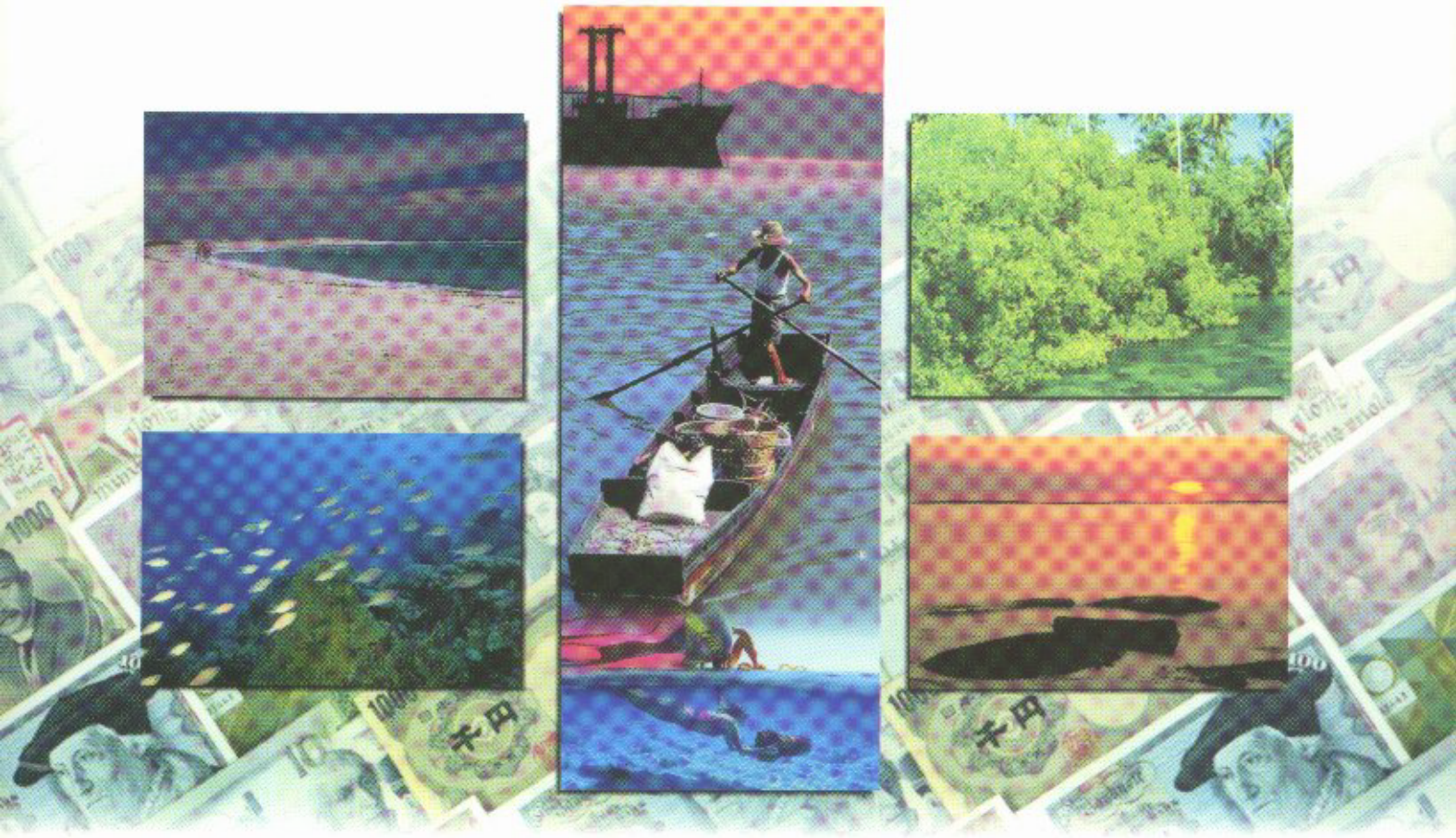
Total Economic Valuation: Coastal and Marine Resources in the Straits of Malacca



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

Total Economic Valuation: Coastal and Marine Resources in the Straits of Malacca

September 1999

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

TOTAL ECONOMIC VALUATION: COASTAL AND MARINE RESOURCES IN THE STRAITS OF MALACCA

September 1999

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

Printed in Quezon City, Philippines

MPP-EAS. 1999. Total economic valuation: Coastal and marine resources in the Straits of Malacca. MPP-EAS Technical Report No. 24/PEMSEA Technical Report No. 2, 52 p. Global Environment Facility/United Nations Development Programme/International Maritime Organization Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas (MPP-EAS)/Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), Quezon City, Philippines.

A GEF Project Implemented by UNDP

ISBN 971-812-005-X




MISSION STATEMENT

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

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

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

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

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

Contents

List of Tables

List of Appendix Tables

List of Figures

Acknowledgments

This report was prepared by Ms. Maria Corazon M. Ebarvia of the School of Economics, University of the Philippines in partial fulfillment of a contract with the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas. The work represents a component of the Malacca Straits Demonstration Project, which was coordinated by Mr. S. Adrian Ross, Senior Programme Officer of the Regional Programme.

The assistance of the following in the preparation of this document is gratefully acknowledged:

- The faculties and staff of the Universtiy of Malaya, Malaysia, Bogor Agricultural University of Indonesia, and the National University of Singapore who completed the economic valuation and mapping of marine and coastal resources in their respective countries, in particular:

  Bogor Agricultural Universtiy of Indonesia: Trodoyo Kusumastanto, Indra Jaya, Vincentius P. Siregar, M. Fedi A. Sondita, Yus Rustandi, Erliza Noor, Sigid Hariyadi, Rokhmin Dahuri;
  University of Malaya: A. Sasekumar, V.C. Chong, S.M. Phang, Low Kum Sang; and
  National University of Singapore: Loo Y.Y., K.S. Tan;

- Dr. Chua Thia-Eng, Regional Programme Manager of the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas for technical advice;
- Ms. Bresilda Gervacio for technical assistance, Dr. Leticia Dizon for editorial supervision, and Ms. Maricel Bigal and Mr. Leo Rex Cayaban for editorial assistance; and
- Mr. Noel Robles and Mr. Jonel Dulay for the preparation of the maps and figures.

Executive Summary

This report provides a framework for the economic valuation and initial estimates of the total economic value of coastal and marine resources in the Straits of Malacca. Often, resources are appreciated only in terms of the direct market values they provide. Because non-use values and ecosystem services are not fully quantified in markets, they are often given little weight in policy-making. The undervaluation of resources results in conflicting policies, such as conversion of resource areas to other uses, and overexploitation by people who are not well-informed of the consequent impacts. Valuation of natural resources and the environment necessitates the estimation of benefits and costs of using these natural assets. The concern is whether or not a particular use (and non-use) is contributing *net economic benefits* to society. The gross value of the marine and coastal resources in the Straits of Malacca is estimated to be around $6.83 billion. The total net economic value is around $5.13 billion, of which $1.47 billion were accounted for by net market values, and $3.66 billion by non-market values. Because of these benefits, which accrue to the global community (and not just to the countries where the resources are found), sustainable management of coastal and marine resources is warranted for all users and beneficiaries. The valuation exercise done and presented in this report shows the importance of valuation to decision-making, and highlights the magnitude of potential losses without proper management.

Introduction

We sow a thought and reap an act;
We sow an act and reap a habit;
We sow a habit and reap a character;
We sow a character and reap a destiny.
William Thackeray

Generally, coastal ecosystems provide food (major protein sources), economic development opportunities (e.g., tourism, commercial fishery, mariculture, sea-based transportation), raw materials for construction, firewood, recreational opportunities, shoreline protection and buffering and important life-support functions. This report provides both a framework and the estimates of the total economic value of the various coastal and marine resources in the Straits of Malacca (referred to as Straits). Unless the value of the natural environment is expressed in monetary units, it will continue to be assigned a zero value. Often, resources are appreciated only in terms of the direct market values they provide. Because non-use values and ecosystem services are not fully quantified in markets, they are often given little weight in policy-making. The undervaluation of resources results in overexploitation because the users, general public and policy-makers are not well-informed of the consequent impacts. The results of this study are, therefore, intended to demonstrate the value of resources and the environment, and the subsequent importance of proper management.

One fundamental factor that is important in developing plans is the realistic recognition of the likely availability of resources for human use, life-support systems, education and management. It is important to note, however, that there are extensive difficulties involved in arriving at a general agreement about what monetary value to attach to a certain benefit. On the other hand, if no monetary value is given to a natural resource, the 'zero' value leaves the resource open for overexploitation.

This report is an extension of the work done by Sasekumar et al. (1998) and Tridoyo et al. (1998) as part of the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas Malacca Straits Demonstration Project. The following sections provide the rationale for undertaking resource valuation and presents a brief discussion on the different use and non-use values (or market and non-market values) of coastal and marine ecosystems and resources. The second part of this report shows the valuation procedures, the assumptions used and the estimates of the economic values of each ecosystem for each of the littoral State within the Straits. This report includes both gross and net estimates of resource values. The last part of the report contains the integration of the results and conclusion.

Some of the estimates and assumptions used may be subject to academic debate, and for this reason, the methodology and valuation procedures have been defined. Nevertheless, the results of this initial valuation exercise provide useful information on the relative importance of coastal resources and the services that they provide to the people of the littoral States and other users of the Straits.

Rationale for Resource Valuation

The policy-maker needs to begin viewing the management of ecosystems in the broader context of social and economic objectives. Valuation of natural resources and the environment necessitates the estimation of benefits and costs of using natural assets. The concern is whether or not a particular use (and non-use) is contributing *net economic benefits* to society. Where a particular objective is in conflict with another objective, tradeoffs will be inevitable. With resource valuation, the policy-maker will have access to information on the contribution that a particular resource is providing, and

how management decisions on the use of that resource will affect society. For example, benefit-cost analysis (BCA) that includes valuation of environmental and other external benefits and costs would show the importance and comparison—in monetary terms—of alternative management interventions or programs. BCA also indicates whether a particular activity is economically sustainable. Conservation or protection of ecosystems entails costs: in terms of both opportunity cost of foregoing other socially valued uses as well as cost of additional resources required for ensuring that the ecosystems are actually being protected.

Another rationale for resource valuation lies in the desire of policy-makers and managers to influence resource allocation by making those responsible pay for the environmental costs associated with their activities. Fines and penalties associated with command-and-control approaches to resource management can be set at levels that will reflect the cost of the damage or loss of environmental assets. Likewise, one key design factor of economic or market-based instruments is the setting of prices of resources correctly. Thus, user charges, effluent taxes and environmental bonds should be based on the value of the environment as a waste repository or the cost of the damage resulting from pollutive and unsustainable activities. Pricing of the natural environment is a signal to users that there are opportunity costs involved in using resources. From another perspective, the 'price' reflects the additional benefits from additional units of these coastal and marine resources.

CONCEPTUAL FRAMEWORK

The *total economic value* (TEV) of a natural system is the sum of all *net benefits* from all compatible uses and non-use values. As an example, Figure 1 shows the various use and non-use values of a coastal resource. These environmental and economic values are at risk due to a number of factors, primarily, population growth and unregulated development. In particular, coastal and marine resources are threatened due to overfishing, use of destructive fishing gears and methods, widespread deforestation and eventual siltation and sedimentation, conversion of mangroves, pollution and overexploitation of corals and other marine organisms. These problems, if not mitigated, will lead to the loss of economic values.

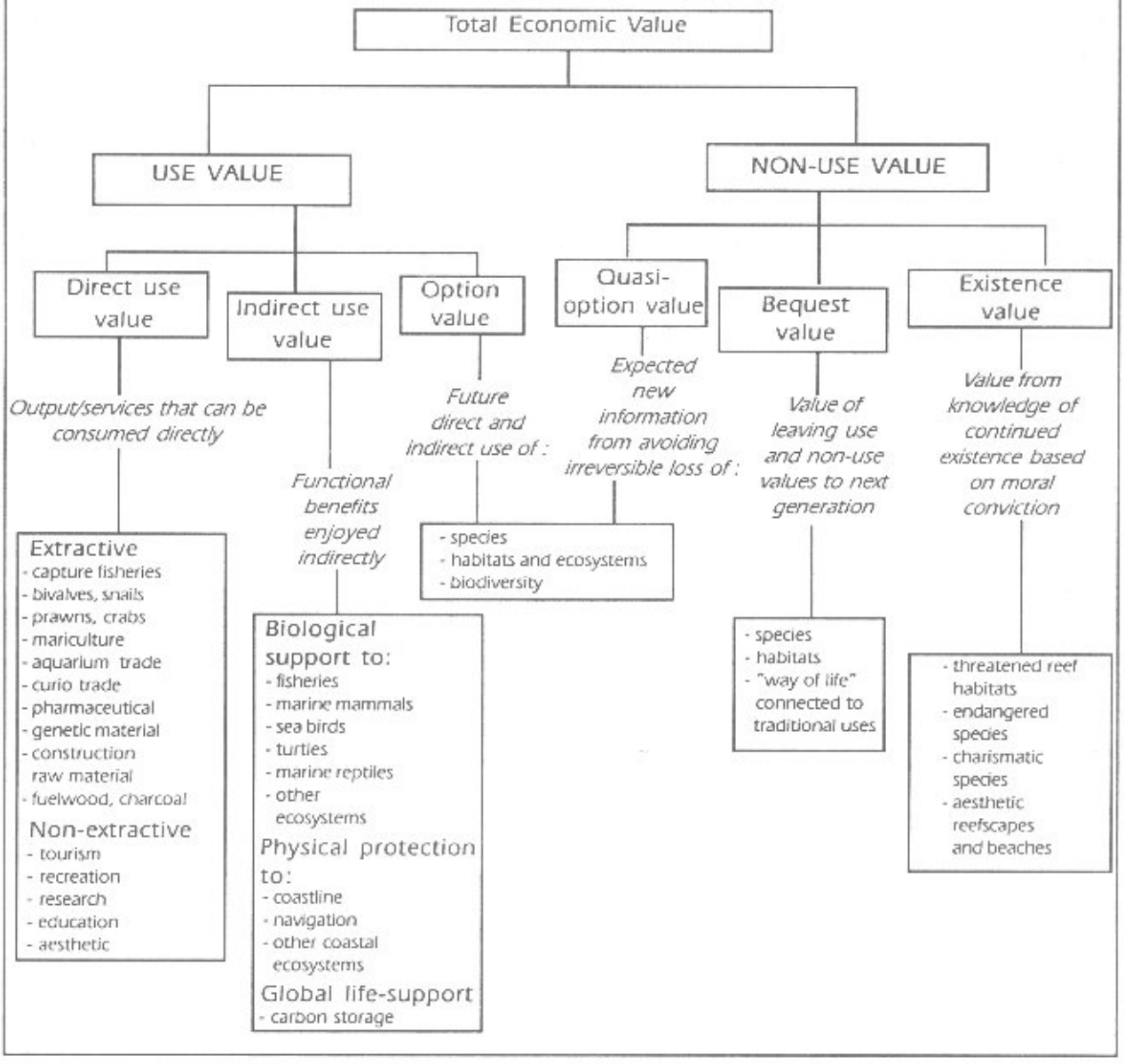
The total economic value consists of (i) use value (UV) and (ii) non-use value (NUV). *Use values* may be broken down further into direct use value (DUV), indirect use (IUV), and option value (OV). Moreover, direct uses can be extractive or consumptive and non-extractive or non-consumptive. For direct use values, market prices are available for quantification and monetization. Examples of *direct extractive use* values that can be derived from coastal and marine resources include the net revenues from fishery, fuelwood and raw materials, while *non-extractive direct use values* include recreation and tourism.

In addition to the products produced, the natural system also provides a number of biological life-support functions, such as coastline protection functions, carbon sequestration and nutrients and habitat for fish, shellfish, marine mammals and reptiles. These are called *indirect use values*. There are no direct market prices for these functions since these values are provided outside the usual market system. There are valuation methods, however, that can be used to quantify these indirect uses as well as the non-use values provided by natural resources and the environment (e.g., contingent valuation method).

The concept of *option value* can be understood as the *potential* direct and indirect uses of a natural system. It is the additional amount that an individual would be willing to pay above the actual current price to maintain the natural resource and avoid irreversible damage that would inhibit possible future use of the resource. Biodiversity yields an option value to society. It includes plants, animals and microorganisms together with ecosystems and ecological processes to which it belongs, and it even extends to the genetic information from which this diversity results (Magrath et al., 1995).

Non-use values consist of the existence value (EV), bequest value (BV) and quasi-option value (QOV). *Existence value* (EV) arises from the satisfaction of merely knowing that an ecosystem or species exists, regardless of whether it will be used or not. It can be closely tied to aesthetic, cultural, religious and moral aspects. *Bequest value* (BV) is related to the value derived from preserving the natural heritage for use by future generations. *Quasi-option value* (QOV) is related to the option value in that avoiding irreversible damage bestows value *today*. For example, it is expected that new scientific information and commercial values may be gained from maintaining biodiversity.

Figure 1. Total Economic Value of a Coastal Resource.



Modified from Spurgeon (1992).

METHODOLOGY

This report used a compilation of secondary data obtained from various studies and statistical accounts of the three countries for the estimation of economic values. Malaysia is subdivided into fisheries administrative districts (FADs) on the west coast while Indonesia is subdivided into the districts on the east coast of Sumatra and Riau province along the Straits of Malacca. The area of each ecosystem, the length of coastline of each district in the three littoral States, and the market and non-market values of the coastal resources were determined by the faculties and staff of University of Malaya, Bogor Agricultural University of Indonesia, and National University of Singapore who were involved in the Malacca Straits Demonstration Project. Table 1 shows the use and non-use values for the coastal and marine resources in the Straits of Malacca that have been identified for quantification. The length of the coastline and area of coastal ecosystem in each district in each country are shown in Table 2. Figure 2 is a map that shows the different districts of the three littoral States.

As stated earlier, the economic value is the *net* benefit from using a resource, thus, the production costs (capital, operating and maintenance costs) incurred from utilizing the resources have to be subtracted from the gross revenues. For the direct use or market values, both the gross revenues and the net figures are reported herein. It is customary for an activity or resource use (and non-use) to be analyzed over time, which could be assumed to be the life of a development, or an arbitrarily set period, and future benefits and costs are therefore discounted to yield their present value. For purposes of understanding present use and non-use, this report utilized data for a given year. The values are in 1995 prices and the exchange rates used are Rp2,500/US$1 for Indonesia, RM2.5/US$1 for Malaysia and S$1.5/US$1 for Singapore. The capital costs of fishing as well as the value of coastal protection, which was derived from the cost of constructing seawalls and dikes, are annualized (using 10% discount rate and life span of 10 years).

The whole concept of economic value is founded on willingness to pay (or accept), which implies conscious preferences for uses or non-use characteristics of the ecosystem (Universitetet I Bergen Senter for Miljø-og Ressursstudier, 1994). For indirect use and non-use valuation, due to the time and cost involved in the collection of primary data for a full-scale valuation, the use of 'benefits transfer' is often advocated. The benefits transfer method (BTM) involves taking an estimate of the economic value of a similar environment or resource from an existing study and transferring it to the area of concern or policy site, assuming that the existing value can be used as an approximation. A correction factor is employed to adjust the economic value of the impact in the new location or the site of policy interest. Since willingness to pay is also affected by income, the original value is adjusted using the gross domestic product (GDP) per capita to reflect income difference between the original and policy sites. Adjustments involving price changes are made to consider the effect of changes over time since the original study was undertaken. The assumptions used in the estimation of use and non-use values are shown in Appendix Table 1. The following section shows the valuation procedures and assumptions used in this report.

Table 1. Major Economic Values of Coastal and Marine Resources in the Malacca Straits.

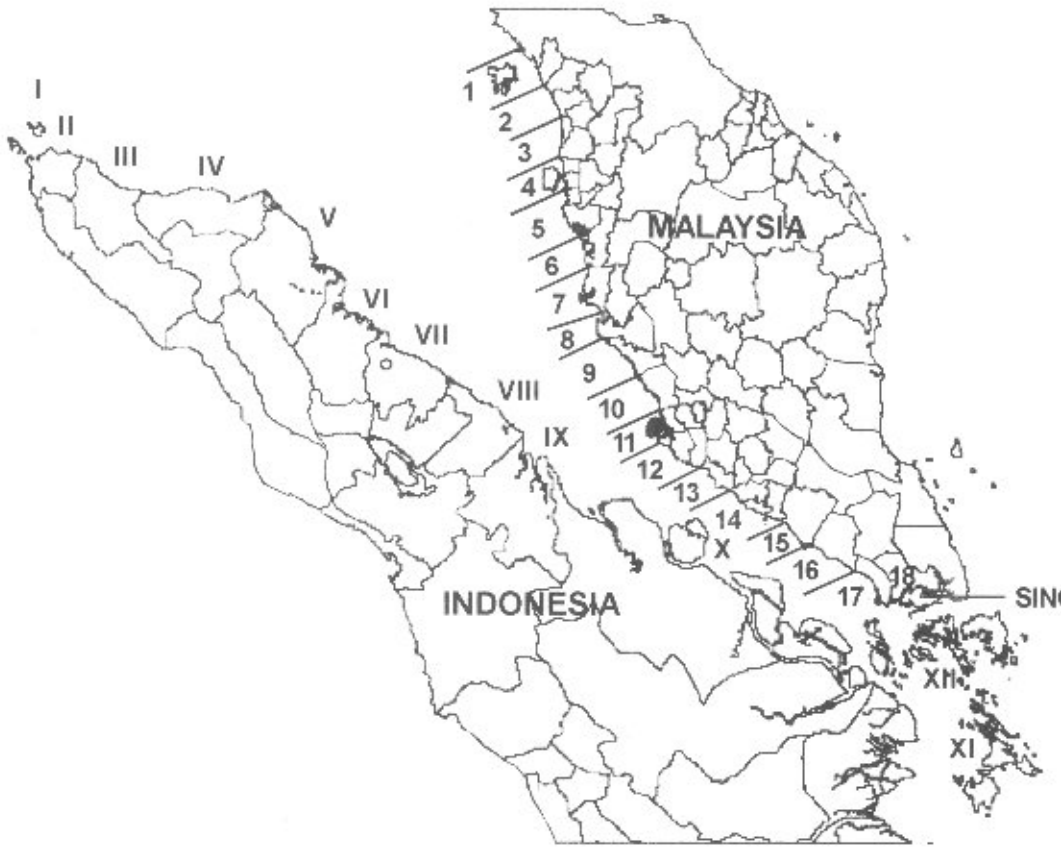
Habitat		Use Value			Non-use Value
		Direct	Indirect	Option	
Mangroves	Market	Charcoal and poles Fish, prawns Mud crabs Wildlife Tourism Traditional, non-commercial use	Nursery role: fish and prawns		
	Non-market		Shoreline protection Carbon sequestration	Capturable biodiversity	Existence value
Mudflats	Market	Cockles and bivalves Fish and prawns Gastropods, snails Shrimps (*Acetes*)			
	Non-market		Nursery role/habitat Feeding grounds of birds	Biodiversity	
Beaches	Market	Tourism Turtle eggs			
Coral reefs	Market	Fisheries Tourism Raw materials Research			
	Non-market		Shoreline protection Carbon sequestration	Biodiversity	
Seagrasses and seaweeds	Market	Fisheries Raw materials Research			
	Non-market		Shoreline protection Carbon sequestration	Biodiversity	
Sea lanes	Non-market	Shipping lanes			

Table 2. Area of Coastal/Marine Ecosystems and Length of Coastline.

Malaysia		Coastline (km)	Mangroves area (ha)	Mudflats area (ha)	Beaches area (ha)	Coral reefs area (ha)	Seagrasses area (ha)	Seaweeds area (ha)
TOTAL		938.27	83,259	32,363.90	8,434.62	1,318	456	1,421
FAD1	K. Perlis-Langkawi	20.47	3,116	0.22		897.5	89.75	897.5
FAD2	Kedah Utara	38.15		1,124.39				.69
FAD3	Kedah Selatan	46.72	4,833	359.07				.69
FAD4	Penang	54.13	345	1,489.90		60	30	60
FAD5	Krian	57.57	11,394.5	2,390.98				
FAD6	Larut-Matang	44.96	28,756.6	2,211.77				
FAD7	Manjung	78.38		1,535.08		120	12	12
FAD8	Hilir Perak	31.75		1,659.81				
FAD9	Selangor Utara	35.07	2,915	2,435.58				
FAD10	Selangor Tengah	42.83	379	4,826.44				
FAD11	Port Klang	53.75	9,008	5,098.15				60
FAD12	Selangor Selatan	58.03	2,791	648.33				60
FAD13	Port Dickson	51.04	233	301.62		120	12	120
FAD14	Melaka	73.70	238	1,012.85		120	12	60
FAD15	Muar	47.71		895.95				
FAD16	Batu Pahat	63.86		1,884.41				
FAD17	Pontian	43.61	1,334	2,842.01				
FAD18	Johor Bahru	96.49	17,916	1,647.34			300	150
Indonesia								
TOTAL		1,641	264,180	3,500	228,848	521,462	no data	1,750
I	Sabang	61				2,600		
	We Island/Sabang							
II	Aceh Besar	76	2,150			212,500		250
III	Pidie	81	7,650					
IV	Aceh Utara	103	750					
V	Aceh Timur	159	22,130					
VI	Langkat	112	15,000					
VII	Deli/Medan	120	15,000					
VIII	Asahan/T. Balai	94	15,000			254,500		
IX	Labuhan Batu	77	15,000					
X	Bengkalis	446	102,400					
XI	Riau Islands	217	65,700			51,862		1,500
XII	Batam	96	3,400					
Singapore		130	258	1,371.93	287	287	166.4	no data

FAD: Fisheries Administrative District

Figure 2. The Districts of Malaysia and Indonesia.



LEGEND

Fisheries Administrative Districts (MALAYSIA)

1. K. Perlis-Langkawi
2. Kedah Utara
3. Kedah Selatan
4. Penang
5. Krian
6. Larut and Matang
7. Manjung
8. Hilir Perak
9. Selangor Utara
10. Selangor Tengah
11. Pelabuhan Klang
12. Selangor Selatan
13. Port Dickson
14. Melaka
15. Muar
16. Batu Pahat
17. Pontian
18. Johor Bahru

LEGEND

Districts (INDONESIA)

I Sabang
II Aceh Besar
III Pidie
IV Aceh Utara
V Aceh Timur
VI Langkat
VII Deli/Medan
VIII Asahan
IX Labuhan Batu
X Bengkalis
XI Riau Islands
XII Batam

Source: MPP-EAS (1999b).

Valuation Procedures and Estimation

Mangroves

Mangrove forests serve as transition zones between dry land and offshore marine and estuarine environments. They produce energy that supports the rest of the coastal and marine ecosystems. Mangroves also trap nutrient-rich terrigenous sediments and offer diverse habitat to fish, birds, molluscs and shellfish. Table 3 shows the gross and net market values and the non-market values of mangrove ecosystems in the three littoral States. The various direct use values quantified in this report are fish, prawns and mud crabs, charcoal and poles, tourism and traditional use benefits. Fisheries production accounts for about 84% of the market value of mangroves in Indonesia and Malaysia and 97% in Singapore (Table 3). For indirect use values, the life-support functions, such as nursery role, carbon sequestration and shoreline protection, were estimated in this report. Option and existence values were also derived. Figure 3 presents a map showing mangrove areas along the Straits of Malacca.

Direct Use Values

a. *Charcoal and poles:* Among the direct use values of mangroves is charcoal production. The value of charcoal and poles is estimated to be US$344/ha/yr (Sasekumar et al., 1998). For the FADs on the west coast of Malaysia, charcoal and poles have a total value of US$28,641,027 (Appendix Table 5). For the east coast of Sumatra and Riau province of Indonesia, the estimated value of charcoal production is US$90,877,920 (Appendix Table 6).

The cost of production was derived from the financial profile of a charcoal factory in Sumatra (Chua Thia-Eng et al., 1997). The net return or profit is about 30% of total revenue. Thus, the net benefit from charcoal production in mangrove areas is valued at US$8,592,339 for Malaysia and US$27,263,376 for Indonesia (Appendix Tables 5 and 6).

b. *Fish and prawns:* The other important direct use value of mangrove ecosystems is in the form of a large yield of fish and other aquatic species that are of commercial importance. Sasekumar et al. (1998) reported that the fish and prawn catch, using pushnets *(pukat surung)* for the FADs on the west coast of Malaysia had a value of US$5,099,344 in 1995 (Appendix Tables 5 and 8). Tridoyo et al. (1998) reported that for the Indonesian side of the Malacca Straits, the fish and prawn catch from mangroves had a value of US$587,736,510 in 1995.

For Malaysia, the net return from fishing, using pushnets, was about 29.34% of gross revenues (Appendix Table 2). Thus, the net revenues from fish and prawn catch in the Malaysian side amounted to US$1,496,148. For Indonesia, Tridoyo et al. (1998) reported that the fishing cost was about US$681.95/ha/yr. The net revenue for fish and prawn catch in the Indonesian side, therefore, was around US$407, 578,959 for the mangrove area of 264,180 ha.

c. *Mud crabs:* In Malaysia, the value of mud crabs was reported to be $4,800/tonne and the total production

Table 3. Economic Value of Mangroves.

Economic Value	Indonesia	Malaysia	Singapore	TOTAL
Non-market value	1,360,469,162	1,278,788,063	26,881,265	2,666,138,490
Market value (gross)	900,006,045	416,487,066	4,348,339	1,321,774,420
Fisheries (gross revenues)	753,592,205	352,544,077	4,200,000	1,110,336,282
Net market value	481,106,414	100,226,443	917,663	582,250,520
TOTAL (net):				
non-market + net market	1,841,575,576	1,379,014,506	27,798,929	3,248,389,011

of mud crabs in the FADs on the west coast in 1995 was 880.15 tonnes, resulting in the total value of US$4,224,720. The net return of 29.34% of gross revenues (Appendix Table 2) was used to derive the net revenue, hence, resulting in the net value of US$1,239,533. There was no reported production value of mud crabs in Indonesia and Singapore.

d. *Tourism:* The value of US$424/ha/yr was adopted from the estimated revenues from tourism in mangrove areas, based on a study conducted in Sarawak, Malaysia (Bennett and Reynolds, 1993, cited in Sasekumar et al., 1998). For the 83,259 ha of mangroves in the west coast of Peninsular Malaysia, the gross tourism revenue for Malaysia was US$35,301,858. For Indonesia and Singapore, the per hectare tourism values of mangroves are US$169 and US$574, respectively, resulting in corresponding gross revenues of US$44,646,420 and US$148,339.

   The approximate net return from tourism is about 60% of revenues (Cesar, 1996). The net benefits from tourism are valued at US$21,181,115 US$26,791,022 and US$89,003 for the Malaysian, Indonesian and Singaporean parts of the Straits, respectively.

e. *Traditional, non-commercial use.* For this direct use value, Sasekumar et al. (1998) adopted the value of US$33/ha/yr from Ruitenbeek's (1992) study in Irian Jaya, Indonesia. Local, non-commercial uses include traditional fishing, hunting, gathering and manufacturing. The gross benefits provided by mangroves in terms of traditional uses are US$8.7 million for Indonesia. There are no data for Malaysia and Singapore. For Indonesia, the net return of 10% was adopted from Bambang et al. (1994). This direct use has a net value of US$871,794.

Indirect Use Values

The indirect use values are in terms of the vital ecological functions, such as control of coastal erosion, carbon storage, protection of adjacent coral reefs from suspended solids and provision of feeding, nursery and breeding areas for fish, crustaceans, birds and wildlife. According to the Ministry of State for Environment, Indonesia (1996), about 90% of tropical marine species depend partly or entirely of their life cycle on mangrove ecosystems. In the last few decades, however, there has been substantial mangrove forest loss because of coastal reclamation projects and conversion to aquaculture farms. Conflicts between some of the direct uses (e.g., fuelwood and poles, silviculture) and the indirect uses are causes for concern.

a. *Nursery role for fish and prawns:* Sasekumar et al. (1998) assumed that 50% of the fish landings could be attributed to mangroves. This off-site catch is valued at US$343,220,013 for all the FADs on the west coast of Malaysia (Appendix Table 8) and US$4.2 million in Singapore. On the Indonesian side of the Straits, the fish catch value of US$165,855,695 is attributed to this indirect use value of mangroves (Appendix Table 9).

   The weighted average net return of fishing, for all gear types, is estimated to be 19.73% and 10% for Malaysia and Indonesia, respectively (Appendix Tables 2 and 3). The net value of nursery and habitat role provided by mangroves for fish and prawns, therefore, was around US$67.7 million, US$16.6 million and US$828,660 in 1995 for Malaysia, Indonesia and Singapore, respectively.

b. *Carbon sequestration:* The mean net primary productivity of the mangroves in Matang, Malaysia is 90.5 tonnes-carbon/ha/yr (Gong et al., 1991) and the value of carbon storage, in terms of avoided future cost of climate change, is US$20/tonne of carbon per year (Fankhauser, 1994). Hence, the carbon sequestration value of mangroves is about US$1,810/ha/yr. For the entire mangrove area of 83,259 ha on the Malaysian side, the total carbon storage value amounts to US$150.7 million/yr (Appendix Table 8). For the Indonesian side, the annual carbon storage value is US$478 million for the mangrove area of 264,180 ha, while US$467,758 for Singapore's mangrove area of 258 ha (Appendix Tables 6, 7 and 9).

c. *Shoreline protection:* This indirect use value provided by mangroves was estimated by using the replacement cost approach: the cost of building artificial structures. The cost of constructing protective seawalls and dikes is, on average, about US$1.36 million/km in Malaysia (Hiew and Lim, 1994). These seawalls and dikes have an average life span of 10 years. The annualized cost is about US$221,333.74/km/yr, applying 10% discount rate. In Indonesia, the cost of constructing a seawall or breakwater is about US$1.2 million/km (Dahuri,

1995) or US$195,294.47/km/yr, assuming 10-year life span and 10% discount rate. Mangroves protect an estimated 956.22 km of coastline in Malaysia, 1,641.2 km in Indonesia and 30 km in Singapore. Using the annualized cost as the proxy value results in shoreline protection values of US$207,659,742 in Malaysia, US$308,662,910 in Indonesia and US$6,640,012 in Singapore (Appendix Tables 5 to 7). These values are lower bound figures since seawalls are not perfect substitutes for the coastal ecosystems. Seawalls eventually lead to erosion problems (Chua Thia-Eng, pers.comm., 1999).

Option Value

Biodiversity: Mangroves are highly productive ecosystems and have high conservation values. Ruitenbeek (1992) estimated the 'capturable biodiversity value' of mangrove forests in Irian Jaya, Indonesia, and this amounts to US$15/ha/yr. This was measured using a rough proxy of international willingness to pay, evaluated through the amount of transfers between developed and developing countries for conservation initiatives for large tracts of undisturbed biodiverse ecosystems. The estimated annual capturable biodiversity values of mangroves are US$1,248,887, US$3,962,700 and US$3,876 for the Malaysian, Indonesian and Singaporean parts of the Straits, respectively (Appendix Tables 5 to 7).

Existence Value

An example of a non-use value is the existence value, which is the premium placed by individuals on the continued existence of natural resources even if there is no intention of using them. The existence value of mangroves in Indonesia is around US$2,156/ha (Meilani et al., 1996, cited in Tridoyo et al., 1998). This value was adjusted using the GDP per capita to derive the existence values for Malaysia and Singapore. The estimated existence values for Malaysia, Indonesia and Singapore were US$919,180,464, US$569,677,752 and US$19,769,877, respectively (Appendix Tables 5 to 7).

MUDFLATS

The market value of mudflats consists of the direct use while non-market values include indirect use and option values. Table 4 shows the gross and net market values and the non-market values of mudflats in the three littoral States. Mudflat areas along the Straits of Malacca are shown in Figure 4.

Direct Use Values

a. *Cockles (Anadara):* For cockle production in mudflats, Sasekumar et al. (1998) reported the retail or market value and the tonnes of cockles produced in each FAD along the west coast of Peninsular Malaysia (Appendix Table 8). In 1995, the total cockle production was valued at US$26,370,547. The net return of 60% of revenues was derived using the figures from Yogarani Kanagrajah (1984). Thus, the net revenue of cockle production was about US$15.8 million.

b. *Bivalves (Paphia):* In 1995, the price of bivalves was US$2,600/tonne and the total bivalve production was valued at US$17,639,960 (Sasekumar et al., 1998). Just like in the cockle production, the net return of 60% of gross revenues was adopted to compute for the net revenue. The net revenue is, therefore, US$10.58 million.

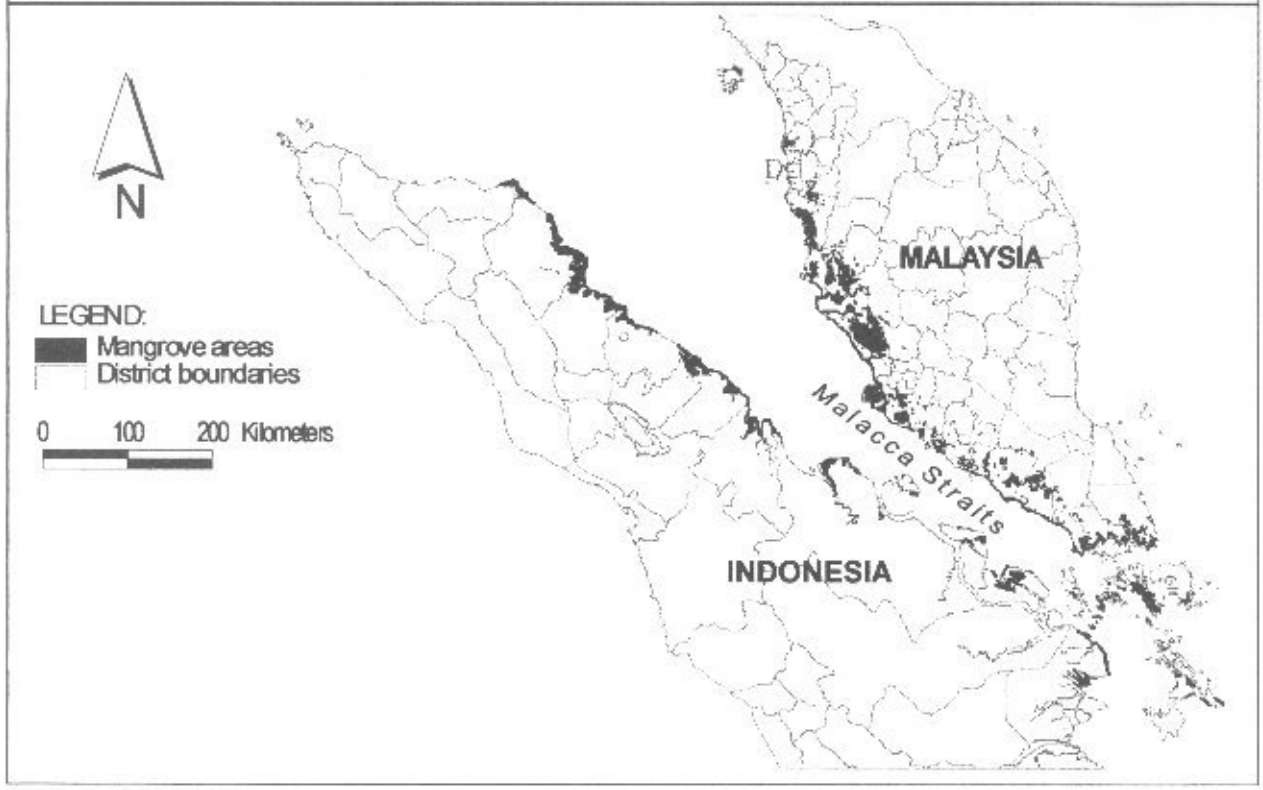
c. *Gastropods/snails and shrimps: Siput* and *Acetes* were priced at US$600/tonne and US$200/tonne, respectively, in 1995 (Sasekumar et al., 1998). The total production has a gross value of US$344,879 for *Siput* and US$2.9 million for *Acetes* for all the concerned FADs in Malaysia (Appendix Table 8). Assuming a 29.34% net return (Appendix Table 2), the net revenue would be US$101,187.5 for *Siput* and US$852,946 for *Acetes*.

d. *Fish and prawns:* The estimated value of fish and prawn production on the west coast of Peninsular Malaysia, using barrier nets (*pukat rentang*), is

Table 4. Economic Value of Mudflats.

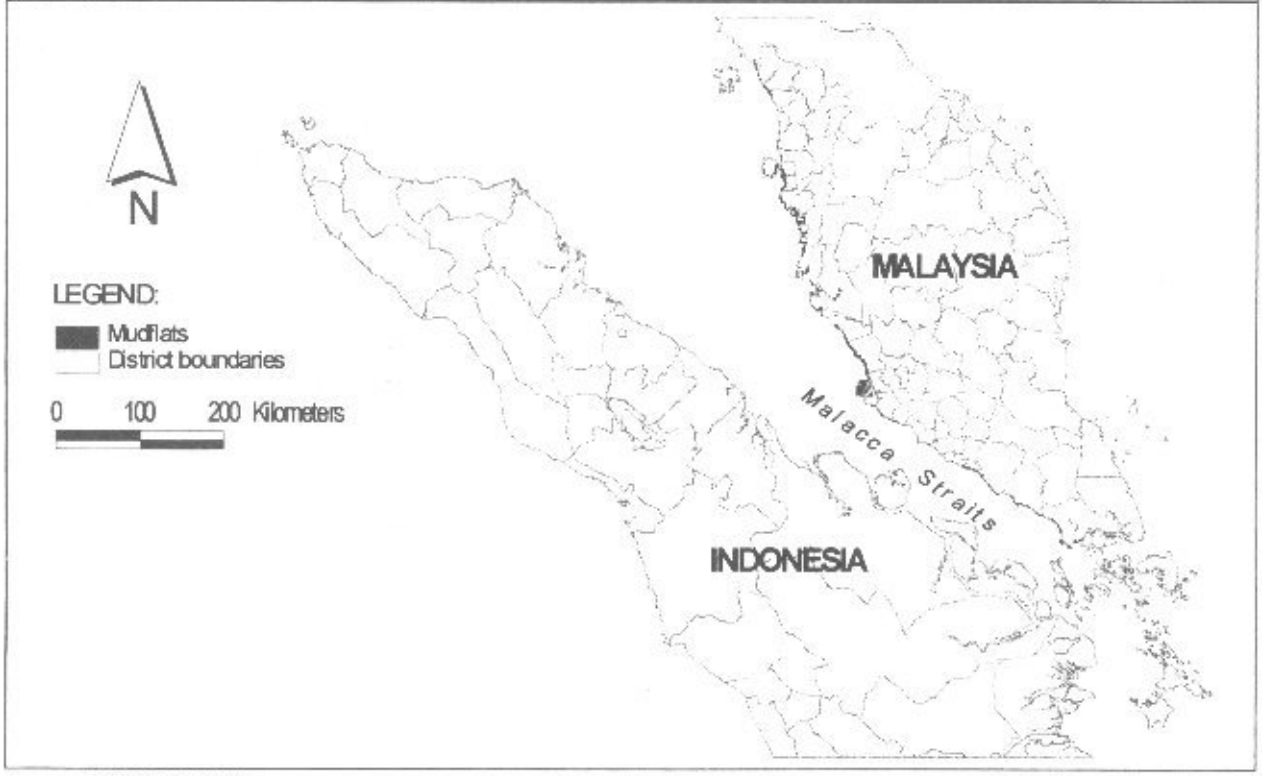
	Indonesia	Malaysia	Singapore	TOTAL
Market value (gross)	no data	49,417,104	no data	49,417,104
Market value (net)		27,868,925		27,868,925
Non-market value	26,250	262,979	10,289	299,518
TOTAL (net):				
non-market + net market	26,250	28,131,904	10,289	28,168,443

Figure 3. Mangrove Areas Along the Straits of Malacca.



Source: MPP-EAS (1999b).

Figure 4. Mudflat Areas Along the Straits of Malacca (Peninsular Malaysia).



Source: MPP-EAS (1999b).

US$2,154,608 (Sasekumar et al., 1998). The net return is about 23.6% of gross revenues (Pakpoy and Associates, 1982) or US$508,487.5.

Indirect Use Value

One indirect use value attributed to mudflats is its role as nursery for certain species of fish. Mudflats are also rich in invertebrate biomass and provide nutrient source for fish and birds. Another important life-support function of mudflats is the provision of habitats to migratory birds. These values were not quantified, however, as there are no data available.

Option Value

Biodiversity. Sasekumar et al. (1998) assumed that the biodiversity value of mudflats is half of the biodiversity value of mangroves and tropical rainforests. Thus, the biodiversity of mudflats would have a value of US$7.5/ha/yr. The estimated values are US$262,979, US$26,250 and US$10,289 for Malaysia, Indonesia and Singapore, respectively.

BEACHES

Sandy beaches serve many ecological functions, such as primary nesting habitat for rare sea turtles, seals and other marine mammals and reptiles as well as socioeconomic functions, such as recreational and tourism destination sites and as fishing ports. There are many beach areas along the Straits of Malacca (Figure 5). Beach areas have a total (net) economic value of US$69.3 million, US$248.8 million and US$248.3 million in Malaysia, Indonesia and Singapore, respectively (Appendix Tables 5 to 7). The indirect use and non-use values of beach areas have not been estimated due to lack of information about these values in the three littoral States.

Use Values

a. *Tourism:* The major use value of beach areas is the tourism revenues they generate. Tourism is a major coastal activity, and is increasing throughout Southeast Asia. Swimming accounts for around 27% of activities of tourists coming for vacation in Malaysia (Ahmad Tajuddin Hj. Kechic et al., 1991). Table 5 shows the gross and net revenues from tourism in the three countries. The number of tourists for Malaysia refers to those going to the west coast of Peninsular Malaysia, while for Indonesia, this refers to those going to the east coast of Sumatra and Riau provinces. The value of recreation experience may be above what the tourists actually paid for in the market system, thus, the gross revenues reported in this paper have not incorporated the consumer surplus value.

   The approximate net return from tourism is about 60% of revenues (Cesar, 1996). These figures, however, have not considered the carrying capacity of beaches and the impacts of unregulated tourism development. Thus, the actual cost of tourism may be higher.

b. *Turtle eggs:* The beach areas also play an important role as nesting ground for turtles. The turtle eggs are valued at US$1.2/egg in Malaysia. The estimated value of beach as habitat for sea turtles is US$26,520 for Malaysia (Appendix Table 5). For Indonesia, the value of the beach as sea turtle habitat is US$486/ha/yr

Table 5. Tourism Revenues.

	Indonesia	Malaysia	Singapore	TOTAL
Number of tourists[a]	1,167,480	2,928,800	3,965,000*	
Purpose (% - vacation)[a]	66%	67%	100%	
Length of stay (days)[a]	11	4.8	1-3	
Daily expenditure ($)[a]	108.4	45.37	386.54	
Activity (% - swimming)[b]	27%	27%	27%	
Gross revenue ($)	248,072,782	115,382,063	413,810,397	777,265,242
Net revenue ($)	148,843,669	69,229,238	248,286,238	466,359,145

* This figure refers to the number of tourists going to Singapore for vacation.

[a] Department of Tourism, Posts and Telecommunication-Indonesia; Malaysian Tourism Promotion Board; Singapore Tourism Promotion Board.

[b] Ahmad Tajuddin Hj. Kechic et al. (1991).

(Tridoyo et al., 1998) and applying this figure for the total beach area of 228,848 ha results in the total value of US$99.96 million (Appendix Table 6). This figure may be an over-estimate as the beach areas that actually serve as turtle sanctuaries have to be identified.

CORAL REEFS

There are several coral reefs that can be found along the Straits of Malacca (Figure 6). The coral reefs have provided the foundation for many other ecosystems, such as mangroves, tidal swamp forests and seagrass beds and source of sand for beaches. There are other important use values provided by coral reefs, such as marine fishery, recreational and tourism benefits and natural protection for ports and docks. Coral reefs also provide coral rock and sand for construction of buildings in coastal communities, but there are no data available for the value of raw materials from coral reefs. Moreover, mining the reefs has been banned. For the estimation of the economic value of coral reefs in this report, the market value includes all the direct use values such as fisheries, tourism and research values. The non-market values include all the indirect use (e.g., carbon sequestration and shoreline protection) and option values. Table 6 shows the gross and net market values and the non-market values of coral reef ecosystems in the three littoral States. Fisheries and tourism revenues account for almost all of the market value of coral reefs (Table 6).

Direct Use Values

a. *Fisheries:* Coral reefs have been significant in the development of traditional societies throughout coastal ASEAN, with the provision of large amounts of quality protein food as fish or invertebrates (Wilkinson et al., 1994). Sasekumar et al. (1998) assumed that 4.2% of total fish catch in Malaysia can be attributed to coral reefs. The value of fisheries derived from coral reefs was US$10.2 million in 1995 (Appendix Table 8). The weighted average of net return for all types of gears is 19.73% of gross revenues (Ahmad Adnan bin Nurrudin and Lim Chai Fong, 1994). The net revenue is estimated to be US$2 million.

For Indonesia, the value of fish catch from coral reefs was US$105,403,545 in 1995 (Tridoyo et al., 1998). Assuming 31% net return for coral reef fishery (Riopelle, 1995), the net revenue would be US$32,675,099.

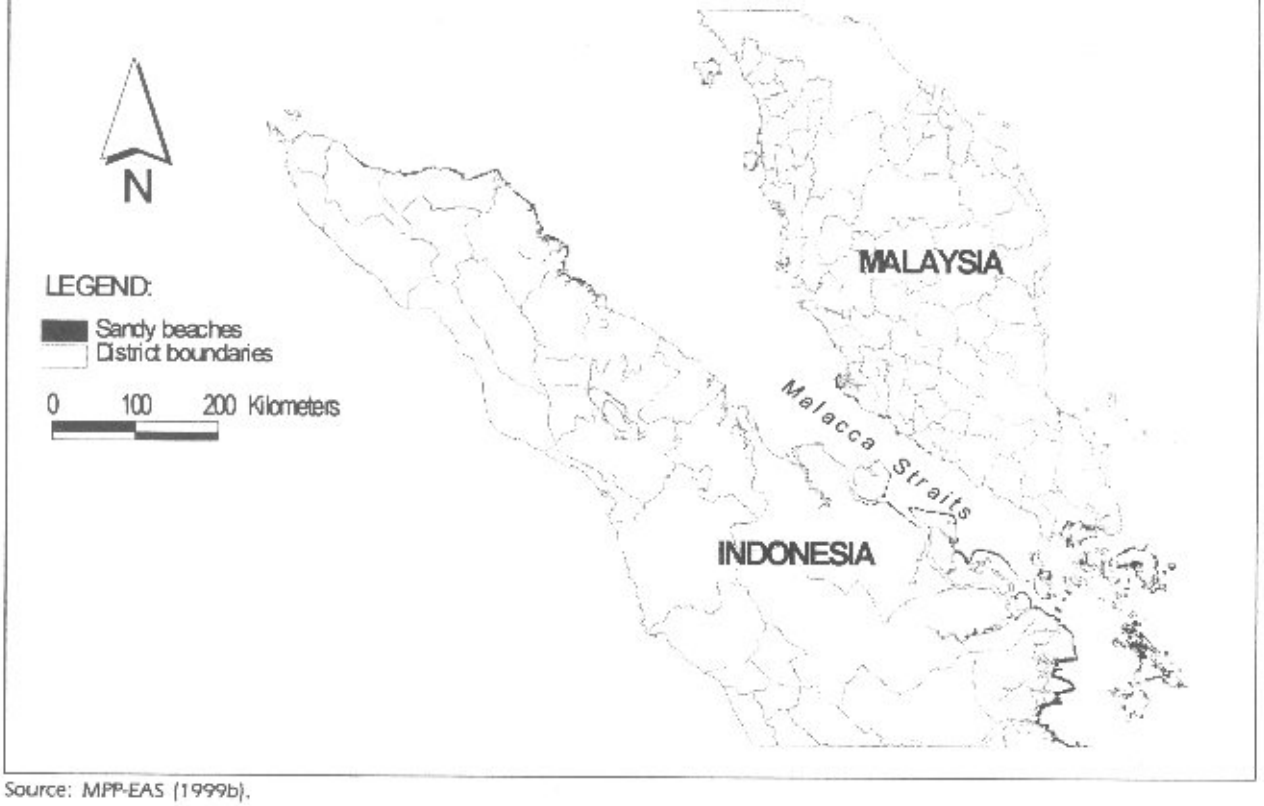
b. *Tourism:* Tourism is now a major 'export' industry or dollar-earner for the three littoral countries, with the coral reefs, beach and warm tropical seas being a significant component. Snorkeling and diving (7.7% of activities of tourists going for vacation) are the most important coral reef-related activities of tourists (Ahmad Tajuddin Hj. Kechic et al., 1991). The approximate net return from tourism is about 60% of revenues (Cesar, 1996). Note that this net return only reflects production costs (capital and labor) and does not include the cost associated with the environmental impacts of tourism activities. On the other hand, the consumer surplus derived by tourists was not included in the estimation of benefits. The estimated net revenues from coral reef-related tourism are around US$19,743,153, US$42,448,009 and US$70,807,557 for Malaysia, Indonesia and Singapore, respectively. Singapore's tourism revenues are higher compared to Malaysia even if the former has relatively very little coral reef areas because there are more tourists coming to Singapore and they also spend more.

c. *Research:* The research expenditures can be construed as the 'revealed' willingness to pay for access to reef areas with research value. In Malaysia, the annual

Table 6. Economic Value of Coral Reefs.

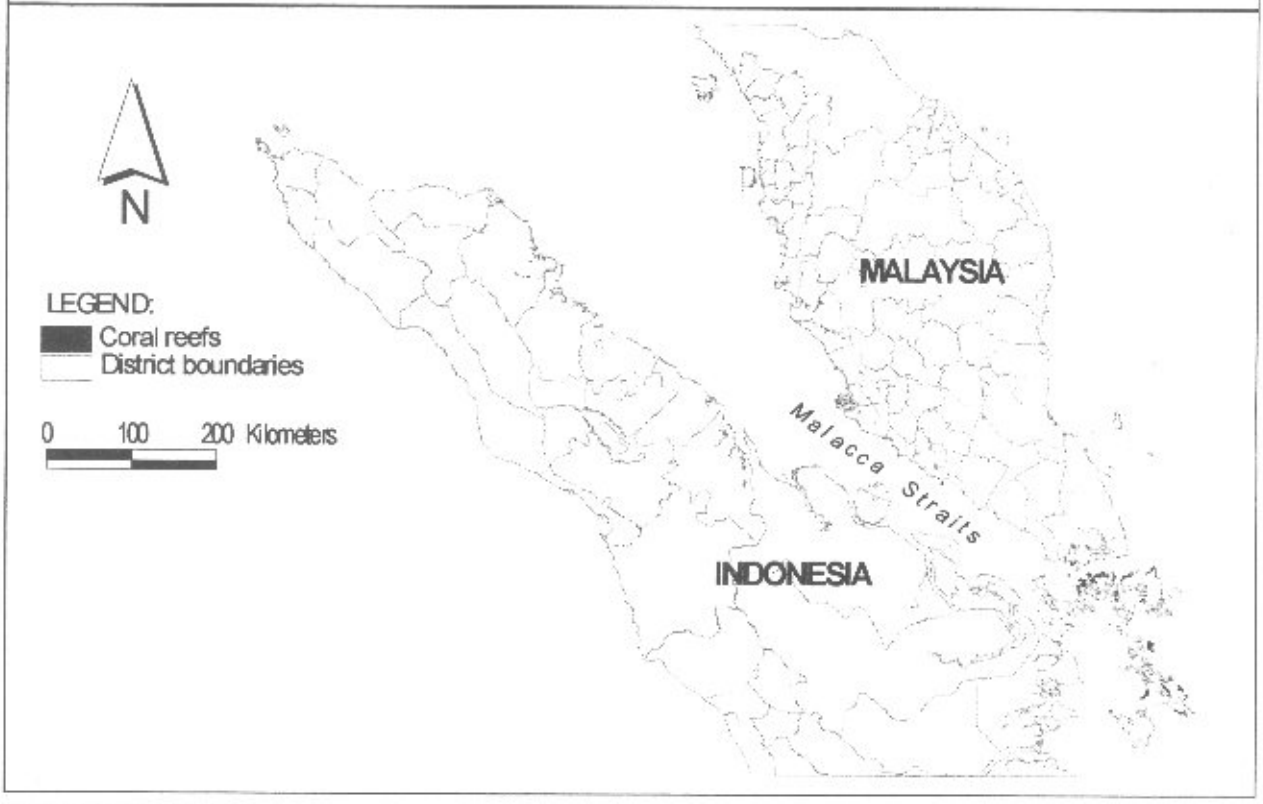
	Indonesia	Malaysia	Singapore	TOTAL
Non-market value	391,237,295	4,267,480	55,965	393,610,398
Gross market value	176,150,227	43,235,825	118,012,595	337,398,647
Fisheries (gross revenues)	105,403,545	10,210,570		115,614,115
Tourism (gross revenues)	70,746,682	32,905,255	118,012,595	221,664,532
Net market value	75,123,108	21,877,698	70,807,557	167,808,363
TOTAL (net): non-market + net market	466,360,403	26,145,178	70,863,522	563,369,103

Figure 5. Beach Areas Along the Straits of Malacca.



Source: MPP-EAS (1999b).

Figure 6. Coral Reefs Along the Straits of Malacca



Source: MPP-EAS (1999b).

research expenditure for coral reef studies amount to US$120,000 (Sasekumar et al., 1998). This gross financial expenditure, however, is just the minimum amount of the educational and research value generated by coral reefs and may not even be the optimal level.

Indirect Use Values

a. *Carbon sequestration:* Coral reef ecosystems also play a major role in reducing global warming because of their function as carbon sink. The net primary productivity of coral reefs is 900 gC/m²/yr or 9 tonnes-carbon/ha/yr (Whittaker and Likens, 1973). Applying the avoided future cost of climate change of $20/tonne-carbon (Fankhauser, 1994), the estimated carbon storage value of coral reefs is US$240/ha/yr. This results in annual values of US$237,150 for the coral reef area of 1,317.5 ha in the Malaysian side, US$93,863,160 for 521,462 ha of coral reefs in the Indonesian side of the Straits and US$51,660 for the coral reef area of 287 ha in Singapore.

b. *Shoreline protection:* Coral reef structures, likewise, protect islands and properties from heavy wave action and storm surges. The annualized cost of constructing bunds or dikes, which was estimated earlier as US$221,333.74/km/yr for Malaysia, was also adopted for this indirect use value provided by this ecosystem. In Malaysia, about 18.12 km of coastline are being protected by coral reefs (Sasekumar et al., 1998), resulting in the shoreline protection value of $4 million/yr. In Indonesia, the estimated shoreline protection value was reported as US$555.27/ha/yr (Tridoyo et al., 1998) or US$289.55 million/yr.

Option Value

Biodiversity: Coral reefs are complex ecosystems, biologically diverse, and serve as major reservoirs of genetic variability, and therefore, have high conservation values, just like rainforests. The value of US$15/ha/yr is assumed to be the biodiversity value of coral reefs in Indonesia (Sasekumar et al., 1998). Applying this value to the corresponding area (ha) of coral reefs in the three littoral States results in the values of US$19,763, US$7,781,930 and US$4,305 for the coral reefs in the Malaysian, Indonesian and Singaporean sides of the Straits.

SEAGRASS BEDS

Seagrass beds serve as nursery grounds of many mangrove, reef and offshore fish, and as habitat for rare species of marine turtles and marine mammals (e.g., dugong, manatees) and also for many finfish, shellfish and their larvae that feed and take shelter within the seagrass blades and roots. Table 7 shows the gross and net market values and the non-market values of seagrass beds in the three littoral States.

Direct Use Values

a. *Fisheries:* Seagrass beds are important to finfish and shellfish. About 4.2% of annual fish catch in Malaysia is attributed to seagrass, and the value of fisheries derived from this ecosystem on the west coast of Peninsular Malaysia was US$10.5 million in 1995 (Sasekumar et al., 1998). The weighted average of net return of around 19.73% of gross revenues for all types of gears (Ahmad Adnan bin Nurrudin and Lim Chai Fong, 1994) was used to derive the net revenue from fishing. The net revenue is valued at US$2 million. No data was reported for Indonesia and Singapore.

b. *Research:* The annual research funding for seagrass studies amounts to US$64,000/yr in Malaysia (Sasekumar et al., 1998).

Indirect Use Values

a. *Carbon sequestration:* The gross primary productivity of seagrass beds ranks among the highest recorded natural ecosystems (Ministry of State for Environment,

Table 7. Economic Value of Seagrasses.

	Indonesia	Malaysia	Singapore	TOTAL
Non-market value		196,383	71,702	268,085
Gross market value		10,568,972	no data	10,568,972
Net market value		2,137,273		2,137,273
TOTAL (net): non-market + net market	no data	2,333,656	71,702	2,405,358

1996). Using the net primary productivity of 5.8 gC/m²/day (Colinvaux, 1993) or 21.17 tonne-carbon/ha/yr and the avoided cost of future climate change of $20/tonne (Fankhauser, 1994), the carbon storage value of seagrass is US$423.2/tonne/yr. Thus, the estimated carbon storage value of seagrass is US$192,965/yr and US$70,454/yr for Malaysia and Singapore, respectively. There are no data available on the area of seagrass beds on the Indonesian side of the Straits.

b. *Shoreline protection:* One of the indirect use values of seagrass ecosystems is their function as sediment stabilizers, which prevent coastal erosion. Since they do not have hard substrates, the shoreline protection value based on the construction of seawalls was not attributed to seagrass (Sasekumar, pers. comm. 1999).

Option Value

Biodiversity: The other use values of seagrass ecosystems are their option values, such as the use of seagrass for new pharmaceutical products and agricultural cultivars (Ministry of State for Environment, 1996). The value of US$7.5/ha/yr was adopted by Sasekumar et al. (1998) as the biodiversity value of seagrass. The estimated annual biodiversity values are US$3,418 and US$1,248 for Malaysia and Singapore, respectively.

SEAWEEDS

The market value of seaweeds includes such direct use values as fisheries, raw materials and research value while non-market values considered in this report include carbon storage and biodiversity values. Table 8 shows the gross and net market values and the non-market values of seaweeds in the three littoral States.

Direct Use Values

a. *Fisheries:* Assuming that 0.8% of annual fish catch can be attributed to seaweed ecosystem, the gross value of fish catch was US$2,875,737 in 1995 for the Malaysian side of the Straits (Sasekumar et al., 1998). Applying the net return of 19.73% of gross revenues, the net value of fish catch would be US$567,382.95. For Indonesia, the estimated fish catch is US$9,174/ha/yr (Tridoyo et al., 1998) and the net return for fishing is 10% of gross revenues (Appendix Table 3), resulting in the net revenue of US$1.61 million.

b. *Raw materials:* Seaweeds are collected or cultured on reef flats. Mariculture is an increasingly important industry with the development of biotechnological industries that utilize seaweeds as sources of agar-agar, algin and carrageenan. Coastal communities have traditionally used seaweeds for raw and cooked vegetables and medicines. Sasekumar et al. (1998) estimated the value of raw materials as US$3,617/yr for Malaysia.

c. *Research:* The research funding for seaweed studies was US$200,000/yr in Malaysia in 1995 (Sasekumar et al., 1998).

Indirect Use Value

Carbon storage: The net primary productivity of seaweeds is 900 gC/m²/yr (Whittaker and Likens, 1973) and the carbon sequestration value of seaweeds is estimated to be US$180/ha/yr (similar to coral reefs). The

Table 8. Economic Value of Seaweeds.

	Indonesia	Malaysia	Singapore	TOTAL
Non-market value	328,125	266,413		594,538
Gross market value	16,054,500	3,079,354		19,133,854
Net market value	1,605450	771,000		2,376,450
TOTAL (net): non-market + net market	1 933,575	1,037,413	no data	2,970,988

carbon storage value per year is US$255,757 and US$315,000 for Malaysia and Indonesia, respectively.

Option Value

Biodiversity: The biodiversity value of seaweeds is assumed to be the same as that of seagrass (Sasekumar et al., 1998). Applying the value of US$7.5/ha/yr to the area of seaweeds in Indonesia and Malaysia results in biodiversity values of US$13,125 and US$10,657 in the two countries, respectively.

FISHERIES AND AQUACULTURE

One major direct benefit provided by the Straits of Malacca is the value of fisheries and aquaculture. The fish caught in the mangroves and coral reefs have been an important source of protein for the coastal communities in Southeast Asia. The net revenues from these industries contribute around 12% to the total economic value of the resources in the Straits. As of 1995, the net revenues from fisheries were valued at US$614.5 million and US$67 million for aquaculture. Table 9 shows the value of fisheries and aquaculture in the three littoral States. Fishery production related to mangroves (on-site and off-site) accounts for about 78% of total net fish production in the three littoral States. Note that the production value may be overestimated if harvest rates are above the socially optimal rate. Thus, the net fishery revenues reported in this paper may be assumed not to continue in perpetuity, if such is the case in the Straits of Malacca. Moreover, the dynamics (ecological-economic linkages) with the surrounding ecosystems have to be considered as they affect fish productivity and sustainability.

SHIPPING LANES

A major contribution of the Straits of Malacca is the value of the shipping lanes to many regions of the world. Oil tankers, cargo ships and fishing boats pass through the Straits (Table 10). This resource value is measured in terms of the 'opportunity cost', i.e., the difference in shipping cost offered by the Straits of Malacca compared to the best alternative routes. For ships coming from the Middle East or the Gulf and South Africa, the Straits of Malacca is the shorter route to East Asia compared to the Sunda Straits and Lombok-Makassar Straits (Figure 7). Thus, for example, over half of the oil tankers bound for Japan from the Gulf passed through the Straits in 1993 (MPP-EAS, 1999).

In 1995, for the Straits of Malacca, the number of transits of bulk liquid cargo tankers with an average deadweight tonne (dwt) of 152,842 was 5,265 (Lloyd's Maritime Information Services, Ltd., 1995, cited in Sakura Institute of Research, 1998). The additional travel time of tankers with 150,000 dwt would be 3.5 days if they pass through the Lombok-Makassar Straits, and the net additional cost per tanker is about $114,000 for the 3.5-day voyage (Chia Lin Sien, 1997). Thus, the amount of savings in terms of the difference in transportation cost between the Straits of Malacca and the other alternative

Table 9. Gross and Net Revenues from Fisheries and Aquaculture.

	Indonesia		Malaysia		Singapore	
	Gross	Net	Gross	Net	Gross	Net
Fisheries	875,050,250	458,445,077	686,340,025	154,429,860	8,400,000	1,657,320
Mangroves	753,592,205	424,164,529	352,544,077	70,452,989	4,200,000	828,660
Mudflats			49,417,104	27,868,925		
Coral reefs	105,403,545	32,675,099	10,210,570	2,014,545		
Seagrass			10,504,172	2,072,473		
Seaweeds	16,054,500	1,605,450	2,875,737	567,383		
From ecosystems	875,050,250	458,445,077	425,551,661	102,976,316	4,200,000	828,660
From outside ecosystems			260,788,364	51,453,544	4,200,000	828,660
Aquaculture	170,940,387	17,094,039	97,852,203	38,973,538	18,600,000	11,160,000
Inshore						
Shrimp			37,430,180	14,972,072		
Finfish			33,658,648	7,943,441		
Molluscs			26,763,375	16,058,025		

Gross revenues are from Sasekumar et al. (1998).

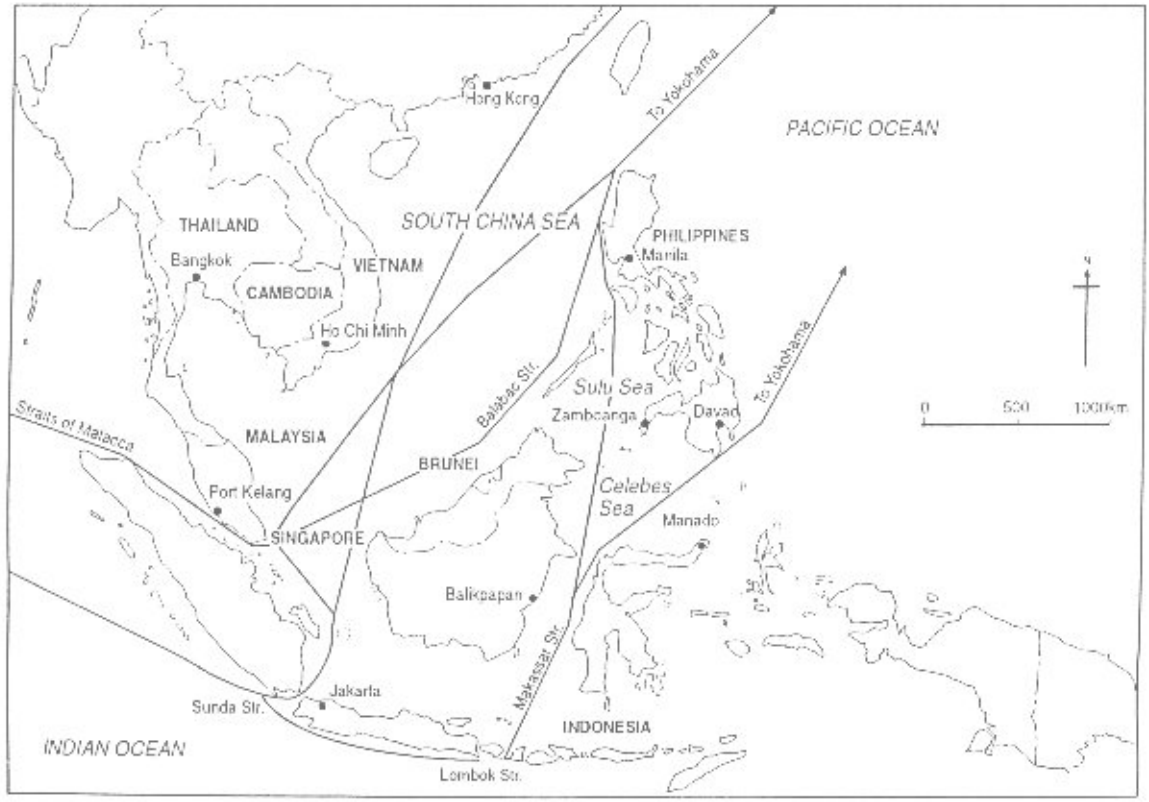
routes was more than $600 million for the 1995 bulk liquid cargo tanker traffic alone. This figure accounts only for the transits of this type of vessel, which were just 12.6% of the total number of transits of all vessel types that passed through the Straits of Malacca in 1995. Moreover, this is just the minimum worth of the "shipping lanes value" of the Straits. For instance, in 1995, the value of the goods transported through the Straits—around $968.5 billion, in CIF prices[1]—would be higher if the goods were transported via alternative routes due to increased border prices that reflect the additional freight costs.

Table 10. Types of Ships Passing through the Straits of Malacca at One Fathom Bank (1994).

Type of Vessel	Number
Conventional cargo	11,620
Tanker	9,688
Container	5,244
Fishing crafts	1,622
Tug and tow	1,579
RoRo (roll-on/roll-off)	1,130
Passenger	440
Military vessels	252
Patrol crafts	172
Submarines	4
TOTAL	31,755

Source: Hamzah and Basiron (1997).

Figure 7. Tanker Routes Between the Indian and Pacific Oceans.



Source: Chia Lin Sien (1997b).

[1] *This figure accounts only for the value of goods transported through the Straits of Malacca by Malaysia, intra-trade among Malaysia, Singapore, Indonesia and Myanmar and the value of oil bound for Japan through the Middle East and, therefore, does not include the value of goods transported by other countries through the Straits (Sasekumar et al., 1998).*

Conclusion

The natural environment provides goods and services that are valuable to people and many of these values can be expressed in monetary terms. The dearth of valuation studies about coastal and marine ecosystems shows the need for more research on basic information about ecological-economic linkages and institutional arrangements that affect such relationships. This report is one of the pioneering activities towards finding the 'price' of coastal and marine resources of the Malacca Straits. This price is critical in policy-making as this information can be used in setting charges and in benefit-cost analysis of alternative management programs and investments, which have consequent impacts on the state of these resources.

The gross value of the marine and coastal resources in the Straits of Malacca is estimated to be about US$6.83 billion. The total economic value (net) is around US$5.13 billion, of which US$1.47 billion are accounted for by net market or direct use values and US$3.66 billion by non-market values (Table 11). The gross market and non-market values of the ecosystems in each district in Malaysia and Indonesia are presented in Appendix Table 4. The various market and non-market values of the different coastal ecosystems in the three countries are shown in detail in Appendix Tables 5 to 7.

Among the coastal ecosystems, mangroves yield the highest value, which is about US$3.25 billion (net) or 63.3% of the total economic value (Table 12 and Figure 8). Coral reefs and beach areas also contribute about 10.98% and 11.7%, respectively, and most of their benefits come from the tourism revenues. There are also other benefits extended by coastal and marine resources that have not been identified and quantified in this report. For example, waste treatment, disturbance regulation, biological control, genetic resources, etc. are some of the other indirect use values of coral reefs (Costanza et al., 1998). The value of mudflats as habitat and feeding grounds of birds and fish was also not included. Likewise, the consumer surplus of local residents and tourists who enjoyed the beach, coral reefs and mangrove forests was not evaluated in this report. The economic values for each resource/ecosystem are shown in Tables 12 and 13.

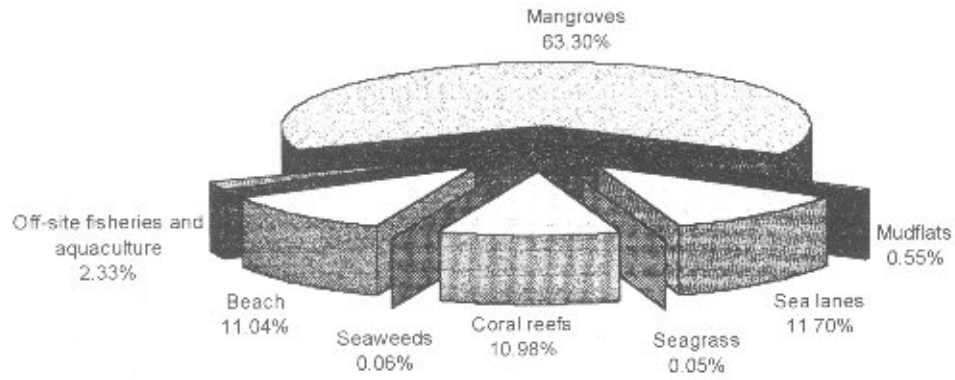
The main direct use or market benefits of coastal resources are tourism and fisheries (Figure 9). The net revenues from tourism and fisheries and aquaculture activities are valued at US$637.65 million and US$681.76 million, respectively, and correspondingly account for 12.4% and 13.3% of the total (net) economic value of the Straits. Nonetheless, the tourism and fisheries resources are dependent on the quality of the ecosystems.

Table 11. Total Economic Value (US$, in 1995 prices).

	Total (Gross)	Gross Market Value	Non-market Value
Indonesia	3,363,245,622	1,611,184,790	1,752,060,832
Malaysia	2,280,618,789	996,837,471	1,283,781,318
Singapore	585,990,552	558,971,331	27,019,222
TOTAL	6,830,064,963*	3,166,993,592	3,663,071,372*
	Total (Net)	Net Market Value	Non-market Value
Indonesia	2,575,794,362	823,733,530	1,752,060,832
Malaysia	1,596,345,497	312,564,180	1,283,781,318
Singapore	359,019,340	332,000,118	27,019,222
TOTAL	5,131,369,199*	1,468,297,828	3,663,071,372*

* Includes the value of the Straits of Malacca as shipping lanes.

Figure 8. Net Benefits of Coastal and Marine Environments.



The costs of unregulated tourism development and unsustainable fishing methods will lower the net economic values of these resources. Hence, management of these activities and protection of coastal ecosystems affect the sustainability of these revenues.

The most important non-market benefits being extended by coastal ecosystems are carbon storage with a value of US$724.3 million and control of coastal erosion with a value of $816.5 million (Figure 8) and they account for 14.12% and 15.91%, respectively, of the total (net) economic value of the Straits. Conservation or sustainable management of these ecosystems would contribute to the avoidance of future cost of climate change as well as ensure shoreline protection. The latter benefit is an alternative to additional investment in infrastructure, such as seawalls, that would otherwise be required. Note however that seawalls eventually have to be rehabilitated or replaced, and also lead to erosion problems, and therefore, do not serve as perfect substitutes to the coastal ecosystems.

Another non-market benefit is biodiversity. From a conceptual standpoint, the term is an eloquent expression for highlighting the rapid and irreversible species loss now occurring throughout the world and it provides a useful

Figure 9. Major Use and Non-use Values of Coastal Resources per Year.

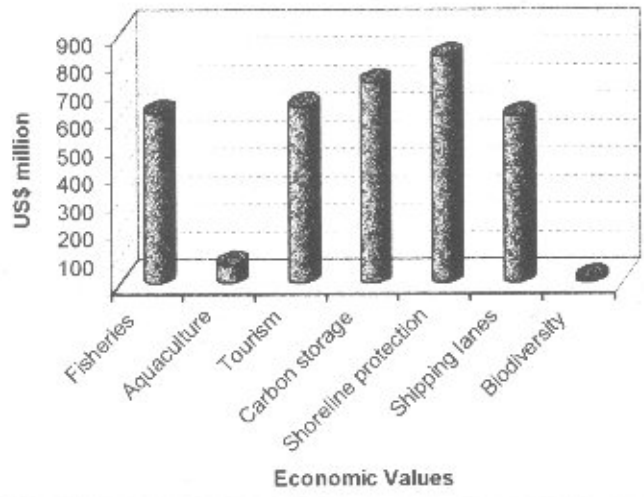


Table 12. Total Economic Value, by Ecosystem, by Country (US$, in 1995 prices).

Ecosystem	Indonesia		Malaysia		Singapore		Total	
	Gross Benefits	Net Benefits	Gross Benefits	Net Benefits	Gross Benefits	Net Benefits	Gross Benefits	Net Benefits
Mangroves	2,260,475,206	1,841,575,576	1,695,275,129	1,379,014,506	31,229,604	27,798,929	3,986,979,940	3,248,389,011
Mudflats	26,250	26,250	49,680,083	28,131,904	10,289	10,289	49,716,623	28,168,444
Beach	348,033,632	248,804,519	115,408,583	69,255,758	413,810,397	248,286,238	877,252,612	566,346,515
Coral reefs	567,387,522	466,360,403	47,503,305	26,145,178	118,068,560	70,863,522	732,959,386	563,369,103
Seagrass		no data	10,765,355	2,333,656	71,702	71,702	10,837,057	2,405,358
Seaweeds	16,382,625	1,933,575	3,345,767	1,037,413		no data	19,728,392	2,970,988
Fisheries	875,050,250	458,445,077	686,340,025	154,429,860	8,400,000	1,657,320	1,569,790,275	614,532,258
from ecosystems	875,050,250	458,445,077	425,551,661	102,976,316	4,200,000	828,660	1,304,801,911	562,250,053
Aquaculture	170,940,387	17,094,039	97,852,203	38,973,538	18,600,000	11,160,000	287,392,590	67,227,576
Sea lanes[3]							600,210,000	600,210,000
Total	3,363,245,622[1]	2,575,794,362[1]	2,280,618,789[2]	1,596,345,497[2]	585,990,552[2]	359,019,340[2]	6,830,064,963	5,131,369,199

[1] The total figure excludes the value of fisheries since this has been already accounted for under the ecosystems.
[2] The total figure excludes the value of fisheries from the ecosystem since this has been already accounted for under the ecosystems.
[3] The value of sea lanes refers to the shipping costs saved by bulk liquid cargo tankers (150,000 dwt) from using the Straits of Malacca instead of alternative routes.

Table 13. Gross Market and Non-market Benefits, by Ecosystem, by Country (US$, in 1995 prices).

Ecosystem	Indonesia		Malaysia		Singapore		Total	
	Market	Nonmarket	Market	Nonmarket	Market	Nonmarket	Market	Nonmarket
Mangroves	900,006,045	1,360,469,162	416,487,066	1,278,788,063	4,348,339	26,881,265	1,320,841,449	2,666,138,490
Mudflats		26,250	49,417,104	262,979		10,289	49,417,104	299,519
Beach	348,033,632		115,408,583		413,810,397		877,252,612	-
Coral reefs	176,150,227	391,237,295	43,235,825	4,267,480	118,012,595	55,965	337,398,647	395,560,740
Seagrass	no data	no data	10,568,972	196,383	no data	71,702	10,568,972	268,084
Seaweeds	16,054,500	328,125	3,079,354	266,413	no data	no data	19,133,854	594,538
Fisheries	875,050,250		686,340,025		8,400,000		1,569,790,275	
from ecosystems	875,050,250		425,551,661		4,200,000		1,304,801,911	
Aquaculture	170,940,387		97,852,203		18,600,000		287,392,590	
Sea lanes[3]								600,210,000
Total	1,611,184,790[1]	1,752,060,832	996,837,471[2]	1,283,781,318	558,971,331[2]	27,019,222	3,166,993,592	3,663,071,371
Market & Nonmarket	3,363,245,622		2,280,618,789		585,990,552		6,830,064,963	

[1] The total figure excludes the value of fisheries since this has been already accounted for under the ecosystems.
[2] The total figure excludes the value of fisheries from the ecosystem since this has been already accounted for under the ecosystems.
[3] The value of sea lanes refers to the shipping costs saved by bulk liquid cargo tankers (150,000 dwt) from using the Straits of Malacca instead of alternative routes.

framework for orienting and promoting conservation activities (Magrath et al., 1995). The estimated annual value of biodiversity of the coastal ecosystems in the Straits of Malacca is around US$13.4 million.

The Straits of Malacca also serve as important shipping lanes. In particular, vessels travelling between the Middle East and East Asia save on transportation costs, which would have been incurred if other routes were used instead. For tankers with 150,000 dwt, the amount of savings in terms of the difference in transportation cost between the Straits of Malacca and the Lombok and Makassar Straits, the other alternative routes, was more than US$600 million for the 1995 vessel traffic. The value of shipping lanes contributes about 11.7% to the total economic value of the Straits of Malacca (Figure 8).

Another benefit extended by the Straits of Malacca is its use as a receptacle of waste. The main sources of pollution in the Straits are oil and grease, pathogens, sediments transported through urban and agricultural runoff, heavy metals and nutrients (nitrogen and phosphorus) from pesticides and domestic sewage. The lack of pollution control measures indicates the extent of how the marine environment is providing this service for free. This environmental service, however, is not quantified in this report.

In sum, the total economic value (net) of the coastal and marine resources in the Straits of Malacca is around US$5.13 billion, of which the net market value and non-market values account for 28.6% and 71.4%, respectively. The large non-market values show how resources and environmental assets provide important life-support functions, which are not usually given monetary value. Thus, these results show that non-quantification of non-market values would lead to the undervaluation of these resources and could lead to overexploitation or to misguided policies and management decisions. For instance, fishery resources are being harvested at rates above the efficient and sustainable yields, thereby jeopardizing future availability of these resources. Likewise, mangroves are being indiscriminately converted to other uses, such as aquaculture. The revenues from these actions, however, are actually less than the values of provision of feeding, nursery and breeding areas for fish, crustaceans, birds and wildlife, protection of adjacent coral reefs and seagrass beds from suspended solids, carbon storage, shoreline protection and biodiversity. This shows that some use and non-use values may be incompatible and tradeoffs have to be made. Because of the perceived benefits, which accrue to the global community (and not just to the countries where the resources are found), sustainable management of coastal and marine resources is being promoted. Although the values shown in this report may be studied and further refined, the valuation exercise presented in this report highlights the magnitude of potential losses due to improper management of coastal and marine resources in the Straits of Malacca.

References

Ahmad Tajuddin Hj. Kechic, Mansor Ibrahim, Amran Hamzah and Aminuddin Jaffar. 1991. Guidelines for coastal resources management for tourism and recreation in South Johore, Malaysia, p. 355-364. *In* Chou Loke Ming, Chua Thia-Eng, Khoo Hong Woo, Lim Poh Eng, J.N. Paw, G.T. Silvestre, M.J. Valencia, A.T. White and Wong Poh Kam (eds.) Towards an integrated management of tropical coastal resources. ICLARM Conference Proceedings 22. National University of Singapore and International Center for Living Aquatic Resources Management, Manila, Philippines.

Ahman Adnan bin Nurrudin and Lim Chai Fong. 1994. Biosocioeconomics of fishing for shrimp in Kuala Sepetang, Malaysia. Bay of Bengal Programme BOBP Working Paper 98.

Bambang, W., G.H. Tampubolon and W. Handoko. 1994. Biosocioeconomics of fishing for shrimp in the Langkat District on the East Coast of North Sumatera, Indonesia. Bay of Bengal Programme BOBP Working Paper 99.

Bennett, E.L. and C.J. Reynolds. 1993. The value of mangrove area in Sarawak. Biodiversity and Conservation 2: 359-375.

Cesar, H. 1996. Economic analysis of Indonesian coral reefs. The World Bank, Washington, D.C.

Chia Lin Sien. 1997. The financial cost of risk management in the Straits of Malacca. *In* B.A. Hamzah (ed.) The Straits of Malacca: International cooperation in trade, funding and navigational safety. Pelanduk Publications (M) Sdn Bhd, Malaysia.

Chia Lin Sien. 1997b. Responding to oil spills in the waters of Southeast Asia. *In* Y. Nomura and N. Sakumoto (eds.) Environmental law and policy in Asia: Issues of enforcement. Development and the Environment Series no. 4. Institute of Developing Economies. Japan.

Chua Thia-Eng, S.A. Ross and Huming Yu, (eds.) 1997. Malacca Straits environmental profile. MPP-EAS Techincal Report No. 10, 259 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Colinvaux, P. 1993. Ecology. John Wiley & Sons, Inc., New York.

Costanza, R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Nareem, R.V. O'Neill, J. Paruelo, R.G. Raskin, P. Sutton and M. van der Belt. 1998. The value of the world's ecosystem services and natural capital. Ecol. Econ. 25: 3-15.

Dahuri, R. 1995. Indonesia, p. 277-290. *In* K. Hotta and I.M. Dutton (eds.) Coastal management in the Asia-Pacific region: Issues and approaches. Japan International Marine Science and Technology Federation, Tokyo, Japan.

Dahuri, R., J. Rais, S.P. Ginting dan M.J. Sitepu. 1995. Pengelolaan sumberdaya wilayah pesisir dan lautan secara terpadu. PT. Pradnya Paramita, Jakarta, Indonesia.

Delmendo, M.N. and B.H. Delmendo. 1987. Small-scale aquaculture operations in the ASEAN countries. ASEAN/UNDP/FAO Regional Small-scale Coastal Fisheries Development Project.

Fankhauser, S. 1994. Evaluating the social costs of greenhouse gas emissions. CSERGE Working Paper GEC 94-1. CSERGE, University College, London.

FAO (Food and Agriculture Organization of the United Nations). 1995. Mangrove management in Thailand, Malaysia and Indonesia. FAO Environment Paper.

Gong, W.K., J.-E. Ong and C.-H. Wong. 1991. The light attenuation method for measuring potential primary productivity in mangrove ecosystems. An evaluation paper presented at the Regional Symposium on Living Resources in Coastal Areas, 30 January-1 February 1989, Manila, Philippines.

Hamzah, B.A. and Mohd. Nizam Basiron. 1997. Funding a partnership for safer navigation and a cleaner environment in the Straits of Malacca: Some preliminary thoughts. *In* S.A. Ross, C. Tejam and R. Rosales (eds.) Sustainable financing mechanisms: Public sector-private sector partnership. MPP-EAS Conference Proceedings No. 6, 352 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

Hiew, K.L. and S.T. Lim. 1994. Some experience on the implementation of coastal erosion control works in Malaysia, p. 123-137. *In* Seminar on engineering for coastal development. Institute of Engineering Malaysia.

Jahara Yahaya. 1991. An economic analysis of brackishwater shrimp pond culture in Johore, Peninsular Malaysia, p. 255-266. *In* Chou Loke Ming, Chua Thia-Eng, Khoo Hong Woo, Lim Poh Eng, J.N. Paw, G.T. Silvestre, M.J. Valencia, A.T. White and Wong Poh Kam (eds.) Towards an integrated management of tropical coastal resources. ICLARM Conference Proceedings 22. National University of Singapore and International Center for Living Aquatic Resources Management.

Jin Eong Ong. 1982. Mangroves and aquaculture. Ambio 2(5).

Magrath, W.B., C.M. Peters, Nalin Kishor and Puneet Kishor. 1995. The economic supply of biodiversity in West Kalimantan: Preliminary results. *In* Shen Susan and A. Contreras (eds.) Environmental and economic issues in forests: Selected case studies in Asia. World Bank Technical Paper No. 281.

Md. Yussof Nair. 1987. An appraisal of the economic potential of mangrove swamps. Universiti Pertanian Malaysia. M.S. thesis.

Meilani, M., K. Tridoyo and A. Fahrudin. 1996. An economic analysis of mangrove use. Faculty of Fisheries, Bogor Agricultural University, Indonesia.

Ministry of State for Environment. 1996. Indonesian country study on integrated coastal and marine biodiversity management. Republic of Indonesia and Kingdom of Norway.

MPP-EAS. 1999. Marine pollution management in the Malacca/Singapore Straits: Lessons learned. MPP-EAS/Info/99/195, 168 p. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

MPP-EAS. 1999b. Straits of Malacca Environmental Information System (SMEIS). CD-ROM. GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas, Quezon City, Philippines.

P.G. Pakpoy and Associates. 1982. Baseline and socioeconomic studies. Integrated Fisheries Development Project. Food and Agriculture Organization.

Riopelle, M. 1995. The economic valuation of coral reefs: A case study of West Lombok, Indonesia. Dalhousie University, Halifax, Nova Scotia. Masteral degree thesis.

Ruitenbeek, H.J. 1992. Mangrove management: An economic analysis of management options with a focus on Bintuni Bay, Irian Jaya. Dalhousie University, Halifax, Nova Scotia.

Sakura Institute of Research. 1998. Research on traffic flows in the Straits of Malacca and Singapore. Unpublished.

Sasekumar, A., V.C. Chong and S.M. Phang. 1998. Marine and coastal resource valuation for the Straits of Malacca. University of Malaya. Report to the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas.

Spurgeon, J.P.G. 1992. The economic valuation of coral reefs. Mar. Pollut. Bull. 24:529-536.

Systems Science Consultants, Inc. 1994. The study on coastal resources inventory management and enhancement in the Republic of Indonesia. Main Report and Appendices. JICA-Ministry of Agriculture, Indonesia.

Tridoyo, K., S. Koeshendrajana, A. Fahrudin and L. Adrianto. 1998. Cost-benefit analysis of habitat conservation in the Malacca Straits. Center for Coastal and Marine Resources Studies, Bogor Agricultural University. Report to the GEF/UNDP/IMO Regional Programme for the Prevention and Management of Marine Pollution in the East Asian Seas.

Universitetet I Bergen Senter for Miljø-og Ressursstudier. 1994. Economic factors and valuation of tropical coastal resources. SMR-report 14-94.

Whittaker, R.H. and G.E. Likens. 1973. Carbon in the biota. *In* G.M. Woofwell and E.V. Pecan (eds.) Carbon and the biosphere. Washington, D.C.

Wilkinson, C.R., S. Sudara and Soekarno. 1994. Socioeconomic values and impacts on ASEAN coral reefs. *In* C.C. Wilkinson, S. Sudara and L.M. Chou (eds.) Proceedings of the Third ASEAN-Australian Symposium on Living Coastal Resources Dept. of Marine Science, Chulalongkorn University, Bangkok, Thailand.

Yogarani Kanagrajah. 1984. The production and marketing of cockles in Peninsular Malaysia. Project paper. Universiti Pertanian Malaysia.

APPENDIX TABLES

Appendix Table 1. Assumptions Used in Valuation.

Ecosystem	Economic Values	Malaysia	Indonesia	Singapore
Mangroves	**Use and Non-use values**			
	Use Values			
	Direct use			
	Charcoal and poles	$344/ha		
	Mud crabs	$4,800/tonne		
	Tourism	$424/ha	$169/ha	$547.01/ha
	Traditional use and recreation fishing		$33/ha	
	Indirect use			
	Nursery role (offshore fish and prawns)	50% of total fish landings		
	Carbon sequestration	$1,810/ha/yr	$1,810/ha/yr	$1,810/ha/yr
	Protection from erosion	$221,333.74/km/yr	195,294.47/km/yr	
	Option value			
	Biodiversity value	$15/ha	$15/ha	$15/ha
	Non-use values			
	Existence value	$11,040/ha	$2,156/ha	$76,499/ha
Mudflats	**Use values**			
	Option value			
	Biodiversity Value	$7.5/ha	$7.5/ha	$7.5/ha
Beaches	**Use values**			
	Direct use			
	Turtle eggs	$1.2/egg	$436/ha	
Coral reefs	**Use values**			
	Indirect use			
	Shoreline protection	$221,333.74/km	$532.13/ha	
	Carbon sequestration	$180/ha/yr	$180/ha/yr	$180/ha/yr
	Option value			
	Biodiversity value	$15/ha	$15/ha	$15/ha
Seagrasses	**Use values**			
	Indirect use			
	Carbon sequestration	$423.4/ha/yr	$423.4/ha/yr	$423.4/ha/yr
	Option value			
	Biodiversity value	$7.5/ha	$7.5/ha	$7.5/ha
Seaweeds	**Use values**			
	Indirect use			
	Carbon sequestration	$180/ha/yr	$180/ha/yr	$180/ha/yr
	Option value			
	Biodiversity value	$7.5/ha	$7.5/ha	$7.5/ha

Appendix Table 2. Net Earnings from Fishing, Malaysia.								
Fishing Gear	Total Revenue RM/yr [1]	Weights % of Total [2]	Average Monthly Revenue [3]	Average Monthly Operating Cost [4]	Average Monthly Net Earning Incl. Dep'n. [5]	Average Monthly Net Earning Excl. Dep'n. [6]=[3]-[4]	% Net Earning, Excl. Dep'n. [7]=[6]/[3]	Weighted % Net Return, Excl. Dep'n. [9]=[7]*[2]
Fish trawler	222,000	57.25	18,500.00	16,507.00	1,510.00	1,993.00	10.77	6.17
Shrimp trawler	74,472	19.20	6,206.00	4,311.00	1,646.00	1,895.00	30.53	5.86
Pushnets	39,378	10.15	3,282.00	2,319.00	878.00	963.00	29.34	2.98
Trammelnets	43,815	11.30	3,651.00	2,680.00	840.00	971.00	26.60	3.00
Bagnet	8,128	2.10	677.00	124.00	454.00	553.00	81.68	1.71
Total	387,793					Average	35.79	19.73

Ahmad Adnan bin Nurrudin and Lim Chai Fong (1994).

Appendix Table 3. Net Earnings from Fishing, Indonesia.

Coral Reef Fisheries	Rp	%
Total revenue	3,917,844,000	
Total cost	2,712,834,498	
Profit	1,205,009,502	31

Source: Riopelle (1995).

Inshore and Offshore Fisheries, North Sumatera	Trammelnet	Gillnet	Bagnet	Total
Revenue by gear (x Rp1,000)	10,363,530	3,078,096	2,294,655	15,736,281
% share to total revenue	66	20	15	
Owner net earnings				
station 1	690	(180)	108	
station 2	612	1,446	189	
station 3	542	1,418	91	
station 4	140	212		
station 5	419	527	42	
Total cost (fixed+variable+crew)				
station 1	4,439	2,340	4,526	
station 2	4,682	3,708	6,509	
station 3	4,382	3,563	3,897	
station 4	5,598	1,953	-	
station 5	3,959	2,737	3,056	
Gross revenue				
station 1	5,129	2,160	4,634	
station 2	5,294	5,154	6,698	
station 3	4,924	4,981	3,988	
station 4	5,738	2,165		
station 5	4,378	3,264	3,097	
% Net returns				
station 1	13.45	-8.33	2.34	
station 2	11.56	28.06	2.82	
station 3	11.01	28.47	2.28	
station 4	2.44	9.79		
station 5	9.57	16.15	1.34	
Average by gear	9.61	14.83	2.19	9.55

Source: Bambang et al. (1994).

Appendix Table 4. Total (Gross) Economic Value, by District (US$, 1995 prices).					
District	**Total (Gross)**	**Market Value**	**Nonmarket Value**	**Coastline (km)**	**Value per km**
MALAYSIA					
All FADs*	**2,280,618,789**	**996,837,471**	**1,283,781,318**	**938.22**	**2,430,793**
K. Perlis-Langkawi	167,972,871	118,988,853	48,984,018	20.47	8,205,807
Kedah Utara	76,629,500	68,177,056	8,452,444	38.15	2,008,637
Kedah Selatan	92,666,084	20,146,005	72,520,079	46.72	1,983,435
Penang	168,113,997	151,627,475	16,486,522	54.13	3,105,745
Krian	212,595,123	53,244,765	159,350,358	57.57	3,692,811
Larut-Matang	507,238,886	127,317,474	379,921,412	44.96	11,282,004
Manjung	135,889,137	118,498,665	17,390,472	78.38	1,733,722
Hilir Perak	78,416,517	71,376,722	7,039,795	31.75	2,469,812
Selangor Utara	127,817,641	82,535,724	45,281,916	35.07	3,644,643
Selangor Tengah	39,500,582	25,108,825	14,391,757	42.83	922,264
Port Klang	165,723,152	37,889,057	127,834,095	53.75	3,083,221
Selangor Selatan	58,962,573	10,196,249	48,766,324	58.03	1,016,071
Port Dickson	22,535,329	8,161,017	14,374,312	51.04	441,523
Melaka	45,284,326	25,862,742	19,421,584	73.7	614,441
Muar	15,311,967	4,745,414	10,566,552	47.71	320,938
Batu Pahat	28,481,467	14,332,961	14,148,506	63.86	445,999
Pontian	53,661,994	26,826,404	26,835,589	43.61	1,230,497
Johor Bahru	283,432,845	31,417,263	252,015,583	96.49	2,937,432
INDONESIA					
All Areas/Districts	**3,363,245,622**	**1,611,184,790**	**1,752,060,832**	**1,641**	**2,049,260**
Sabang	6,541,489	893,722	1,950,702	60.7	107,768
Aceh Besar	288,335,725	100,953,241	182,783,992	75.5	3,819,016
Pidie	81,379,098	30,194,675	46,257,033	80.9	1,005,922
Aceh Utara	198,574,974	169,123,294	23,159,969	103.3	1,922,313
Aceh Timur	209,595,145	80,827,563	119,101,614	158.7	1,320,700
Langkat	153,404,922	64,938,098	81,633,040	112.2	1,367,245
Deli/Medan	422,597,014	263,330,615	83,195,395	120.2	3,515,782
Asahan/T. Balai	526,975,782	252,279,353	268,983,336	93.8	5,618,079
Labuhan Batu	126,347,180	46,898,654	74,758,674	77.0	1,640,872
Bengkalis	633,288,110	111,275,578	494,835,753	446.2	1,419,292
Riau Islands	605,115,490	124,375,911	343,187,692	217.2	2,785,983
Batam	111,396,261	18,392,274	32,187,382	95.5	1,166,453
SINGAPORE					
Singapore	**585,990,552**	**555,073,952**	**30,916,600**	**130**	**4,507,620**

* FADs - Fisheries Administrative Districts

** The total figures may be different from the sum of the district values as some economic values of coastal resources are available only at the national level and not at the district level.

Appendix Table 5. Total Economic Value of Coastal and Marine Ecosystems in Malaysia (US$, 1995 prices).

Ecosystem	Economic Values	Gross Benefits (US$)	Net Benefits (US$)	Assumptions
	TOTAL ECONOMIC VALUE	**2,280,618,789**	**1,596,345,497**	
	Market Value	**996,837,471**	**312,564,180**	
	Nonmarket Value	**1,283,781,318**	**1,283,781,318**	
Mangroves	**Use and Non-use Values**	**1,695,275,129**	**1,379,014,506**	
	Use values	***776,094,665***	***459,834,042***	
	Direct use:	**73,267,053**	**32,509,135**	
	Charcoal and Poles	28,641,130	8,592,339	[1] $344/ha; 83,259.1 ha; 30% net return
	Fish and prawns (pukat surung)	5,099,344	1,496,148	[2] 29.34% net return
	Mud crabs	4,224,720	1,239,533	[3] 29.34% net return
	Tourism	35,301,858	21,181,115	[4] $424/ha; 83,259.1 ha; 60% net return
	Traditional, non-traded use	-	-	
	Indirect use:	**701,578,726**	**426,076,021**	
	Nursery role (inshore and offshore fish and prawns)	343,220,013	67,717,309	[5] 19.73% net return
	Carbon sequestration	150,698,971	150,698,971	$1,810/ha; 83,259.1 ha
	Protection from erosion	207,659,742	207,659,742	$221,333.74/km; 938.22 km
	Option value:	**1,248,887**	**1,248,887**	
	Biodiversity value	1,248,887	1,248,887	[11] $15/ha; 83,259.1 ha
	Non-use values	***919,180,464***	***919,180,464***	
	Existence value	919,180,464	919,180,464	[11] $11,040/ha; 83,259.1 ha
Mudflats	**Use values**	**49,680,083**	**28,131,904**	
	Direct use:	**49,417,104**	**27,868,925**	
	Anadara	26,370,547	15,822,328	[6] 60% net return
	Paphia	17,639,960	10,583,976	[6] 60% net return
	Siput	344,879	101,187	[3] 29.34% net return
	Acetes	2,907,110	852,946	[2] 29.34% net return
	Fish and prawns (pukat rentang)	2,154,608	508,487	[7] 23.6% net return
	Indirect use:	**-**	**-**	
	Nursery role (inshore and offshore fish and prawns)	-	-	
	Birds	-		no reference
	Option value:	**262,979**	**262,979**	
	Biodiversity value	262,979	262,979	$7.5/ha; 35,063.9 ha

continued

Appendix Table 5. Total Economic Value of Coastal and Marine Ecosystems in Malaysia (US$, 1995 prices).

Ecosystem	Economic Values	Gross Benefits (US$)	Net Benefits (US$)	Assumptions
Beach	**Use values**	**115,408,583**	**69,255,758**	
	Direct use:	**115,408,583**	**69,255,758**	
	Tourism	115,382,063	69,229,238	[4,10] 60% net returns
	Turtle eggs	26,520	26,520	$1.2/egg
Coral reefs	**Use values**	**47,503,305**	**26,145,178**	
	Direct use:	**43,235,825**	**21,877,698**	
	Fisheries	10,210,570	2,014,545	[5] 19.73% net return
	Tourism	32,905,255	19,743,153	[4,10] 60% net return
	Research	120,000	120,000	
	Indirect use:	**4,247,717**	**4,247,717**	
	Shoreline protection	4,010,567	4,010,567	$221,333.74/km; 18.07 km
	Carbon sequestration	237,150	237,150	$180/ha; 1,317.5 ha
	Option value:	**19,763**	**19,763**	
	Biodiversity value	19,763	19,763	$15/ha; 1,317.5 ha
Seagrass	**Use values**	**10,765,355**	**2,333,656**	
	Direct use:	**10,568,972**	**2,137,273**	
	Fisheries	10,504,172	2,072,473	[5] 19.73% net return
	Raw materials	-	-	
	Research	64,800	64,800	
	Indirect use:	**192,965**	**192,965**	
	Shoreline protection	-		
	Carbon sequestration	192,965	192,965	$423.4/ha/yr; 455.75 ha
	Option value:	**3,418**	**3,418**	
	Biodiversity value	3,418	3,418	$7.5/ha; 455.75 ha
Seaweeds	**Use values**	**3,345,767**	**1,037,413**	
	Direct use:	**3,079,354**	**771,000**	
	Fisheries	2,875,737	567,383	[5] 19.73% net return
	Raw materials	3,617	3,617	
	Research	200,000	200,000	
	Indirect use:	**255,757**	**255,757**	
	Shoreline protection	-		
	Carbon sequestration	255,757	255,757	$180/ha/yr; 1,420.87 ha
	Option value:	**10,657**	**10,657**	
	Biodiversity value	10,657	10,657	$7.5/ha; 1,420.87 ha

continued

continued

Appendix Table 5. Total Economic Value of Coastal and Marine Ecosystems in Malaysia (US$, 1995 prices).

Ecosystem	Economic Values	Gross Benefits (US$)	Net Benefits (US$)	Assumptions
	FISHERIES	**686,340,025**	**154,429,860**	
	Mangroves	352,544,077	70,452,989	
	on-site			
	fish and prawns	*5,099,344*	*1,496,148*	[2] 29.34% net return
	mud crabs	*4,224,720*	*1,239,533*	[3] 29.34% net return
	off-site	*343,220,013*	67,717,309	[5] 19.73% net return
	Mudflats	49,417,104	27,868,925	See direct use values of mudflats.
	Coral reefs	10,210,570	2,014,545	[5] 19.73% net return
	Seagrass	10,504,172	2,072,473	[5] 19.73% net return
	Seaweeds	2,875,737	567,383	[5] 19.73% net return
				$2.88 M computed fromTable 4.3.1
				$2.39M in Table 5.1.1
	Subtotal: From ecosystems	425,551,661	102,976,316	
	From outside ecosystems	260,788,364	51,453,544	[5] 19.73% net return
	AQUACULTURE	**97,852,203**	**38,973,538**	
	Inshore			
	shrimp	37,430,180	14,972,072	[6] 40% net returns
	finfish	33,658,648	7,943,441	[7] 23.6% net returns
	mollusks	26,763,375	16,058,025	[6,9] 60% net returns
	TOTAL (FISHERIES AND AQUACULTURE)	**784,192,228**	**193,403,398**	

Notes:

[1] Chua, et al., 1997, *Malacca Straits Environmental Profile.*

[2] Returns to capital, labor and management of pushnets computed from: Nurrudin and Fong, 1994, *Biosocioeconomics of Fishing for Shrimp in Kuala Sepetang Malaysia.* Md Yussof Nair, 1977, p. 60.

[3] assumed equal returns to pushnet fishery

[4] Cesar, Herman, 1996, *Economic Analysis of Indonesian Coral Reefs*, The World Bank, p. 21.

[5] Weighted average of all fishing gear returns to capital, labor and management: Nurrudin and Fong, 1994.

[6] Net revenues from cockle culture, computed from : Kanagrajah, Yogarani, 1984, "The Production and Marketing of Cockles in Peninsular Malaysia." Project Paper. Univ. of Pertanian, Malaysia.

[7] Returns to capital, labor and mgt. of barier nets computed from: P.G. Pakpoy and Associates, 1982. Also in Jin Eong Ong (Ambio, 1982).

[8] Jahara Yahaya, 1991.

[9] Delmendo and Delmendo, 1987.

[10] Annual Tourism Statistical Reports and Kechic, et al (1991).
- Number of tourists was adjusted for purpose, length of stay or time spent swimming, sightseeing and eating seafoods

Appendix Table 6. Total Economic Value of Coastal and Marine Ecosystems in Indonesia (US$, 1995 prices).				
Ecosystem	Economic Values	Gross Benefits (US$)	Net Benefits US$	Assumptions
	TOTAL ECONOMIC VALUE	**3,363,245,622**	**2,575,794,362**	
	Market Value	**1,611,184,790**	**823,733,530**	
	Nonmarket Value	**1,752,060,832**	**1,752,060,832**	
Mangroves	**Use and Non-use Values**	**2,260,475,206**	**1,841,575,576**	
	Use values	**1,690,797,454**	**1,271,897,824**	
	Direct use:	**734,150,350**	**464,520,845**	
	Charcoal and Poles	90,877,920	27,263,376	[6] $344/ha; 30% net returns
	Fish and prawns (pukat surung)	587,736,510	407,578,959	[7] Operating cost = $681.95 ha; 264,180 ha
	Wildlife	2,171,560	2,015,693	[8] Rev.= 8.22/ha; Cost = $0.59/ha; 264,180 ha
	Tourism	44,646,420	26,791,022	[15,1] $169.02/ha; 264,180 ha; 60% net returns
	Traditional, non-traded use	8,717,940	871,794	[2] $33/ha; 264,180; 10% net returns
	Indirect use:	**952,684,405**	**803,414,279**	
	Nursery role (offshore fish and prawns)	165,855,695	16,585,570	[2] 10% net return
	Carbon sequestration	478,165,800	478,165,800	$1810/ha; 264,180 ha
	Protection from erosion	308,662,910	308,662,910	1,641.2 km; $195,294.47/km
	Option value:	**3,962,700**	**3,962,700**	
	Biodiversity value	3,962,700	3,962,700	$15/ha; 264,180 ha
	Non-use values	**569,677,752**	**569,677,752**	
	Existence value	569,677,752	569,677,752	$2,156.4/ha; 264,180 ha
Mudflats	**Use values**	**26,250**	**26,250**	
	Direct use:	-	-	
	Fish and prawns	-	-	
	Indirect use:	-	-	
	Nursery role (inshore and offshore fish and prawns)	-	-	
	Birds	-	-	
	Option value:	**26,250**	**26,250**	
	Biodiversity value	26,250	26,250	[9] $7.5/ha; 3,500 ha
Beach	**Use values**	**348,033,632**	**248,804,519**	
	Direct use:	**348,033,632**	**248,804,519**	
	Tourism	248,072,782	148,843,669	[1,16] 60% net return
	Turtle eggs	99,960,850	99,960,850	$436/ha; 228,848.1 ha

continued

Appendix Table 6. Total Economic Value of Coastal and Marine Ecosystems in Indonesia (US$, 1995 prices).				
Ecosystem	**Economic Values**	**Gross Benefits (US$)**	**Net Benefits US$**	**Assumptions**
Coral reefs	**Use values**	**567,387,522**	**466,360,403**	
	Direct use:	**176,150,227**	**75,123,108**	
	Fisheries	105,403,545	32,675,099	[3,13] 31% net return
	Tourism	70,746,682	42,448,009	[1] 60% net return
	Research	-	-	*no data*
	Indirect use:	**383,415,365**	**383,415,365**	
	Shoreline protection	289,552,205	289,552,205	[14] $555.27/ha/yr; 521,462 ha
	Carbon sequestration	93,863,160	93,863,160	[10] $180/ha; 521,462 ha
	Option value:	**7,821,930**	**7,821,930**	
	Biodiversity value	7,821,930	7,821,930	[11] $15/ha; 521,462 ha
Seaweeds	**Use values**	**16,382,625**	**1,933,575**	
	Direct use:	**16,054,500**	**1,605,450**	
	Fisheries	16,054,500	1,605,450	[12,2] 10% net return
	Raw materials	-	-	
	Research	-	-	
	Indirect use:	**315,000**	**315,000**	
	Shoreline protection	-		
	Carbon sequestration	315,000	315,000	[4] $180/ha/yr; 1,750 ha
	Option value:	**13,125**	**13,125**	
	Biodiversity value	13,125	13,125	[5] $7.5/ha/yr; 1,750 ha
Seagrass	*no data*			
	Fisheries	**875,050,250**	**458,445,077**	
	Mangroves	**753,592,205**	**424,164,529**	
	off-site	165,855,695	16,585,570	
	on-site	587,736,510	407,578,959	
	Coral reefs	**105,403,545**	**32,675,099**	
	Seaweeds	**16,054,500**	**1,605,450**	
	Aquaculture	**170,940,387**	**17,094,039**	[2] **10% net return**
	TOTAL FISHERIES AND AQUACULTURE	**1,045,990,637**	**475,539,116**	

continued

[1] 60% net returns for tourism activities (Cesar, 1996).
[2] Weighted returns to labor and owner (105) computed from Bambang et al. (1994).
[3] Net income from coral fishing: 31% of gross revenues (Riopelle, 1995).
[4] Computed from carbon sequestration data of seaweed from Sasekumar et al. (1998).
[5] The biodiversity value of seaweeds is assumed to be half of the biodiversity value of mangroves (Sasekumar et al., 1998).
[6] Chua Thia-Eng et al. (1997).
[7] Tridoyo et al. (1997). Revenues=US$587,736510; Operating cost=US$681.95/ha/yr.
[8] Tridoyo et al. (1997). Revenues=US$8.22/ha; Cost=US$0.59/ha.
[9] The biodiversity value of mudflats is assumed to be half of the biodiversity value of mangroves (Sasekumar et al., 1998). The figure for the area came from the "Indonesian Country Study on Integrated Coastal and Marine Biodiversity Management" (1996)-for North Sumatera and Riau provinces, 3,500 ha.
[10] Computed from carbon sequestration data of coral reefs from Sasekumar et al. (1998).
[11] The biodiversity value of coral reefs is assumed to be the same as the biodiversity value of mangroves (Sasekumar et al., 1998).
[12] Tridoyo et al. (1997). Revenues=$9,174/ha; Net returns=10% of profits, based on the weighted average of all fishing gear returns to capital, labor and management (Bambang et al., 1994).
[13] Tridoyo et al., p. 20. The value of fisheries from coral reefs is US$105,403,545.
[14] Tridoyo et al., p. 22. The value of coastal protection is US$555.27/ha/yr (Dahuri et al., 1995).
[15] In Malaysia, tourism revenues in mangrove areas were estimated to be about US$424/ha. SInce tourism receipts in Indonesia is about 40% of that of Malaysia, the tourism revenue per ha in Indonesia is assumed to be $169.02/ha of mangroves.
[16] Tourism revenues adjusted for number of tourists coming for vacation and average length of stay (Department of Tourism, Post and Telecommunication) and percent of time spent for beach related and coral reef-related activities (Ahmad Tajuddin Hj. Kechic et al., 1991).

Appendix Table 7. Total Economic Value of Coastal and Marine Ecosystems in Singapore (US$, 1995 prices).

Ecosystem	Economic Values	Gross Benefits (US$)	Net Benefits (US$)		Assumptions
	TOTAL ECONOMIC VALUE	**585,990,552**	**359,019,340**		
	Market Value	**558,971,331**	**332,000,118**		
	Nonmarket Value	**27,019,222**	**27,019,222**		
Mangroves	**Use values**	**31,229,604**	**27,798,929**		
	Direct use:	**148,339**	**89,003**		
	Charcoal and Poles		-		
	Fish and prawns (pukat surung)		-		
	Mud crabs		-		
	Tourism	148,339	89,003	1	$574/ha; 258.43 ha; 60% net return
	Traditional, non-traded use			2	
	Indirect use:	**11,307,771**	**7,936,431**		
	Nursery role (offshore fish and prawns)	4,200,000	828,660	3	19.73% net return
	Carbon sequestration	467,758	467,758		$1,810/ha; 258.43 ha
	Protection from erosion	6,640,012	6,640,012		$221,333.74/km; 30 km
	Option value:	**3,876**	**3,876**		
	Biodiversity value	3,876	3,876		$15/ha; 258.43 ha
	Non-use values	**19,769,618**	**19,769,618**		
	Existence value	19,769,618	19,769,618		$76,499/ha; 258.43 ha
Mudflats	**Use values**	**10,289**	**10,289**		
	Direct use:		-		
	Anadara		-		
	Paphia		-		
	Siput		-		
	Acetes		-		
	Fish and prawns (pukat rentang)		-		
	Indirect use:	-	-		
	Nursery role (offshore fish and prawns)		-		
	Birds				
	Option value:	**10,289**	**10,289**		
	Biodiversity value	10,289	10,289		$7.5/ha; 1,371.93 ha
Beach	**Use values**	**413,810,397**	**248,286,238**		
	Direct use:	**413,810,397**	**248,286,238**		
	Tourism	413,810,397	248,286,238	4	
	Turtle eggs		-		

continued

continued

Appendix Table 7. Total Economic Value of Coastal and Marine Ecosystems In Singapore (US$, 1995 prices) (continued).					
Ecosystem	**Economic Values**	**Gross Benefits (US$)**	**Net Benefits (US$)**	**Assumptions**	
Coral reefs	**Use values**	**118,068,560**	**70,863,522**		
	Direct use:	**118,012,595**	**70,807,557**		
	Fisheries		-		
	Tourism	118,012,595	70,807,557		
	Research		-		
	Indirect use:	**51,660**	**51,660**		
	Shoreline protection		-		
	Carbon sequestration	51,660	51,660	[5]	$180/ha; 287 ha
	Option value:	**4,305**	**4,305**		
	Biodiversity value	4,305	4,305	[5]	$15/ha; 287 ha
Seagrass	**Use values**	**71,702**	**71,702**		
	Direct use:		-		
	Fisheries		-		
	Raw materials		-		
	Research		-		
	Indirect use:	**70,454**	**70,454**		
	Shoreline protection		-		
	Carbon sequestration	70,454	70,454	[5]	$423.4/ha; 166.4 ha
	Option value:	**1,248**	**1,248**		
	Biodiversity value	1,248	1,248	[5]	$7.5/ha; 166.4 ha
Seaweeds	*no data*		-		
	Fisheries	**8,400,000**	**1,657,320**	[3]	19.73% net return
	Mangroves	4,200,000	828,660	[3]	19.73% net return
	Aquaculture	**18,600,000**	**11,160,000**	[6]	60% net return
	TOTAL FISHERIES AND AQUACULTURE	**27,000,000**	**12,817,320**		

Notes:

[1] Cesar, Herman, 1996, *Economic Analysis of Indonesian Coral Reefs.*

[2] Returns to capital, labor and management of pushnets computed from: Nurrudin and Fong, 1994.

[3] Weighted average of all fishing gear returns to capital, labor and management: Nurrudin and Fong, 1994.

[4] Tourism revenues adjusted for number of tourists coming for vacation and average length of stay, (Singapore Annual Report on tourism Statistics) and percent of time spent for beach-related activities (Kechick, et al. 1991)

[5] Adopted from Sasekumar, et al. 1998.

[6] Delmendo and Delmendo, 1987. "Small-scale Aquaculture Operations in the ASEAN Countries." Net revenues from cockle culture, computed from : Kanagrajah, Yogarani. 1984.

Appendix Table 8. Total Economic Value, Malaysia (US$).

Ecosystem	Economic Values	FAD1 K. Perlis-Langkawi	FAD2 Kedah Utara	FAD3 Kedah Selatan	FAD4 Penang	FAD5 Krian	FAD6 Larut-Matang	FAD7 Manjung
	TOTAL ECONOMIC VALUE	**167,972,871**	**76,629,500**	**92,666,084**	**168,113,997**	**212,595,123**	**507,238,886**	**135,889,137**
	MARKET VALUE	**118,988,853**	**68,177,056**	**20,146,005**	**151,627,475**	**53,244,765**	**127,317,474**	**118,498,665**
	NONMARKET VALUE	**48,984,018**	**8,452,444**	**72,520,079**	**16,486,522**	**159,350,358**	**379,921,412**	**17,390,472**
Mangroves	***area (ha)***	*3,116*		*4,833*	*345*	*11,394.5*	*28,756.6*	
	coastline (km)	*20.47*	*38.15*	*46.72*	*54.13*	*57.57*	*44.96*	*78.38*
	Use and Non-use values	**79,234,704**	**41,767,056**	**84,261,869**	**52,403,310**	**183,519,919**	**450,941,332**	**68,791,788**
	Use values	**44,834,064**	**41,767,056**	**30,905,549**	**48,594,510**	**57,724,639**	**133,468,468**	**68,791,788**
	Direct use:	***3,104,928***	***107,424***	***4,661,568***	***632,240***	***9,605,760***	***26,305,629***	***556,992***
	Charcoal and Poles	1,071,904	-	1,662,552	118,680	3,919,708	9,892,270	-
	Fish and prawns	-	-	-	95,600	-	3,585,760	-
	Mud crabs	711,840	107,424	949,824	271,680	854,784	634,800	556,992
	Tourism	1,321,184	-	2,049,192	146,280	4,831,268	12,192,798	-
	Traditional, non-traded use							
	Indirect use:	***41,682,396***	***41,659,632***	***26,171,486***	***47,957,095***	***47,947,961***	***106,731,490***	***68,234,796***
	Nursery role (offshore fish)	31,511,734	33,215,750	7,083,044	35,351,850	14,581,733	44,730,879	50,886,657
	Carbon sequestration	5,639,960	-	8,747,730	624,450	20,624,045	52,049,446	-
	Protection from erosion	4,530,702	8,443,882	10,340,712	11,980,795	12,742,183	9,951,165	17,348,139
	Option value:	***46,740***	**-**	***72,495***	***5,175***	***170,918***	***431,349***	-
	Biodiversity value	46,740	-	72,495	5,175	170,918	431,349	-
	Non-use values	**34,400,640**	**-**	**53,356,320**	**3,808,800**	**125,795,280**	**317,472,864**	**-**
	Existence value	***34,400,640***	-	***53,356,320***	***3,808,800***	***125,795,280***	***317,472,864***	**-**
Mudflats	***area (ha)***	*0.22*	*1,124.39*	*359.07*	*4,189.90*	*2,390.98*	*2,211.77*	*1,535.08*
	Use values	**11,637,644**	**5,038,995**	**1,112,473**	**4,803,896**	**6,912,859**	**11,369,935**	**889,161**
	Direct use:	***11,612,202***	***5,030,562***	***1,109,780***	***4,763,912***	***6,880,527***	***11,235,827***	***877,648***
	Anadara	-	-	-	4,377,900	6,264,116	10,804,800	549,535
	Paphia	11,553,698	4,979,676	1,106,586	-	-	-	-
	Siput	-	-	-	15,030	244,439	-	-
	Acetes	58,504	50,886	3,194	33,126	99,736	256,464	-
	Fish and prawns	-	-	-	337,856	272,236	174,563	328,113
	Indirect use:	***25,440***	**-**	**-**	***8,560***	***14,400***	***117,520***	-
	Nursery role (offshore fish)							
	Birds	25,440	-	-	8,560	14,400	117,520	-
	Option value:	***2***	***8,433***	***2,693***	***31,424***	***17,932***	***16,588***	***11,513***
	Biodiversity value	2	8,433	2,693	31,424	17,932	16,588	11,513

continued

Appendix Table 8. Total Economic Value, Malaysia (US$).

Ecosystem	Economic Values	FAD1 K. Perlis-Langkawi	FAD2 Kedah Utara	FAD3 Kedah Selatan	FAD4 Penang	FAD5 Krian	FAD6 Larut-Matang	FAD7 Manjung
Beach	**Use values**	**38,679,377**	**600**	**600**	**61,482,674**	-	-	**3,068,862**
	Direct use:	***38,679,377***	***600***	***600***	***61,482,674***	-	-	***3,068,862***
	Tourism	38,672,657	-	-	61,471,154	-	-	3,061,782
	Turtle eggs	6,720	600	600	11,520			7,080
Coral reefs	***area (ha)***	*897.5*			*60*			*120*
	Use values	**20,796,277**	-	-	**2,981,255**	-	-	**4,297,879**
	Direct use:	***16,637,257***	-	-	***2,969,555***	-	-	***4,274,479***
	Fisheries	2,646,986	-		2,969,555			4,274,479
	Tourism	13,990,272						
	Research							
	Indirect use:	***4,145,557***	-	-	***10,800***	-	-	***21,600***
	Shoreline protection	3,984,007						
	Carbon sequestration	161,550	-	-	10,800	-	-	21,600
	Option value:	***13,463***	-	-	***900***	-	-	***1,800***
	Biodiversity value	13,463	-	-	900	-	-	1,800
Seagrass	***area (ha)***	*89.75*			*30*			*12*
	Use values	**2,685,659**	-	-	**2,982,482**	-	-	**4,279,600**
	Direct use:	***2,646,986***	-	-	***2,969,555***	-	-	***4,274,429***
	Fisheries	2,646,986			2,969,555			4,274,429
	Raw materials							
	Research							
	Indirect use:	***38,000***	-	-	***12,702***	-	-	***5,081***
	Shoreline protection							
	Carbon sequestration	38,000	-	-	12,702	-	-	5,081
	Option value:	***673***	-	-	***225***	-	-	***90***
	Biodiversity value	673	-	-	225	-	-	90
Seaweeds	***area (ha)***	*897.5*	*0.69*	*0.69*	*60*			*12*
	Use values	**672,469**	**324,327**	**324,327**	**576,879**	-	-	**816,436**
	Direct use:	***504,188***	***324,198***	***324,198***	***565,629***	-	-	***814,186***
	Fisheries	504,188	322,390	322,390	565,629			814,186
	Raw materials		1,808	1,808				
	Research							
	Indirect use:	***161,550***	***123***	***123***	***10,800***	-	-	***2,160***
	Shoreline protection							
	Carbon sequestration	161,550	123	123	10,800	-	-	2,160
	Option value:	***6,731***	***5***	***5***	***450***	-	-	***90***
	Biodiversity value	6,731	5	5	450	-	-	90

continued

Appendix Table 8. Total Economic Value, Malaysia (US$).

Ecosystem	Economic Values	FAD1 K. Perlis-Langkawi	FAD2 Kedah Utara	FAD3 Kedah Selatan	FAD4 Penang	FAD5 Krian	FAD6 Larut-Matang	FAD7 Manjung
	FISHERIES	**63,023,468**	**66,431,500**	**14,166,089**	**70,703,699**	**29,163,466**	**89,461,759**	**101,773,314**
	From Ecosystems							
	Mangroves	32,223,574	33,323,174	8,032,868	35,719,130	15,436,517	48,951,439	51,443,649
	on-site							
	fish and prawns	-	-	-	95,600	-	3,585,760	-
	mud crabs	711,840	107,424	949,824	271,680	854,784	634,800	556,992
	off-site	31,511,734	33,215,750	7,083,044	35,351,850	14,581,733	44,730,879	50,886,657
	Mudflats	11,612,202	5,030,562	1,109,780	4,763,912	6,880,527	11,235,827	877,648
	Coral reefs	2,646,986	-	-	2,969,555	-	-	4,274,479
	Seagrass	2,646,986	-	-	2,969,555	-	-	4,274,429
	Seaweeds	504,188	322,390	322,390	565,629	-	-	814,186
	Subtotal:	***49,633,935***	***38,676,126***	***9,465,038***	***46,987,782***	***22,317,044***	***60,187,266***	***61,684,392***
	From outside ecosystems	***13,389,534***	***27,755,374***	***4,701,051***	***23,715,918***	***6,846,422***	***29,274,493***	***40,088,923***
	AQUACULTURE	**902,648**	**1,743,148**	**2,265,764**	**19,176,142**	**15,330,323**	**15,770,646**	**13,656,489**

continued

Appendix Table 8. Total Economic Value, Malaysia (US$).

Ecosystem	Economic Values	FAD8 Hilir Perak	FAD9 Selangor Utara	FAD10 Selangor Tengah	FAD11 Port Klang	FAD12 Selangor Selatan	FAD13 Port Dickson	FAD14 Melaka
	TOTAL ECONOMIC VALUE	**78,416,517**	**127,817,641**	**39,500,582**	**165,723,152**	**58,962,573**	**22,535,329**	**45,284,326**
	MARKET VALUE	**71,376,722**	**82,535,724**	**25,108,825**	**37,889,057**	**10,196,249**	**8,161,017**	**25,862,742**
	NONMARKET VALUE	**7,039,795**	**45,281,916**	**14,391,757**	**127,834,095**	**48,766,324**	**14,374,312**	**19,421,584**
Mangroves	***area (ha)***	*2,915*	*379*	*9,008*	*2,791*	*233*	*238*	
	coastline (km)	*31.75*	*35.07*	*42.83*	*53.75*	*58.03*	*51.04*	*73.70*
	Use and Non-use values	**41,988,085**	**84,931,015**	**25,068,150**	**148,045,106**	**52,825,451**	**15,436,492**	**22,785,515**
	Use values	**41,988,085**	**52,749,415**	**20,883,990**	**48,596,786**	**22,012,811**	**12,864,172**	**20,157,995**
	Direct use:	**-**	***2,308,032***	***291,072***	***7,807,616***	***2,143,488***	***194,304***	***554,944***
	Charcoal and Poles	-	1,002,760	130,376	3,098,752	960,104	80,152	81,872
	Fish and prawns	-	69,312	-	889,472	-	-	371,200
	Mud crabs	-	-	-	-	-	15,360	960
	Tourism	-	1,235,960	160,696	3,819,392	1,183,384	98,792	100,912
	Traditional, non-traded use							
	Indirect use:	***41,988,085***	***50,397,658***	***20,587,233***	***40,654,050***	***19,827,458***	***12,666,373***	***19,599,481***
	Nursery role (offshore fish)	34,960,739	37,359,334	10,421,519	12,452,881	1,931,751	947,769	2,856,404
	Carbon sequestration	-	5,276,150	685,990	16,304,480	5,051,710	421,730	430,780
	Protection from erosion	7,027,346	7,762,174	9,479,724	11,896,689	12,843,997	11,296,874	16,312,297
	Option value:	-	***43,725***	***5,685***	***135,120***	***41,865***	***3,495***	***3,570***
	Biodiversity value	-	43,725	5,685	135,120	41,865	3,495	3,570
	Non-use values	-	**32,181,600**	**4,184,160**	**99,448,320**	**30,812,640**	**2,572,320**	**2,627,520**
	Existence value	-	***32,181,600***	***4,184,160***	***99,448,320***	***30,812,640***	***2,572,320***	***2,627,520***
Mudflats	***area (ha)***	*1,659.81*	*2,435.58*	*4,826.44*	*5,098.15*	*648.33*	*301.62*	*1,012.85*
	Use values	**285,621**	**2,621,369**	**3,312,970**	**1,549,756**	**278,902**	**3,462**	**62,196**
	Direct use:	***259,812***	***2,543,982***	***3,110,052***	***1,348,400***	***273,800***	***1,200***	***54,600***
	Anadara	259,812	1,431,380	2,683,004	-	-	-	-
	Paphia	-	-	-	-	-	-	-
	Siput	-	70,410	-	-	-	1,200	13,800
	Acetes	-	400,800	52,200	1,348,400	273,600	-	40,800
	Fish and prawns	-	641,392	374,848	-	-	-	-
	Indirect use:	***13,360***	***59,120***	***166,720***	***163,120***	***240***	-	-
	Nursery role (offshore fish)							
	Birds	13,360	59,120	166,720	163,120	240	-	-
	Option value:	***12,449***	***18,267***	***36,198***	***38,236***	***4,862***	***2,262***	***7,596***
	Biodiversity value	12,449	18,267	36,198	38,236	4,862	2,262	7,596

continued

Appendix Table 8. Total Economic Value, Malaysia (US$).

Ecosystem	Economic Values	FAD8 Hilir Perak	FAD9 Selangor Utara	FAD10 Selangor Tengah	FAD11 Port Klang	FAD12 Selangor Selatan	FAD13 Port Dickson	FAD14 Melaka
Beach	**Use values**	-	-	-	**58,880**	**58,880**	**1,036,295**	**4,192,286**
	Direct use:	-	-	-	***58,880***	***58,880***	***1,036,295***	***4,192,286***
	Tourism	-	-	-	58,880	58,880	1,036,295	4,192,286
	Turtle eggs							
Coral reefs	*area (ha)*						*120*	*120*
	Use values	-	-	-	-	-	**3,878,488**	**15,429,405**
	Direct use:	-	-	-	-	-	***3,828,528***	***15,406,005***
	Fisheries						79,612	239,938
	Tourism						3,748,916	15,166,068
	Research							
	Indirect use:	-	-	-	-	-	***48,160***	***21,600***
	Shoreline protection						26,560	
	Carbon sequestration	-	-	-	-	-	21,600	21,600
	Option value:	-	-	-	-	-	***1,800***	***1,800***
	Biodiversity value	-	-	-	-	-	1,800	1,800
Seagrass	*area (ha)*						*12*	*12*
	Use values	-	-	-	-	-	**84,783**	**245,108**
	Direct use:	-	-	-	-	-	***79,612***	***239,938***
	Fisheries						79,612	239,938
	Raw materials							
	Research							
	Indirect use:	-	-	-	-	-	***5,081***	***5,081***
	Shoreline protection							
	Carbon sequestration	-	-	-	-	-	5,081	5,081
	Option value:	-	-	-	-	-	***90***	***90***
	Biodiversity value	-	-	-	-	-	90	90
Seaweeds	*area (ha)*				*60*	*60*	*120*	*60*
	Use values	-	-	-	**126,327**	**126,327**	**37,664**	**56,952**
	Direct use:	-	-	-	***115,077***	***115,077***	***15,164***	***45,702***
	Fisheries				115,077	115,077	15,164	45,702
	Raw materials							
	Research							
	Indirect use:	-	-	-	***10,800***	***10,800***	***21,600***	***10,800***
	Shoreline protection							
	Carbon sequestration	-	-	-	10,800	10,800	21,600	10,800
	Option value:	-	-	-	***450***	***450***	***900***	***450***
	Biodiversity value	-	-	-	450	450	900	450

continued

Appendix Table 8. Total Economic Value, Malaysia (US$).

Ecosystem	Economic Values	FAD8 Hilir Perak	FAD9 Selangor Utara	FAD10 Selangor Tengah	FAD11 Port Klang	FAD12 Selangor Selatan	FAD13 Port Dickson	FAD14 Melaka
	FISHERIES	**69,921,477**	**74,718,668**	**20,743,037**	**24,905,762**	**3,863,501**	**1,895,537**	**5,712,809**
	From Ecosystems							
	Mangroves	34,960,739	37,428,646	10,421,519	13,342,353	1,931,751	963,129	3,228,564
	on-site							
	fish and prawns	-	69,312	-	889,472	-	-	371,200
	mud crabs	-	-	-	-	-	15,360	960
	off-site	34,960,739	37,359,334	10,421,519	12,452,881	1,931,751	947,769	2,856,404
	Mudflats	259,812	2,543,982	3,110,052	1,348,400	273,800	1,200	54,600
	Coral reefs	-	-	-	-	-	79,612	239,938
	Seagrass	-	-	-	-	-	79,612	239,938
	Seaweeds	-	-	-	115,077	115,077	15,164	45,702
	Subtotal:	***35,220,551***	***39,972,628***	***13,531,571***	***14,805,830***	***2,320,628***	***1,138,718***	***3,808,742***
	From outside ecosystems	***34,700,926***	***34,746,040***	***7,211,466***	***10,099,932***	***1,542,873***	***756,819***	***1,904,067***
	AQUACULTURE	**1,455,245**	**5,578,336**	**4,074,716**	**6,006,270**	**4,130,379**	**1,301,325**	**608,796**

continued

Appendix Table 8. Total Economic Value, Malaysia (US$).

Ecosystem	Economic Values	FAD15 Muar	FAD16 Batu Pahat	FAD17 Pontian	FAD18 Johor Bahru	Sum ALL FADs
	TOTAL ECONOMIC VALUE	**15,311,967**	**28,481,467**	**53,661,994**	**283,432,845**	**2,285,150,316**
	MARKET VALUE	**4,745,414**	**14,332,961**	**26,826,404**	**31,417,263**	**1,001,368,998**
	NONMARKET VALUE	**10,566,552**	**14,148,506**	**26,835,589**	**252,015,583**	**1,283,781,318**
Mangroves	*area (ha)*			*1,334*	*17,916*	*83,259.10*
	coastline (km)	*47.71*	*63.86*	*43.61*	*96.49*	*938.22*
	Use and Non-use values	**12,698,994**	**21,116,287**	**40,169,527**	**269,290,530**	**1,695,275,129**
	Use values	**12,698,994**	**21,116,287**	**25,442,167**	**71,497,890**	**776,094,665**
	Direct use:	-	-	***1,044,224***	***13,948,832***	***73,267,053***
	Charcoal and Poles	-	-	458,896	6,163,104	28,641,130
	Fish and prawns	-	-	6,080	81,920	5,099,344
	Mud crabs	-	-	13,632	107,424	4,224,720
	Tourism	-	-	565,616	7,596,384	35,301,858
	Traditional, non-traded use					-
	Indirect use:	***12,698,994***	***21,116,287***	***24,377,933***	***57,280,318***	***701,578,726***
	Nursery role (offshore fish)	2,139,161	6,981,914	12,311,029	3,495,865	343,220,013
	Carbon sequestration	-	-	2,414,540	32,427,960	150,698,971
	Protection from erosion	10,559,833	14,134,373	9,652,364	21,356,493	207,659,742
	Option value:	-	-	***20,010***	***268,740***	***1,248,887***
	Biodiversity value	-	-	20,010	268,740	1,248,887
	Non-use values	**-**	**-**	**14,727,360**	**197,792,640**	**919,180,464**
	Existence value	-	-	***14,727,360***	***197,792,640***	***919,180,464***
Mudflats	*area (ha)*	*895.95*	*1,884.41*	*2,842.01*	*1,647.34*	*35,063.90*
	Use values	**6,720**	**15,893**	**47,231**	**343,559**	**50,292,643**
	Direct use:	-	-	***21,716***	***293,084***	***49,417,104***
	Anadara	-	-	-	-	26,370,547
	Paphia	-	-	-	-	17,639,960
	Siput	-	-	-	-	344,879
	Acetes	-	-	19,956	269,244	2,907,110
	Fish and prawns	-	-	1,760	23,840	2,154,608
	Indirect use:	-	***1,760***	***4,200***	***38,120***	***612,560***
	Nursery role (offshore fish)					
	Birds	-	1,760	4,200	38,120	612,560
	Option value:	***6,720***	***14,133***	***21,315***	***12,355***	***262,979***
	Biodiversity value	6,720	14,133	21,315	12,355	262,979

continued

Appendix Table 8. Total Economic Value, Malaysia (US$).						
Ecosystem	Economic Values	FAD15 Muar	FAD16 Batu Pahat	FAD17 Pontian	FAD18 Johor Bahru	Sum ALL FADs
Beach	**Use values**	-	-	-	**6,830,128**	**115,408,583**
	Direct use:	-	-	-	***6,830,128***	***115,408,583***
	Tourism	-	-	-	6,830,128	115,382,063
	Turtle eggs					26,520
Coral reefs	***area (ha)***					*1,317.5*
	Use values	-	-	-	-	**47,503,305**
	Direct use:	-	-	-	-	***43,235,825***
	Fisheries					10,210,570
	Tourism					32,905,255
	Research					120,000
	Indirect use:	-	-	-	-	***4,247,717***
	Shoreline protection					4,010,567
	Carbon sequestration	-	-	-	-	237,150
	Option value:	-	-	-	-	***19,763***
	Biodiversity value	-	-	-	-	19,763
Seagrass	***area (ha)***				*300*	*455.75*
	Use values	-	-	-	**422,922**	**10,765,355**
	Direct use:	-	-	-	***293,652***	***10,568,972***
	Fisheries				293,652	10,504,172
	Raw materials					-
	Research					64,800
	Indirect use:	-	-	-	***127,020***	***192,965***
	Shoreline protection					-
	Carbon sequestration	-	-	-	127,020	192,965
	Option value:	-	-	-	***2,250***	***3,418***
	Biodiversity value	-	-	-	2,250	3,418
Seaweeds	***area (ha)***				*150*	*1,420.87*
	Use values	-	-	-	**84,059**	**3,345,767**
	Direct use:	-	-	-	***55,934***	***3,079,354***
	Fisheries				55,934	2,875,737
	Raw materials					3,617
	Research					200,000
	Indirect use:	-	-	-	***27,000***	***255,757***
	Shoreline protection					
	Carbon sequestration	-	-	-	27,000	255,757
	Option value:	-	-	-	***1,125***	***10,657***
	Biodiversity value	-	-	-	1,125	10,657

continued

continued

Appendix Table 8. Total Economic Value, Malaysia (US$).

Ecosystem	Economic Values	FAD15 Muar	FAD16 Batu Pahat	FAD17 Pontian	FAD18 Johor Bahru	Sum ALL FADs
	FISHERIES	**4,278,321**	**13,963,828**	**24,622,057**	**6,991,730**	**686,340,025**
	From Ecosystems					
	Mangroves	2,139,161	6,981,914	12,330,741	3,685,209	***352,544,077***
	on-site					
	fish and prawns	-	-	6,080	81,920	*5,099,344*
	mud crabs	-	-	13,632	107,424	*4,224,720*
	off-site	2,139,161	6,981,914	12,311,029	3,495,865	*343,220,013*
	Mudflats	-	-	21,716	293,084	***49,417,104***
	Coral reefs	-	-	-	-	***10,210,570***
	Seagrass	-	-	-	293,652	***10,504,172***
	Seaweeds	-	-	-	55,934	***2,875,737***
	Subtotal:	***2,139,161***	***6,981,914***	***12,352,457***	***4,327,879***	***425,551,661***
	From outside ecosystems	***2,139,160***	***6,981,914***	***12,269,600***	***2,663,851***	***260,788,364***
	AQUACULTURE	**467,093**	**369,132**	**1,179,835**	**3,835,916**	**102,383,730**

Appendix Table 9. Total Economic Value, Indonesia (US$).

Ecosystem	Economic Values	All Areas	Sabang	Aceh Besar	Pidie	Aceh Utara	Aceh Timur	Langkat
	TOTAL ECONOMIC VALUE	**3,363,245,622**	**6,541,489**	**288,335,725**	**81,379,098**	**198,574,974**	**209,595,145**	**153,404,922**
	MARKET VALUE	**1,611,184,790**	**4,590,787**	**105,551,732**	**35,122,065**	**175,415,005**	**90,493,531**	**71,771,882**
	NONMARKET VALUE	**1,752,060,832**	**1,950,702**	**182,783,992**	**46,257,033**	**23,159,969**	**119,101,614**	**81,633,040**
Mangroves	**Use and Non-use Values**	**2,260,475,206**	**-**	**45,772,603**	**66,904,488**	**165,383,563**	**158,142,457**	**121,024,169**
	Use values	**1,690,797,454**	**-**	**41,136,343**	**50,408,028**	**163,766,263**	**110,421,325**	**88,678,169**
	Direct use	***734,150,350***	**-**	***17,785,231***	***17,036,343***	***111,013,541***	***33,147,809***	***32,551,310***
	Charcoal and Poles	90,877,920	-	739,600	2,631,600	258,000	7,612,720	5,160,000
	Fish and prawns	*587,736,510*	-	16,593,658	12,796,560	110,597,876	20,882,920	24,238,010
	Wildlife	*2,171,560*	-	17,673	62,883	6,165	181,909	123,300
	Tourism	44,646,420	-	363,350	1,292,850	126,750	3,739,970	2,535,000
	Traditional, non-traded use	8,717,940	-	70,950	252,450	24,750	730,290	495,000
	Indirect use	***952,684,405***	-	***23,318,862***	***33,256,935***	***52,741,472***	***76,941,566***	***55,901,860***
	Nursery role	165,855,695		4,682,630	3,611,112	31,210,053	5,893,034	6,839,820
	Carbon sequestration	478,165,800	-	3,891,500	13,846,500	1,357,500	40,055,300	27,150,000
	Protection from erosion	308,662,910		14,744,732	15,799,323	20,173,919	30,993,232	21,912,040
	Option value	***3,962,700***	-	***32,250***	***114,750***	***11,250***	***331,950***	***225,000***
	Biodiversity value	3,962,700	-	32,250	114,750	11,250	331,950	225,000
	Non-use values	**569,677,752**	-	**4,636,260**	**16,496,460**	**1,617,300**	**47,721,132**	**32,346,000**
	Existence value	***569,677,752***	-	***4,636,260***	***16,496,460***	***1,617,300***	***47,721,132***	***32,346,000***
Mudflats	**Use values**	**26,250**						
	Direct use							
	Indirect use							
	Option value (biodiversity)	***26,250***						
Beach	**Use values**	**348,033,632**	**3,697,065**	**4,598,491**	**4,927,390**	**6,291,711**	**9,665,968**	**6,833,785**
	Direct use	***348,033,632***	***3,697,065***	***4,598,491***	***4,927,390***	***6,291,711***	***9,665,968***	***6,833,785***
	Tourism	*248,072,782*						
	Turtle eggs	*99,960,850*	3,697,065	4,598,491	4,927,390	6,291,711	9,665,968	6,833,785
Coral reefs	**Use values**	**567,387,522**	**2,828,984**	**231,215,023**	-	-	-	-
	Direct use	***176,150,227***	***878,282***	***71,782,648***	-	-	-	-
	Fisheries	*105,403,545*	525,540	42,952,801	-	-	-	-
	Tourism	*70,746,682*	352,742	28,829,848	-	-	-	-
	Research	-						
	Indirect use	***383,415,365***	***1,911,702***	***156,244,875***	-	-	-	-
	Shoreline protection	289,552,205	1,443,702	117,994,875	-	-	-	-
	Carbon sequestration	93,863,160	*468,000*	*38,250,000*	-	-	-	-
	Option value	***7,821,930***	***39,000***	***3,187,500***	-	-	-	-
	Biodiversity value	7,821,930	39,000	3,187,500	-	-	-	-

continued

Appendix Table 9. Total Economic Value, Indonesia (US$).

Ecosystem	Economic Values	All Areas	Sabang	Aceh Besar	Pidie	Aceh Utara	Aceh Timur	Langkat
Seagrass	**Use values**	-						
Seaweeds	**Use values**	16,382,625	-	2,340,375	-	-	-	-
	Direct use	***16,054,500***	-	***2,293,500***	-	-	-	-
	Fisheries	16,054,500	-	2,293,500	-	-	-	-
	Indirect use	***315,000***	-	***45,000***	-	-	-	-
	Shoreline protection	-						
	Carbon sequestration	315,000	-	45,000	-	-	-	-
	Option value (biodiversity)	***13,125***	-	***1,875***	-	-	-	-
	TOTAL FISHERIES	**875,050,250**	**525,540**	**66,522,588**	**16,407,672**	**141,807,929**	**26,775,954**	**31,077,830**
	Mangroves	**753,592,205**	-	**21,276,288**	**16,407,672**	**141,807,929**	**26,775,954**	**31,077,830**
	off-site	165,855,695	-	4,682,630	3,611,112	31,210,053	5,893,034	6,839,820
	on-site	587,736,510	-	16,593,658	12,796,560	110,597,876	20,882,920	24,238,010
	Coral reefs	**105,403,545**	**525,540**	**42,952,801**	-	-	-	-
	Seaweeds	**16,054,500**	-	**2,293,500**	-	-	-	-
	AQUACULTURE	**170,940,387**	**15,440**	**4,409,232**	**9,547,220**	**26,899,700**	**41,786,720**	**25,546,968**
GEOGRAPHIC DATA								
	Length of coastline (km)	**1,641.2**	61	76	81	103	159	112
	AREA (ha)	-						
	Mangroves	264,180	-	2,150	7,650	750	22,130	15,000
	Mudflats	3,500						
	Beach	228,848						
	Coral reefs	521,462	2,600	212,500				
	Seagrass	no data						
	Seaweeds	1,750		250				

continued

Appendix Table 9. Total Economic Value, Indonesia (US$).

Ecosystem	Economic Values	Deli/Medan	Asahan/T. Balai	Labuhan Batu	Bengkalis	Riau Islands	Batam
	TOTAL ECONOMIC VALUE	**422,597,014**	**526,975,782**	**126,347,180**	**633,288,110**	**604,795,678**	**111,384,254**
	MARKET VALUE	**339,401,619**	**257,992,445**	**51,588,506**	**138,452,358**	**261,607,987**	**79,196,872**
	NONMARKET VALUE	**83,195,395**	**268,983,336**	**74,758,674**	**494,835,753**	**343,187,692**	**32,187,382**
Mangroves	**Use and Non-use Values**	**287,636,630**	**241,044,377**	**121,115,928**	**606,111,324**	**396,772,019**	**50,567,649**
	Use values	**255,290,630**	**208,698,377**	**88,769,928**	**385,295,964**	**255,096,539**	**43,235,889**
	Direct use	***161,276,066***	***128,959,208***	***37,984,282***	***99,275,681***	***80,371,146***	***14,749,733***
	Charcoal and poles	5,160,000	5,160,000	5,160,000	35,225,600	22,600,800	1,169,600
	Fish and prawns	152,962,766	120,645,908	29,670,982	42,523,553	43,958,892	12,865,385
	Wildlife	123,300	123,300	123,300	841,728	540,054	27,948
	Tourism	2,535,000	2,535,000	2,535,000	17,305,600	11,103,300	574,600
	Traditional, non-traded use	495,000	495,000	495,000	3,379,200	2,168,100	112,200
	Indirect use	***93,789,564***	***79,514,168***	***50,560,646***	***284,484,283***	***173,739,893***	***28,435,156***
	Nursery role	43,165,169	34,045,547	8,372,972	11,999,890	12,404,934	3,630,534
	Carbon sequestration	27,150,000	27,150,000	27,150,000	185,344,000	118,917,000	6,154,000
	Protection from erosion	23,474,395	18,318,621	15,037,674	87,140,393	42,417,959	18,650,622
	Option value	***225,000***	***225,000***	***225,000***	***1,536,000***	***985,500***	***51,000***
	Biodiversity value	225,000	225,000	225,000	1,536,000	985,500	51,000
	Non-use values	**32,346,000**	**32,346,000**	**32,346,000**	**220,815,360**	**141,675,480**	**7,331,760**
	Existence value	***32,346,000***	***32,346,000***	***32,346,000***	***220,815,360***	***141,675,480***	***7,331,760***
Mudflats	**Use values**						
	Direct use						
	Indirect use						
	Option value (biodiversity)						
Beach	**Use values**	**76,071,005**	**5,713,093**	**4,689,852**	**27,176,780**	**137,551,887**	**60,816,605**
	Direct use	***76,071,005***	***5,713,093***	***4,689,852***	***27,176,780***	***137,551,887***	***60,816,605***
	Tourism	68,749,963				124,322,849	54,999,970
	Turtle eggs	7,321,042	5,713,093	4,689,852	27,176,780	13,229,038	5,816,635
Coral reefs	**Use values**	-	**276,913,992**	-	-	**56,429,523**	-
	Direct use	-	***85,970,277***	-	-	***17,519,020***	-
	Fisheries	-	51,442,295	-	-	10,482,909	-
	Tourism	-	34,527,982	-	-	7,036,111	-
	Research						
	Indirect use	-	***187,126,215***	-	-	***38,132,573***	-
	Shoreline protection	-	141,316,215	-	-	28,797,413	-
	Carbon sequestration	-	*45,810,000*	-	-	*9,335,160*	-
	Option value	-	***3,817,500***	-	-	***777,930***	-
	Biodiversity value	-	3,817,500	-	-	777,930	-

continued

continued

Appendix Table 9. Total Economic Value, Indonesia (US$).

Ecosystem	Economic Values	Deli/Medan	Asahan/T. Balai	Labuhan Batu	Bengkalis	Riau Islands	Batam
Seagrass	Use values						
Seaweeds	Use values	-	-	-	-	**14,042,250**	-
	Direct use	-	-	-	-	***13,761,000***	-
	Fisheries	-	-	-	-	13,761,000	-
	Indirect use	-	-	-	-	***270,000***	-
	Shoreline protection						
	Carbon sequestration	-	-	-	-	270,000	-
	Option value (biodiversity)	-	-	-	-	***11,250***	-
	TOTAL FISHERIES	**196,127,935**	**206,133,751**	**38,043,954**	**54,523,443**	**80,607,735**	**16,495,919**
	Mangroves	**196,127,935**	**154,691,455**	**38,043,954**	**54,523,443**	**56,363,826**	**16,495,919**
	off-site	43,165,169	34,045,547	8,372,972	11,999,890	12,404,934	3,630,534
	on-site	152,962,766	120,645,908	29,670,982	42,523,553	43,958,892	12,865,385
	Coral reefs	-	**51,442,295**	-	-	**10,482,909**	-
	Seaweeds	-	-	-	-	**13,761,000**	-
	AQUACULTURE	58,889,380	3,304,320	541,400	6.6		
GEOGRAPHIC DATA							
	Length of coastline (km)	120	94	77	446	217	96
	AREA (ha)						
	Mangroves	15,000	15,000	15,000	102,400	65,700	3,400
	Mudflats						
	Beach						
	Coral reefs		254,500			51,862	
	Seagrass						
	Seaweeds					1,500	

For information on the Regional Programme publications, please contact the:

PUBLICATIONS UNIT
GEF/UNDP/IMO Regional Programme on Partnerships in Environmental Management for the Seas of East Asia (PEMSEA)
DENR Compound, Visayas Avenue, Quezon City 1101, Philippines
Mailing Address: P.O. Box 2502, Quezon City 1165, Philippines
Telephone: (632) 926-9712, 920-2211 loc. 7
Fax: (632) 926-9712
Email: info@imo.org.ph
Website: http://www.imo.org.ph