Cilacap. Directorate General of Forest Protection and Nature Conservation, Bogor. 21 p. (Unpublished).
- Rahardjo, W. 1982. Geological features of the Cilacap Region, p. 23-26. *In* E.C.F. Bird, A. Soegiarto, K.A. Soegiarto and N. Rosengen (eds.) Proceedings of the Workshop on Coastal Resources Management in Cilacap Region, 20-24 August 1980. Gadjah Mada University, Yogyakarta.
- RMI (Resources Management International, Inc.). 1986. Citanduy Basin resources inventory, Jakarta, Indonesia. Resources Management International, Inc., Indonesia.
- Romimohtarto, K. 1989. The final report of the water quality study of Segara Anakan, Cilacap, Central Java, Indonesia. ASEAN/US CRMP Indonesia Subproject. 33 p. (Unpublished).
- SOC (Statistical Office of Cilacap). 1990. Annual report for 1990. Statistical Office of Cilacap, Cilacap.
- Soemodihardjo, S. 1989. Assessment of mangrove degradation and zoning for development: final report for ASEAN/US CRMP. LON-LIPI, Jakarta. 25 p. (Unpublished).
- Sujastani, T. 1989. Population, socioeconomics and land use, p. 47-55. *In* A.T. White, P. Martosubroto and M.S.M. Sadorra (eds.) The coastal environmental profile of Segara Anakan-Cilacap, South Java, Indonesia. ICLARM Tech. Rep. 25, 82 p.
- Taufik, A.W. 1988. Formulation of marine protected area management plan in the Segara Anakan, Cilacap. Directorate General of Forest Protection and Nature Conservation, Bogor, Indonesia. 45 p. (Unpublished).
- Thayib, S.S., D.H. Kunarso and Ruyitno. 1991. A study of microbial indicators in Segara Anakan, Java, and its adjacent waters, p. 431. *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., P. Martosubroto and M.S.M. Sadorra, editors. 1989. The coastal environmental profile of Segara Anakan-Cilacap, South Java, Indonesia. ICLARM Tech. Rep. 25, 82 p.

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- The coastal environmental profile of Brunei Darussalam: resource assessment and management issues.** T.-E. Chua, L.M. Chou and M.S.M. Sadorra, editors. 1987. No. 18, 193 p. Out of print - available in photocopied form at \$29, including airmail cost; P270.
- The coastal environmental profile of Ban Don Bay and Phangnga Bay, Thailand.** J.N. Paw, S. Bunpapong, A.T. White and M.S.M. Sadorra, editors. 1988. No. 20, 79 p. Out of print - available in photocopied form at \$12, including airmail cost; P110.
- The coastal environmental profile of Singapore.** L.S. Chia, H. Khan and L.M. Chou. 1988. No. 21, 92 p. Out of print - available in photocopied form at \$14, including airmail cost; P128.
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