South and South-East Asian Coastal Fisheries: Their Status and Directions for Improved Management. Conference Synopsis and Recommendations*

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Abstract

As a step to address the problems of coastal fisheries in Asia, the WorldFish Center joined forces with fisheries agencies from eight developing Asian countries (Bangladesh, India, Indonesia, Malaysia, The Philippines, Sri Lanka, Thailand and Vietnam) and the Asian Development Bank, to implement a project entitled "Sustainable Management of Coastal Fish Stocks in Asia" (also known as the "TrawlBase" project). The project was implemented between 1998 and 2001. The main achievements of this partnership were: (a) Development of a database called "Fisheries Resource Information System and Tools" (FiRST), which contains trawl research survey data and socioeconomic information for selected fisheries, and facilitates its analysis; (b) Evaluation of the extent of resource decline and over-fishing, both biological and economic, in the region; (c) Identification of the measures needed to manage coastal fisheries in the participating countries, resulting in draft strategies and action plans; and (d) Strengthening of national capacity in coastal fisheries assessment, planning and management.

The analyses show an alarming decline in coastal fishery resources throughout the

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region, with biomasses down to 5 - 30% of levels prior to the expansion of fishing. The relative abundance of the larger, more valuable fish has decreased sharply and that there has been a proportionate increase in smaller, less valuable species. The socioeconomic characteristics of the coastal fisheries, including fleet dynamics and cost efficiency has also been documented. These results provide a clear picture of the extent of stock rehabilitation and management required to restore maximum economic value to the fisheries of the region.

The project has contributed to increasing awareness of key issues and opportunities in coastal fisheries management at the national and regional levels and illustrated the benefits of collaborative efforts in addressing issues of regional concern. It has also highlighted the need and urgency for concerted action at various levels of the institutional hierarchy to successfully resolve fisheries issues. There is a need to foster regional/national collaboration and cooperation among scientists and institutions involved in assessment and management of coastal fisheries. These gains provide the base (and momentum!) for the effective follow-up actions by the countries and international agencies to sustain the benefits derived from coastal fisheries by developing Asian countries.

The directions for follow-up action towards improving the management of coastal fisheries resources presented in this paper were based on the results of a multisectoral consultation conducted in the region. The main goal of fisheries management suggested is the sustainable utilization of coastal fishery resources in South and Southeast Asia, defined with environmental, socioeconomic and institutional objectives. Eight interventions to achieve these objectives are presented. These are grouped into interventions for implementation by the national fisheries institutions in the respective countries and regional support activities. We also urge that the countries must commit to continuous, long-term capacity building and institutional strengthening.

Introduction

Globally, fisheries face the challenge of meeting increasing demand for fish[1] while the abundance of fish stocks is declining. In Asia, as in many parts of the world, capture fisheries are showing signs of being fully exploited or over-fished, with their production leveling off or declining (FAO 2000; Silvestre and Pauly 1997a; Silvestre and Pauly 1997b; Watson and Pauly 2001) . This is a critical issue as fish plays an important role in terms of food security, employment and income in Asian countries. Fish contributes 15 to 54% of the animal protein intake in Asian countries and is a particularly important protein source for poor coastal communities (see Table 1). The global demand for fish is expected to increase 0.5% annually, due to increases in population size and economic development (Delgado et al. 2002). Given this situation effective management and utilization of fish stocks is vital in ensuring long-term sustainability and maximum production from fisheries.

In 1996, the Asian Development Bank (ADB) provided a small scale technical assistance grant (TA)[2] to the WorldFish Center (formerly known as the International Center for Living Aquatic Resources Management - ICLARM), for a "Review of Sustainable Exploitation of Coastal Fish Stocks in Asia". The Center, in collaboration with participating national fisheries agencies from developing member countries (DMCs) of ADB, implemented the study from March to August 1996. This study identified key issues impacting coastal fisheries resources that were common across the region: (i) over-fishing and excessive fishing pressure; (ii) inappropriate exploitation patterns; (ii) post-harvest losses; (iv) large vs. small scale fisheries conflicts; (v) habitat degradation; (vi) a deficit of research and information; and (vii) institutional weaknesses and constraints

[1] Fish is used to refer to all aquatic products, including crustaceans, shellfish, etc.
[2] RETA No. 5651, approved on 4 December 1995 involving ICLARM and seven of the Bank's Developing Member Countries (DMCs), namely: Bangladesh, Indonesia, Malaysia, the Philippines, Sri Lanka, Thailand and Vietnam.

Table 1. Selected statistics for trophical developing countries in South and Southeast Asia.

Country	Population ($\times 10^6$)[1] (2001)	Percent under Poverty line[2]	Fisheries employment (million)	Share of fisheries in total employment (%)	Number of Fishers ($\times 10^3$)[3]	Continental Shelf (0 - 200m depth) ($\times 10^3$ km^2)	Total Fisheries Production ($\times 10^3$t·year^{-1})[4] (2000)	Marine Fisheries Production ($\times 10^3$t·year^{-1})[5] (2000)	Fishery Exports (US$ $\times 10^6$ year^{-1})[6] (2000)	Per Capita Fish Consumption (kg·year^{-1})[7] (2000)
Bangladesh	140.4	36.0	1.55 (1996 - 97)	2.84 (1996 - 97)	1 445	55	1 661	330	371.5	10.9
India	1 025.1	39.7	6.00 (1995)	–	5 959	452	5 684	2 788	1405.2	4.5
Indonesia	214.8	7.2	2.09 (1997)	2.40 (1997)	4 568	2 777	4 858	3 897	1 584.5	19.5
Malaysia	22.6	<2.0	0.08 (1997)	0.91 (1997)	101	374	1 441	1 131	349.1	57.9
Philippines	77.1	14.6	0.99 (1997)	3.55 (1997)	991	178	2 287	1 809	400.3	29.6
Sri Lanka	19.1	6.6	0.12 (1997)	2.06 (1997)	125	27	308	250	134.5	21.1
Thailand	63.6	<2.0	0.61 (1995)	1.87 (1995)	439	86	3 643	2 671	4 367.3	28.7
Vietnam	79.2	17.7	1.40 (1995)	4.03 (1995)	3 030	328	1 961	1 321	1 480.1	19.2
Total	1 641.9	–	12.84		16 658	4 277	21 843	14 197	10 092.5	23.9
World	6 134.1	–	28.50			21 426	130 400	83 663	55 197.3	

Note: [1] **FAO Stat 2001. http://apps.fao.org**
[2] **http://www.developmentgoals.org (proportion of population below $1 a day)**
[3] **APFIC 1998**
[4] **FAO 2000. FishStat + database**
[5] **FAO 2002. FAO Yearbook. Fisheries Statistics - Capture and Aquaculture 2000. Vol 90/1 and 2**
[6] **FAO 2002. FAO Yearbook. Fisheries Statistics - Commodotoes 2000, Vol 91.**
[7] **FAO 2001. Food Balance Sheet database (http://faostat.fao.org/faostat)**

(Silvestre and Pauly 1997c). Collectively these issues have impacted fishery resources, the supply and price of fish to consumers, the income of fishers and the welfare of coastal communities.

The 1996 study documented the existence of management strategies to address these issues in varying degrees among the countries in South and Southeast Asia (Silvestre and Pauly 1997a; Silvestre and Pauly 1997c). However, there were underlying concerns that these interventions (if and when they existed) lacked sufficient scope, resources and information to reverse the interrelated problems. The concern regarding the lack of information referred to ensuring that management has the necessary baselines and understanding of the resource status to develop appropriate strategies.

In the Asian region many countries have conducted resource surveys, most commonly with trawl gear, some starting in the 1920s. However, most of the available trawl surveys had not been sufficiently documented, or analyzed, for their resource management implications (Silvestre and Pauly 1997a). The 1996 study highlighted the need for documentation and retrospective analyses of these surveys to provide baselines for improved resource management. These baselines, combined with related biological and socioeconomic information, can lead to more appropriate strategies to manage and rehabilitate the stocks and sustain the benefits derived from coastal fisheries (Silvestre and Pauly 1997c).

The 1996 study acknowledged that the multiplicity of issues required action on a broad front. Success in reversing or mitigating fisheries issues will depend on institutional capabilities and resources mobilization in the countries. However, most national institutions face considerable technical, manpower and financial constraints. The consensus achieved in 1996 was that there was a need to catalytically assist the countries in the region in identifying, prioritizing and implementing the interventions to address the issues. The 1996 study identified key elements for an expanded regional collaboration. This led to the implementation of the project "Sustainable Management of Coastal Fish Stocks in Asia" or the "TrawlBase" project as it has been referred to in the region. The TrawlBase project was implemented with support from the WorldFish Center, ADB and the eight partner countries, Bangladesh, India, Indonesia, Malaysia, the Philippines, Sri Lanka, Thailand and Vietnam (Fig. 1).

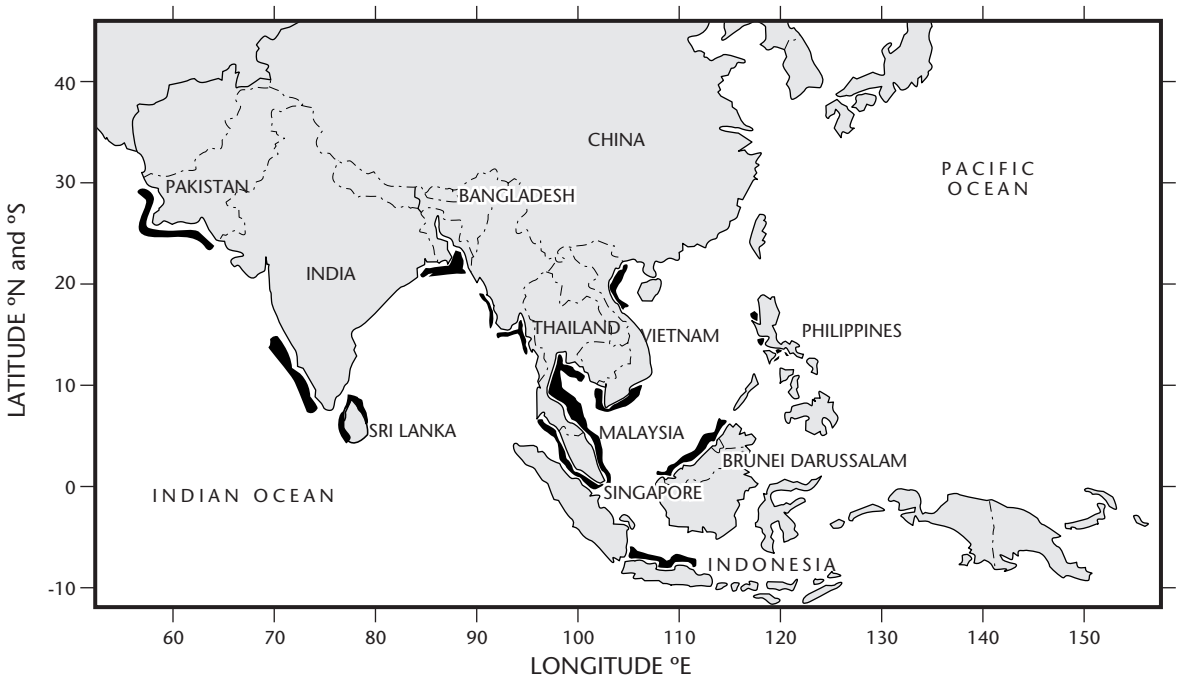

Fig. 1. Geographical coverage of trawl survey data in FiRST (Ver. 2001).

As part of the TrawlBase project's culminating activities, a workshop entitled "International Workshop on Management of Tropical Coastal Fisheries in Asia" was organized during 20 - 23 March 2001 in Penang, Malaysia. The workshop aimed to:

1. review the results of project activities (i.e. database establishment, resource and socioeconomics analyses, and management planning);

2. examine the key issues and opportunities at the national and regional levels for improved management of coastal fisheries in developing Asian countries;

3. discuss strategies and programs of action (both planned and ongoing) of national/international agencies towards improved management of coastal fisheries in the region; and

4. explore follow-up action and support activities for regional collaboration to enhance national efforts in the area of coastal fisheries management.

The technical contributions in this volume were presented at this workshop.

In this synopsis, we present a brief sectoral background of the coastal fisheries in the South and Southeast Asian region and description of the "TrawlBase" project to provide the context. The paper then summarizes the key scientific outputs of the collaborative project, the details of which are provided in the technical contributions. We emphasize the utility of developing a fisheries resource information system and retrospective analysis of the compiled data. The analyses provide a better understanding of the resource condition and a solid basis for management. The host of fisheries management issues identified by the country level contributions in this volume is then summarized to provide a regional perspective.

We then present a strategy to assist the eight countries in addressing the issues identified. The strategy was formulated with substantial inputs from various stakeholders including scientists and resource managers from the eight countries as well as participants of the final project workshop. The primary goal of the strategy is to continue our progress towards sustainable utilization of coastal fishery resources. The focus is on the implementation of the interventions identified. Its specific objectives include: (1) protecting fishery resources and the environment that sustains them; (2) maximizing economic benefits from the utilization of resources; (3) minimizing poverty among artisanal fishers; (4) minimizing resource use conflicts; (5) strengthening national institutional capabilities and linkages; and (6) increasing regional cooperation and collaboration.

Sectoral Background

The study focused on coastal fisheries, from the shoreline to 200 m depth, which exploit the continental shelves, the most productive part of the ocean (Longhurst and Pauly 1987). The eight participating countries have a combined population of about 1.6 billion people, approximately one quarter of the global population (Table 1). The proportion of the population below the official poverty line in these countries is high, varying between 2% in Malaysia and 36% in Bangladesh (Table 1). Poverty in rural areas is more severe than the national average, ranging from 18% of the rural population in Malaysia to 51% in the Philippines.

The fisheries sector is important to these countries in terms of employment, revenue and food security. Fisheries provide a livelihood to about 12 million fishers and their families and export revenues of about US$10 billion annually (Table 1). The sector generates food totaling 16.1 million t of fish$\cdot$year^{-1} in these countries. Fish is an important part of the diet with per capita fish consumption averaging 24 kg$\cdot$year^{-1}, while the worldwide average is around 15 kg$\cdot$year^{-1}. In coastal communities, fish makes up as much as 70% of the animal protein intake. Coastal fisheries are particularly important in rural, coastal areas where the sector contributes substantially to food security and social stability of the poorest segment of the population.

The geographic extent of marine resources varies among the countries. Indonesia has the largest Exclusive Economic Zone (EEZ), while Bangladesh has the smallest (Table 1). The area of EEZ per person, which provides a rough indicator of the amount of marine resources available per capita, is highest in Malaysia and lowest in Bangladesh. The proportion of the EEZ covered by the continental shelf varies from 5 to 72% among the countries. As the continental shelves are the most productive part of the ocean (Longhurst and Pauly 1987), their extent may influence fish production (Chua and Garces 1994).

In 2000 the eight DMCs contributed nearly 22 million t to global fish production (Table 1). Trends in total fish production (Fig. 2) show that the eight countries fall into three groups: high-producing countries, India, Indonesia and Thailand, producing more than 3.5 million t, moderate-producing countries Bangladesh, Malaysia, the Philippines and Vietnam, with production of 1 - 2 million t, and Sri Lanka, which is a nominal fish producer.

Marine fisheries are the most significant to total fish production in these countries contributing 60 to 97% (Table 1) and amounting to 16.1 million t in 2000. In most countries 60 to 85% of the marine production comes from the coastal fisheries, of which demersal species dominate (Abu Talib and Alias 1997; Barut et al. 1997; Eiamsa-ard and Amornchairojkul 1997). Thus, production trends in demersal fish production may be used to infer general trends in the exploitation of coastal fishery resources.

The trends in demersal fish production (Fig. 3) show some differences to the total fish production (Fig. 2). India is clearly the leader in demersal production. From the mid-seventies to the present, India's demersal production has been higher than its nearest rivals by 100 000 t to as much as 400 000 t. A sharp increase in demersal fish production during the early seventies and another sharp increase from the mid-eighties to the early nineties placed India way ahead of the others. Except for a leveling off in production during the nineties, the trend of India's demersal fisheries production largely reflects its total fish production. The Philippines demersal fish production figures were the second highest from the fifties until the end of the eighties, after which Indonesia's production overtook the Philippines production. Demersal production in the Philippines was highly variable from the fifties till the mid-seventies, after which it stayed from 260 000 t to 350 000 t. The relatively constant annual demersal production, since the mid-seventies, contrasts with the steadily increasing total fisheries production during the same period. This suggests that other sources such as aquaculture were responsible for increasing the total production in the Philippines.

Indonesia's demersal production increased gradually from the fifties till the mid-seventies, followed by larger, but still steady, annual increases till the present, mirrored in the increase in total produc-

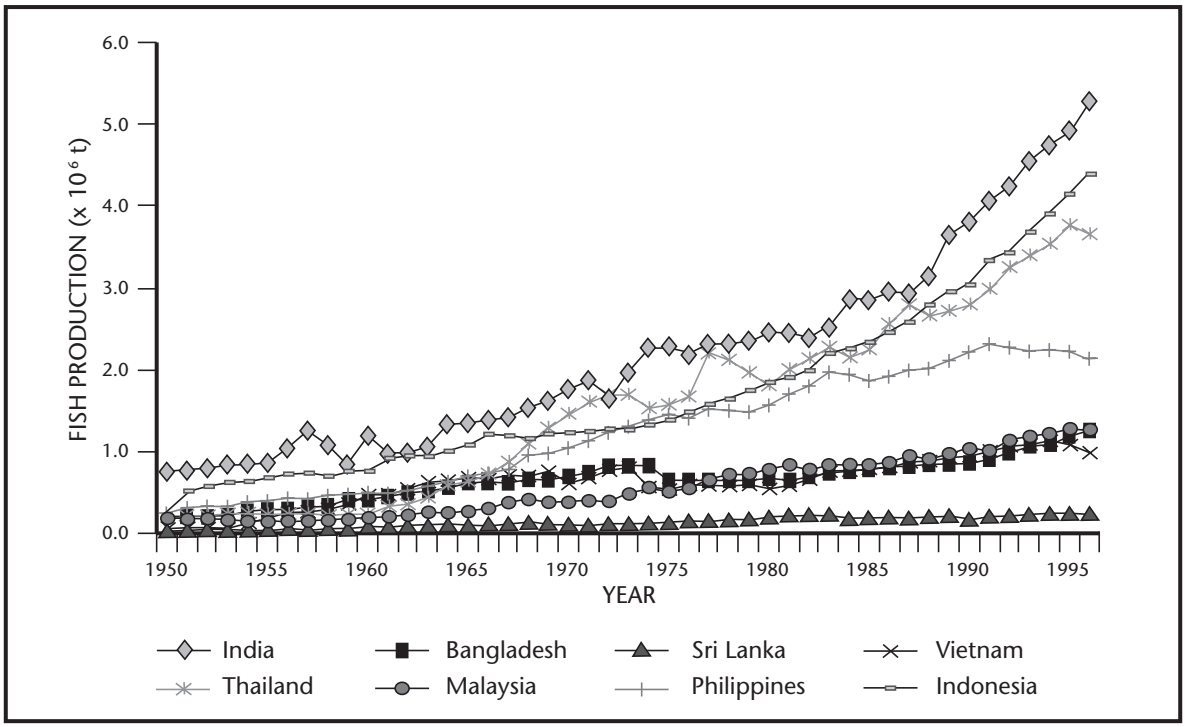

Fig. 2. Trends in fish production in the eight countries, 1950 - 96. Source: FAO 1998.

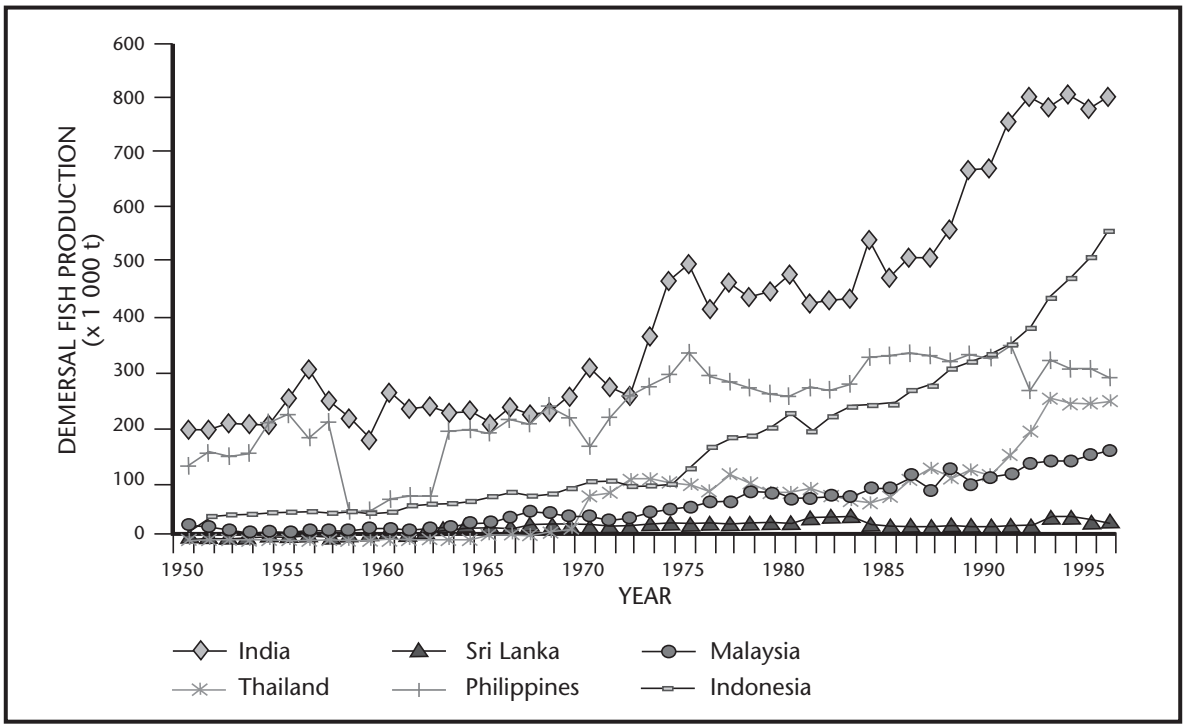

Fig. 3. Trends in demersal fish production in six countries, 1950 - 96. Source: FAO 1998.

tion. Thailand's demersal production is characterized by two periods of sharp increase alternating between years of relatively constant production. The first sharp increase occurred in 1970 while the other happened from 1990 to 1993. This differs markedly from the trend in total production, which displays an accelerated increase, suggesting that increases in total fish production were coming from sources other than demersals. In the case of Malaysia the steady increase in demersals mirrors the trend in overall production. Likewise, Sri Lanka's demersal production remained relatively constant, similar to its total fisheries production.

Capture fisheries in the region are conventionally classified into and managed as artisanal (small scale) and commercial (industrial) sectors. In most of the countries, the small scale fisheries contribute significantly to the fisheries catches as well as accounting for the majority of the gear types in terms of numbers. The catch of the coastal fisheries is generally a highly diverse multispecies one. Approximately 150 fish families occur in the demersal catch from the continental shelf in tropical Asia (Longhurst and Pauly 1987). A wide range of gear is used to exploit the multispecies resource (Silvestre and Pauly 1997a). The gear varies from the relatively simple types such as hand-lines and gillnets using no watercraft or dug-out boats to large trawls and purse seines using boats with powerful inboard engines equipped with Global Positioning Systems (GPS) and sonar. In most fishing grounds in the region, the areas of deployment of the different gear types overlap. For example, demersal trawlers operating close inshore not only compete for the same resources as the small scale fishers, but also often destroy their passive gear (Pauly 1996a). Variations in technological and biological interactions of the coastal fisheries also make assessment and management difficult (Murawski et al. 1991; Pauly and Murphy 1982).

The Sustainable Management of Coastal Fish Stocks Project

Objectives and Scope

The primary objective of the project ("Sustainable Management of Coastal Fish Stocks in Asia" - RETA No. 5766) was to provide partner countries (Bangladesh, India, Indonesia, Malaysia, the Philippines,

Sri Lanka, Thailand and Vietnam) with improved tools and strategies to advance management and sustainable utilization of their coastal fisheries resources and related ecological systems. Specifically, the study aimed to:

i. develop a fisheries resource information system that relates environmental and socioeconomic factors to resource management needs of partner countries;
ii. develop appropriate strategies and action plans to assist partner countries in managing and rehabilitating their coastal fish stocks; and
iii. strengthen the capabilities of partner country institutions in coastal fisheries assessment and management.

Project Components

The project involved collaborative work among multidisciplinary teams from the partner countries and the WorldFish Center, as well as close interactions with managers and policy-makers at the national level, and staff of various regional and international organizations. The project included the following main activities:

a. Fisheries Resource Information System[3]
   i. Development of resource databases within the participating countries (based on trawl research surveys) and their consolidation into a single regional database management system.
   ii. Review and analysis of the compiled data and related information to examine the biological and socioeconomic status of the fisheries resources.

b. Strategies and action plans
   i. Strategic review of the fisheries management situation and programs at the national and regional levels, including resources management trends and opportunities.
   ii. Development of national and regional strategies and action plans.

c. Capacity building
   i. Training at the national level in the use of databases and analytical software tools.
   ii. Training programs in the fields of stock assessment, assemblage and ecological analyses, socioeconomic analyses, and coastal resource management/policy analysis and planning.
   iii. National workshops for data consolidation/generation and consultative planning.
   iv. Regional workshops to consolidate data analysis results and to discuss regional trends, strategies and action programs.

In pursuit of the project objectives, the WorldFish Center organized four working groups (research components), namely: (1) Fisheries resource information system development; (2) Resource assessment (stock assessment, assemblage and ecosystem analyses); (3) Socioeconomics analysis and bioeconomic modeling; and (4) Fisheries management (policy/planning) (Fig. 4). The eight participating countries organized similar national research teams, each with a national team leader. The technical reports presented in this publication are grouped to reflect their contribution to the relevant component.

The WorldFish Center as the Executing Agency was responsible for implementing the project in collaboration with national fisheries agencies in the eight participating countries executing country-specific tasks/activities. The total cost of the project over its three-year implementation period was estimated at US$2.86 million. The Bank approved US$1.4 million (49% of the total cost) to cover part of the cost of services, travel, training, workshops, administrative support and operating expenses. About US$1 million was provided by the WorldFish Center, and the balance of US$460 000 came from the collaborating agencies of participating countries. Full details of the project are described in *http://www.worldfishcenter.org/trawl*.

Key Scientific Outputs

Fisheries Resource Information System and Tools

In South and Southeast Asia, at least 301 trawl surveys covering about 40 000 trawl stations have been carried out since the 1920s (Silvestre and Pauly 1997a). As detailed previously, in 1996 South and Southeast Asia countries agreed on the importance of compiling and analyzing past trawl surveys. A prototype database system and analyti-

[3] A system to organize, store, retrieve and exchange historical and contemporary trawl survey data. The system includes relevant socioeconomic and environmental information, and is linked with complementary analysis, statistical and other database systems to allow comprehensive analyses.

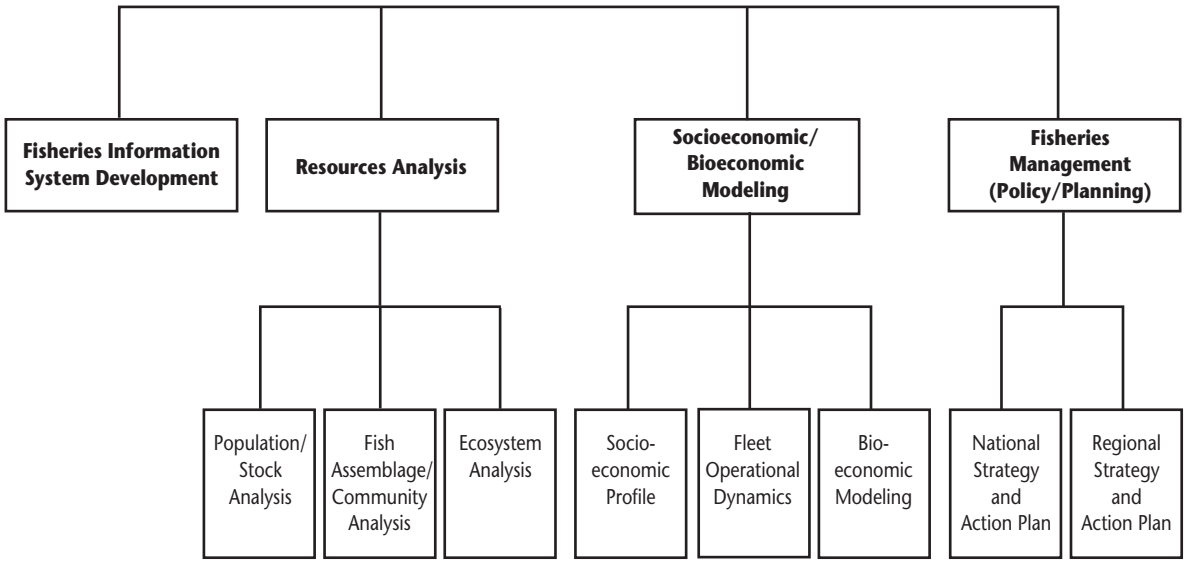

Fig. 4. Multidisciplinary design of the project showing how the four working groups are interrelated.

cal tool for this purpose was evaluated in a workshop in 1996 (Gayanilo et al. 1997). This provided the basis for the Fisheries Resource Information System and Tools (FiRST).

FiRST was developed as a data container of trawl research surveys with the focus on facilitating key analyses to assist management decisions (Gayanilo et al. 2001; Garces and Silvestre this vol.) In order to provide a management focus, the database system includes generic socioeconomic data, as well as catch and effort statistics. Basic analytical routines, such as models to approximate biomasses, have been made an integral part of FiRST. The system also facilitates analyses using external software by data extraction routines.

The FiRST software has been distributed to the participating countries, which have each established national databases. The database system is now becoming an important facility for storing trawl survey information and provided the basis for the analyses documented in these proceedings. The data access protocol agreed upon by the participating countries was that permission must be secured from the particular country for access to country-specific data.

Collectively, the regional database system contains about 20 620 hauls/stations (Table 2) from eight participating DMCs, and published trawl data from Singapore and Myanmar. Fig. 1 gives the geographical distribution of these data. In addition to the trawl survey data, the database includes socioeconomic and related information from the eight participating DMCs. Efforts have been made by all participating countries to encode more trawl survey data for inclusion in FiRST beyond the project's lifespan. Around 19 000 hauls/stations remain for validation/uploading by the countries. Efforts to expand the geographic coverage of the database system as well as to facilitate national data repatriation from international research institutions to the countries will be a priority of the WorldFish Center and the participating countries in the follow-up phase of the project.

Resource Assessment

The historical data available, from the 1920s to the 1990s, provide a basis for retrospective analyses (Table 3) that can assist in clarifying resource status. These analyses can also assist in determining achievable goals for restoration and management of coastal ecosystems that could not be contemplated based on the limited perspective of recent observations alone (Jackson et al. 2001).

The resource analyses undertaken aimed to elaborate the biological status of the coastal fishery resources and establish resource baselines for stock rehabilitation. To achieve this, a review and analysis (at the stock, assemblage and ecosystem level) of each national fisheries resource situation was conducted. Analyses at the stock level focused on biomass decline and exploitation levels of the dominant fish species (Khan et al.; Abu Talib et al. and Kongprom et al. this vol.). Analyses of fish assemblages focused on determining assemblage boundaries, the environmental gradients influencing these, and the implications pertaining to delineation of fishing zones (Mustafa; Pillai et al.; Nurhakim; Alias; Campos and Kongchai et al. this vol.). The ecosystem modeling aimed to develop ecosystem/trophic models for selected areas fisheries (Mustafa; Pillai et al.; Nurhakim; Alias; Garces et al.; Campos and Vibunpant et al. this vol.).

Table 2. The trawl surveys contained in the database system (FiRST ver. 2001) for each country.

Country	No. of Cruises	No. of Stations	Years
Malaysia	177	4 418	1926 - 93
Philippines	125	838	1947 - 95
Thailand	106	5 890	1968 - 95
Singapore	42	925	1969 - 73
Indonesia	2	1 376	1974 - 79
Myanmar	4	375	1979 - 80
Bangladesh	55	1 450	1980 - 88
India	12	613	1994 - 95
Sri Lanka	16	618	1920 - 80
Vietnam	84	4 021	1979 - 88
Pakistan	5	96	1976
TOTAL		20 620	

Overall, the resource analyses illustrate substantive degradation and over-fishing of coastal fish stocks. The stock analyses indicate that catch rates and hence resource biomass have declined to 4 - 44% of original ("baseline") biomass levels in the fishery areas (Table 4) studied. Fig. 5 illustrates the evident decline in biomass in the case of Manila Bay and the Gulf of Thailand up to the early 1980s. In Manila Bay, biomass in 1981 was down to about 31% of prior levels, due to the massive expansion of fishing effort in the late 1940s (Barut et al. this vol.). In the Gulf of Thailand, resource biomass in 1983 was down to 14% of the level in the early 1960s (Kongprom et al. this vol.). Later reference points (mid - 1990s) indicate that biomass in Manila Bay and the Gulf of Thailand had further deteriorated to 8 - 12% of original unexploited biomass levels (Pura et al. 1994; Kongprom et al. this vol.).

Table 3. The geographic and temporal scope of the resource analyses.

Country	Survey Area	Survey Period	Reference
Bangladesh	Inner Bay of Bengal (up to 100 m depth)	1984 - 86	Khan et al. (this vol.)
India	Southwest coast of India	1994 - 96	*
Indonesia	North coast of Central Java (NCCJ)	1979	*
Malaysia	West coast peninsular Malaysia (WCPM) East coast peninsular Malaysia (ECPM) Sabah and Sarawak (SS)	1972, 1981, 1987, 1991 and 1997	Abu Talib et al. (this vol.)
Philippines	San Pedro Bay Samar Sea Manila Bay	1994 - 95 1979 - 80 1992 - 93	Barut et al. (this vol.)
Sri Lanka	Southwest coast of Sri Lanka	1978 - 80	*
Thailand	Gulf of Thailand	1973 - 95	Kongprom et al. (this vol.)
Vietnam	Southwest coast of Vietnam	1993 - 95	*

Note: * Technical reports to the project.

Table 4. The estimates of demersal biomass trends from the resource assessments based on the trawl surveys documented by the TrawlBase project and also from previous studies in the region.

Country/Area	Year	Stock density ($t \cdot km^{-2}$)	Relative density (%)	Source
BRUNEI DARUSSALAM				
(waters within 0 - 50 m)	1979 - 80	12.8	100.0	Beales et al. (1982)
	1989 - 90	11.7	91.0	Silvestre et al. (1991)
BANGLADESH				
Bay of Bengal	1973	12.3	100.0	Khan et al. (this vol.)
	1985 - 86	5.47	44.0	
INDIA				
Goa	1973 - 74	161*	100.0	Joseph (1980)
	1979 - 80	95*	59.0	
Mangalore	1973 - 74	141*	100.0	Joseph (1980)
	1979 - 80	94*	66.7	
Cochin	1972 - 73	217*	100.0	Joseph (1980)
	1979 - 80	126*	58.1	
Madras	1972 - 73	127*	100.0	Joseph (1980)
	1979 - 80	82*	64.6	
INDONESIA				
Java Sea	1977	3.72	100.0	Dwiponggo and Badrudin (1978)
	1998	2.20	59.1	Aziz et al. (1998)
PHILIPPINES				
Various areas	1947 - 49	7.88	100.0	Barut et al. (this vol.)
	1993 - 95	1.39	17.6	
San Miguel Bay	1947	10.60	100.0	Warfel and Manacop (1950)
	1980 - 81	2.13	20.1	Vakily (1982)
	1992 - 93	1.96	18.5	Cinco et al. (1995)
Lingayen Gulf	1949	92.1*	100.0	Ochavillo et al. (1989)
	1979	63.7*	69.2	
	1987 - 88	31.8*	34.5	
Manila Bay	1949 - 52	4.61	100.0	Warfel and Manacop (1950)
	1992 - 93	0.47	10.2	MADECOR [Mandala Agricultural Development Corporation] and National Museum (1995)
MALAYSIA				
West Coast	1971/72	2.44	100.0	Abu Talib et al. (this vol.)
	1987	1.59	65.2	
	1997	0.36	15.6	
East Coast	1972	5.09	100.0	Abu Talib et al. (this vol.)
	1986	1.93	37.9	
	1998	0.20	3.9	
Sarawak	1972	3.90	100.0	Abu Talib et al. (this vol.)
	1986	1.17	30.0	
	1998	1.11	28.5	
Sabah	1972	12.52	100.0	Abu Talib et al. (this vol.)
	1986	1.52	12.1	
	1998	0.87	6.9	
THAILAND				
Gulf of Thailand	1961	6.70	100.0	Kongprom et al. (this vol.)
	1991	0.55	14.2	

Note: * - in catch rate ($kg \cdot hr^{-1}$).

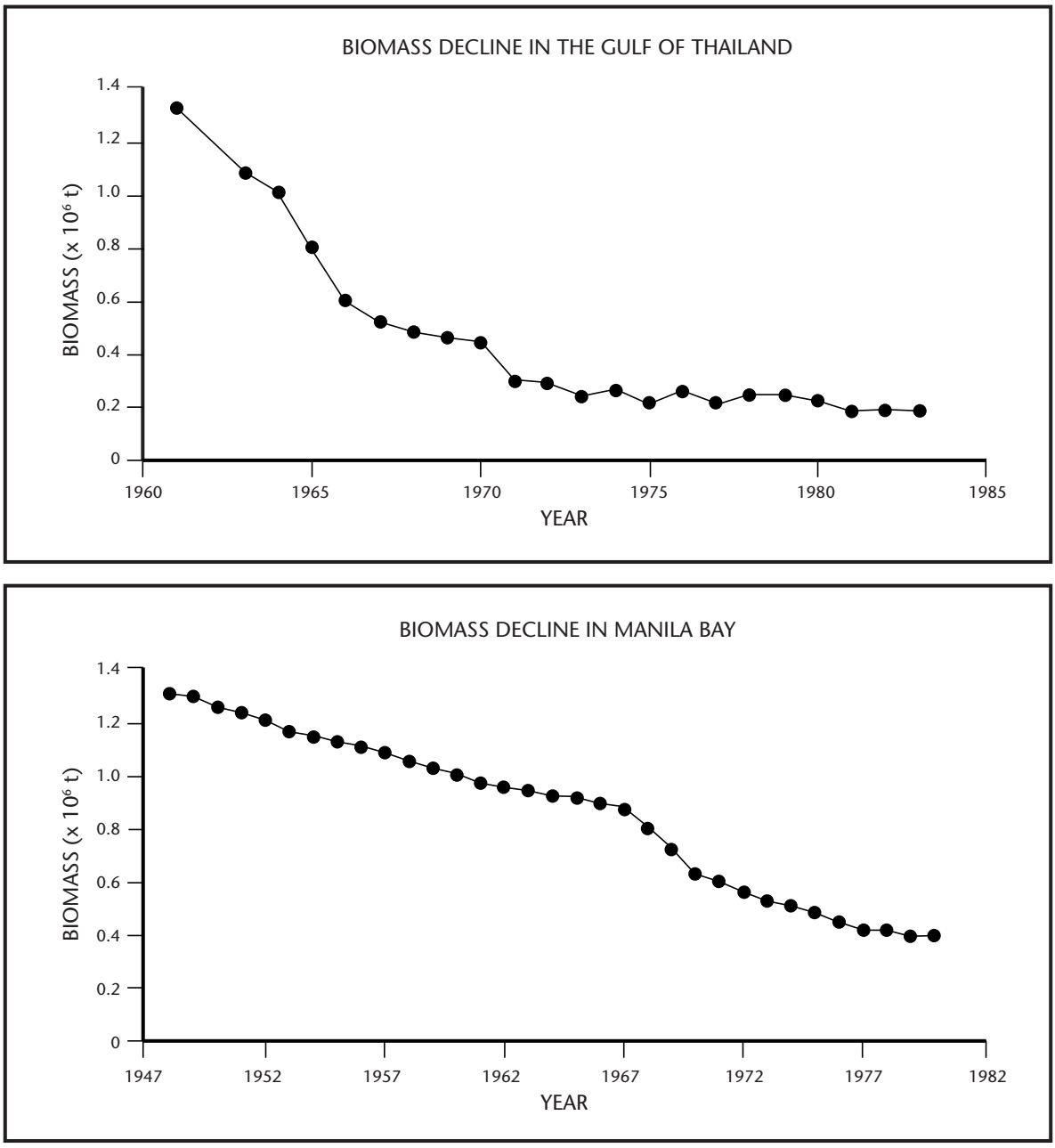

Fig. 5. Illustrative examples of biomass trends in the Gulf of Thailand and Manila Bay, Philippines.

The trends seen in catch per unit of effort (CPUE) from demersal fisheries confirm this decline. The Gulf of Thailand provides a clear example of the regional trends (Fig. 6). While the demersal fish production has increased over time, the CPUE decreases dramatically. The decrease in commercial CPUE has not been as dramatic as that seen in the research surveys. This difference is likely to be due to a range of factors, including the behavior of fishers (e.g. targeting areas of high catch rates) and

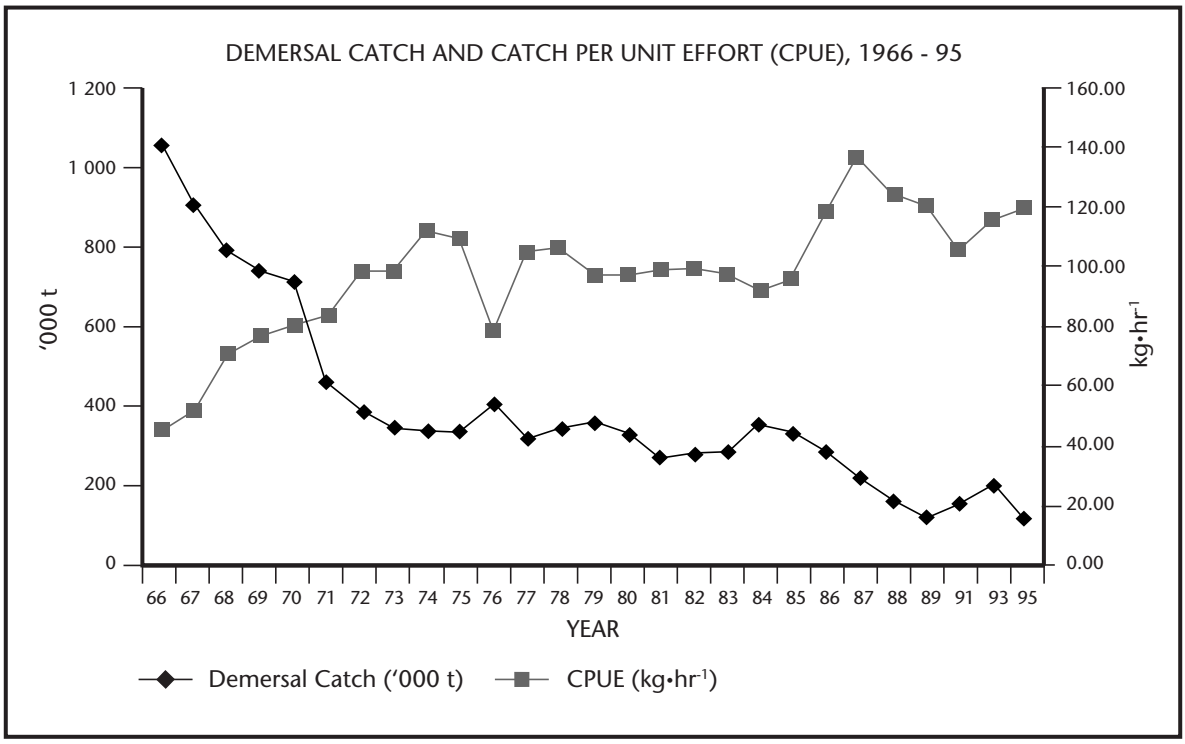

Fig. 6. Trends of catch per unit effort for the fishery exploiting demersal fish in the Gulf of Thailand from 1966 to 1995.

the inability to standardize effort to account for all increases in efficiency (e.g. gear/boat development and use of GPS). This difference highlights the need to have independent resource surveys to assess the status of the resources, and to assist in counteracting the biases seen in commercial fishing data.

The exploitation ratios (E) for species/stocks were calculated and validate the results of the stock analyses. The E values, derived independently from length-based single species assessments, represent the proportion of the fish population that die due to fishing as opposed to total mortality (Beverton and Holt 1966; Pauly 1984b). The distribution of the E values of the species (427 stocks) from South and Southeast Asian regions (Fig. 7) and the overall mean E (~ 0.59) confirm the extent of over-fishing to which the stocks are subjected to. Population analysis models indicate the optimum E range to be 0.30 - 0.50 to maximize biological yield (Gulland 1988; Pauly 1984b). Most of the species exploited in the region show E values above the optimum range. Figure 8 presents the E distribution for 25 species of trawl-caught fish in Brunei Darussalam, a country with limited fishing pressure (Silvestre and Matdanan 1992) Silvestre & Garces in press), compared with E estimates from similar species (119 stocks) in the countries involved in the project. The stocks in Brunei have lower E values, most likely associated with the lower effort. The massive biomass declines and high E values indicate substantive degradation and biological over-fishing of the coastal fish stocks.

The massive declines in resource biomass have led to substantive changes in species composition of the coastal fishery resources. Table 5 illustrates this in the case of the Gulf of Thailand and the Lingayen Gulf in the Philippines. Surveys conducted from the late 1940s to the late 1980s indicate that larger, more valuable species (e.g. groupers, snappers, sharks and rays) high up in the food chain have declined in relative abundance. Comparatively, small species and generalists (e.g. triggerfish, cardinal fish, squids/octopus) lower in the food chain have increased in relative abundance.

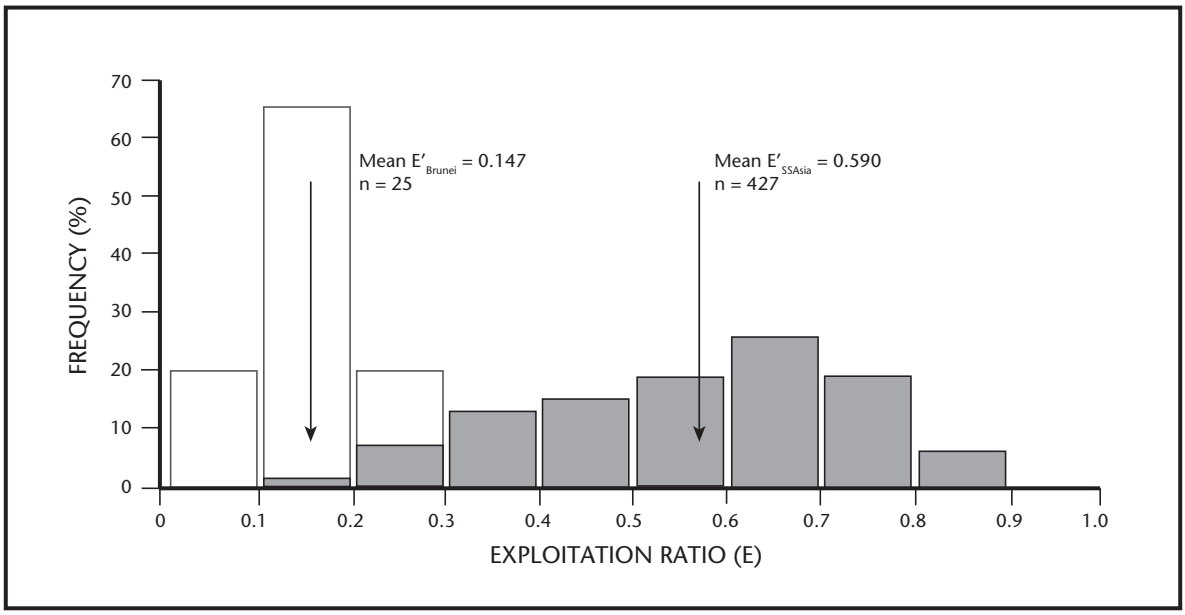

Fig. 7. Distribution of E values for 25 trawl-caught fish in Brunei Darussalam compared with E estimates from the South and Southeast Asian region (grey bars) for similiar species (427 stocks). (Adapted from Silvestre and Garces, in press).

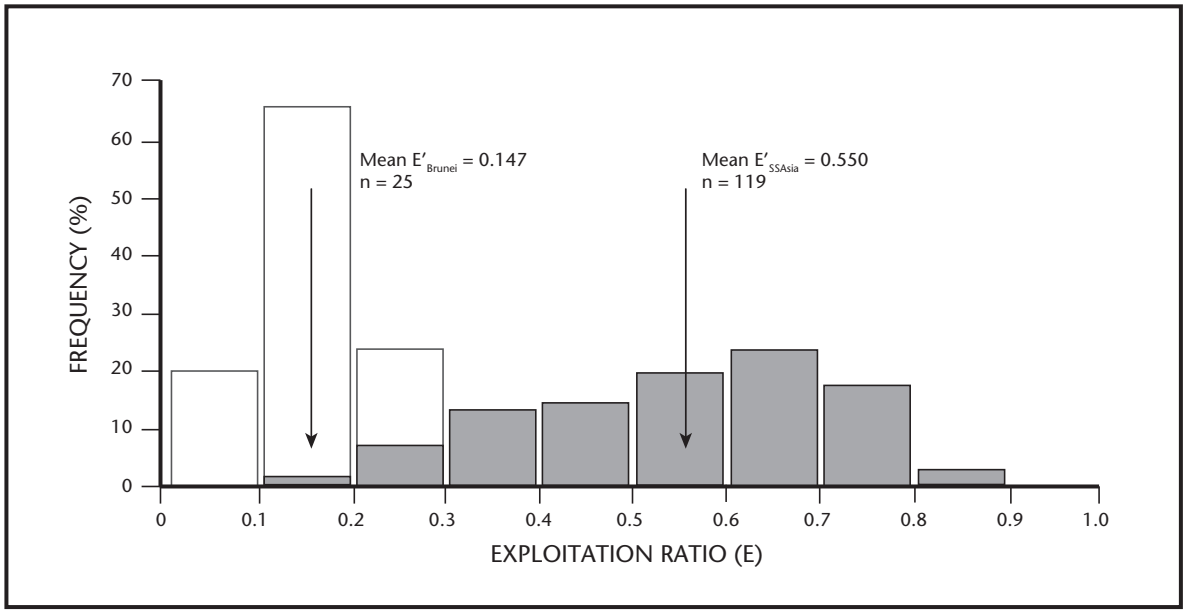

Fig. 8. Distribution of E values for 25 trawl-caught fish in Brunei Darussalam compared with E estimates from the South and Southeast Asian region (grey bars) for similiar species (119 stocks). (Adapted from Silvestre and Garces, in press).

Table 5a. Relative abundance of 10 leading species/taxa during research survey trawls in the Gulf of Thailand.

	1966		1976		1986		1995
Species	**(%)**	**Species**	**(%)**	**Species**	**(%)**	**Species**	**(%)**
Dasyatidae (Rays)	8.15	*Loligo duvauceli*	10.60	*Loligo duvauceli*	10.06	*Leiognathus splendens*	13.06
Nemipterus hexodon	7.39	*Nemipterus hexodon*	5.84	*Priacanthus tayenus*	8.61	*Loligo duvauceli*	9.04
Mullidae	4.97	*Loligo chinensis*	3.83	*Saurida undosquamis*	4.14	*Sphyraena obtusata*	6.96
Nemipterus mesoprion	4.67	*Priacanthus tayenus*	3.80	*Loligo chinensis*	3.59	*Secutor spp.*	5.30
Loligo duvauceli	4.39	*Nemipterus mesoprion*	3.69	*Nemipterus hexodon*	3.48	*Scolopsis taeniopterus*	5.19
Tachysuridae	2.84	*Trichiuridae Lepturus*	3.31	*Priacanthus macracanthus*	2.99	*Saurida undosquamis*	3.96
Priacanthus tayenus	2.54	*Saurida undosquamis*	2.82	*Nemipterus mesoprion*	2.19	Mullidae	3.80
Saurida undosquamis	2.44	Mullidae	2.74	*Scolopsis taeniopterus*	2.05	Siganidae	3.05
Lutjanus lineolatus	1.84	*Loligo sumstrensis*	2.00	Mullidae	1.96	*Loligo chinensis*	3.00
Atule mate	1.73	Gerreidae	1.98	*Loligo sumstrensis*	1.88	*Leiognathus bindus*	2.68

Table 5b. Relative abundance of important families/groups in the Lingayen Gulf, Philippines, 1940s and 1980s.

1940s*		1980s**	
Family/Group	**Relative Abundance (%)**	**Family/Group**	**Relative Abundance (%)**
Leiognathidae	63.0	Leiognathidae	31.4
Synodontidae	7.4	Carangidae	12.9
Pomadasyidae	6.7	Trichiuridae	9.3
Nemipteridae	6.6	Scombridae	6.9
Lutjanidae	3.1	Synodontidae	6.1
Psettooidae	2.5	Mullidae	3.6
Dasyatidae	1.9	Cephalopods	3.5
Lactariidae	1.8	Nemipteridae	3.4
Carangidae	1.4	Engraulidae	2.6
Serranidae	0.9	Apogonidae	2.4
TOTAL	95.3	TOTAL	82.1
Catch rate ($kg \cdot hr^{-1}$)	92.1	Catch rate ($kg \cdot hr^{-1}$)	31.8

Source: Ochavillo et al. 1989.

Table 6. Summary of the major fish assemblages with boundaries observed from community structure analysis.

Tropical Coastal Areas in Asia	Major assemblages			Notes	Source
Indonesia – North coast of Java	Shallow < 20 m	Deep > 20 - 30 m		Spatial analysis based on depth	Nurhakin (this vol.)
Gulf of Thailand	Shallow < 30 m	Deep > 30 m		Spatial analysis based on depth	Khongchai et al. (this vol.)
Philippines – San Pedro Bay	Shallow < 15 - 20 m	Deep > 15 - 20 m		Spatial analysis based on depth	Campos (this vol.)
Philippines – Samar Sea	Shallow < 30 - 40 m	Intermediate 40 - 50 m	Deep > 50 - 60 m	Spatial analysis based on depth	Campos (this vol.)
Malaysia	Shallow/Coastal < 40 m	Intermediate 40 - 90 m	Deep/Offshore > 90 m	Spatial analysis based on depth	Alias (this vol.)
Bangladesh (Bay of Bengal)	Shallow < 90 m	Deep > 90 m		Spatial analysis based on depth	Mustafa (this vol.)
Philippines – Manila Bay	Inner bay	Outer bay		Spatial analysis based on depth	Campos (this vol.)
India – Southwest Coast	Pre-monsoon	Post-monsoon		Temporal analysis	Srinath et al. (this vol.)
India – Southwest Coast	Cochin – Mangalore	Konkan – Goa-Allepey	Wadge bank - Quilon	Based on geographic coverage	Srinath et al. (this vol.)

The assemblage structure analyses undertaken (Table 6) indicate demersal assemblages with boundaries mainly influenced by depth. This is largely consistent with data from the limited number of assemblage/community structure studies conducted previously in the region (Table 7). Fig. 9 gives an illustrative example of results of assemblage analysis work in Malaysia, with the assemblage boundaries evident at around 40 m, 40 - 90 m and > 90 m depth. The assemblage boundaries are comparable with the results of similar analysis in Brunei Darussalam (Fig. 10). The assemblage patterns are associated with a variety of environmental factors. However, it appears that depth, salinity and bottom type are the main structuring factors in the analyses (Mustafa; Pillai et al.; Nurhakim; Alias; Campos; and Kongchai et al. this vol.). Temporal stability of the assemblages requires further in-depth investigation; although it appears from current analyses that the deeper boundaries (40 - 60 m, 80 - 110 m and 180 - 200 m depth) are temporally stable, and the shallower ones (10 - 30 m depth) are seasonally influenced (Campos this vol.).

The critical implication of this spatial structure for fisheries management is the relationship to fisheries management zones (Table 8). The spatial fisheries management measures in the region (e.g. 15 km boundary in the Philippines and fishing zones in Malaysia) are largely inconsistent with the resource assemblage patterns observed (Table 9, see also Alias this vol.). The fisheries management zonation patterns have been determined, primarily, on historical patterns of use and are often aimed to reduce conflicts between gear types or fisheries of different scales (e.g. large scale commercial fisheries *versus* small scale artisanal). The delineation of management zones should also take into account the spatial patterns in resources in order to manage the overall impact from different fishery sectors.

Table 7. Summary of the major assemblages observed from previous community structure studies in tropical Asia.

Region	Major assemblages				Source	Method Used
Pakistan shelf	Shallow shelf zone (coastal stations, relatively stable temperature and oxygen values)	Deeper shelf zone (from about 50 - 80 m, where the environmental conditions change dramatically on a seasonal basis)	Slope zone (average depth 213 m for the September 1983 survey)		Bianchi (1992)	TWINSPAN DCA
Northwest coast of Sumatra	Shallow community (40 m and below)	Deeper community (> 40 m)	Slope stations (average depth 298 m)		Bianchi (1996)	TWINSPAN DCA
Java Sea (including part of southern South China Sea)	Shallow coastal areas (due to the presence of estuaries)	Central and deepest part of the basin (> 30 m depth)			Bianchi et al. (1996)	TWINSPAN DCA
Eastern Gulf of Thailand	< 10 m	10 - 20 m	20 - 30 m	Beyond 30 to 60 m	Chittima and Wannakiat (1992)	Similarity Index (Cπ)
Ragay Gulf, Burias Pass, Ticao Pass, north of Samar Sea	Shallow sub - areas	Shallow – coralline sub-areas (hard bottom with rocks or other structures and the presence of sponge communities and coral patches)	Deep sub-areas (> 100 m)		Federizon (1992)	UPGMA TWINSPAN NMDS CA
Sunda continental shelf (off Vietnam, South China Sea)	Winter	Spring	Summer		Kihara and Itosu (1989)	Affinity Index (I)
Indian Ocean coast of Bali to mid-Sumatra	Shallow (< 100 m)	Deep (> 100 m)			McManus (1996)	TWINSPAN DCA
Southwest shelf of Indonesia	Shallow (non-Java)	Shallow (Java)	Deep (non-Sumbawa) 100 - 120 m	Deep (Sumbawa) 100 - 120 m	McManus (1989)	TWINSPAN
Samar Sea, Philippines	Shallow sub-community (< 40 m)	Deep sub-community (> 40 m)			McManus (1986)	TWINSPAN DCA
Northern continental shelf of South China Sea	West of the Taiwan Bank	40 m	40 - 100 m	100 - 200 m	Continental shelf edge	Qui (1990)	Bray-Curtis Measure of Similarity
Gulf of Thailand (southwestern part of South China Sea)	1975 - 83	1970 - 74	1963		Suvapepun (1991)	Spearman's Rank Correlation of Principle Species Groups

Table 8. Spatial delineation of fisheries management zones in Asia based on existing legislation.

Countries	Fishing Zone I	Fishing Zone II	Fishing Zone III	Fishing Zone IV	Legislation	Reference
Bangladesh	Shore to 18.5 m depth • Traditional/artisanal	18.5 to 40 m depth • Industrial/commercial			Marine Fisheries Ordinance, 1983: • Bangladesh fisheries water • Rule 13, Area of fishing	Management of Fisheries, Coastal Resources and Coastal Environment in Bangladesh: Institutional, Legal and Policy Perspectives (unpublished)
Brunei - Darussalam	Shore to 3 nm • Small scale/artisanal	3 to 20 nm • Industrial: trawlers < 350 HP engine and purse seiners < 20 m LOA*	20 to 45 nm • Industrial: trawlers with 350 - 550 HP engine and purse seiners with 20 - 30 m LOA	45 nm to EEZ limit • Industrial: purse seiners > 30 m LOA		SEAFDEC (1999); Silvestre and Matdanan (1992)
Cambodia	Shore to 20 m depth • Coastal: small scale with/without engine (5 to 50 HP engine)	20 m to EEZ limit • Commercial: > 50 HP				SEAFDEC (1999)
India	Northern sector: Shore to 16 m depth, Southern sector: Shore to 32 m depth • Artisanal craft/ traditional gears	Northern sector: 16 to 20 m depth, Southern sector: 32 to 40 m depth • Motorized craft using traditional gear	Northern sector: 20 to 40 m depth, Southern sector: 40 to 70 m depth • small mechanized: vessels < 25 GRT	Deep seas fishing • vessels > 25 GRT and engine > 120 HP	Marine Fisheries Regulation Acts (No. 16 to 22)	Sathiadhas et al. (1995) Vivekanandan et al. (this vol.)
Indonesia	Shore to 3 nm • Small scale: vessels < 5 GT/ 10 HP engine	3 to 7 nm • Small scale: vessels < 25 GT/50 HP engine	7 to 12 nm • Industrial: vessels < 100 GT/200 HP engine	>12 nm • Industrial: vessels > 100 GT/200 HP engine	Agriculture Minister Decree No. 607/ 1976 concerning Fishing Zonation	Purwaka and Sunoto (1999)
Malaysia	5 nm • Traditional: artisanal, owner-operated vessels	5 nm to 12 nm • Commercial: owner-operated trawlers and purse seines of < 40 GT	12 nm to 30 nm • Commercial: trawlers and purse seines of > 40 GT, wholly owned and operated by Malaysian fishers	30 nm to EEZ • Commercial: deep sea fishing vessels > 70 GT	Fisheries Act of 1985	Abu Talib and Alias (1997)
Myanmar	Northern area: shore to 5 nm, Southern area; shore to 10 nm • Coastal: vessels < 30 feet or engine < 12 HP	Outer limit of Zone I to EEZ • Industrial: vessels > 30 feet or engine > 12 HP				SEAFDEC (1999)
Philippines	Shore to 15 km • Municipal: vessels < 3 GT or fishing not requiring the use of fishing vessels	15km to EEZ limit Commercial: Small scale - passive or active gear and vessels 3.1 GT to 20 GT, Medium scale - active gear and vessels 20.1GT to 150 GT, Large scale - active gear and vessels of > 150 GT	–	–	Republic Act 8550 (1998)	Philippines (1998)
Thailand	Shore to 12 nm • Small scale: vessels < 5 GT operating	12 nm to EEZ limit Large scale: vessels > 5 GT	–	–	Fisheries Act of 1997	SEAFDEC (1999)
Vietnam	Northern and Southern areas: shore line to 30 m depth in, Central area: shore to 50 m depth • Small scale:, vessels with no engine or < 40 HP engine	Limit of Zone I to EEZ limit • Large scale: engine > 40 HP	–	–	–	SEAFDEC (1999)

Note: * LOA = overall length

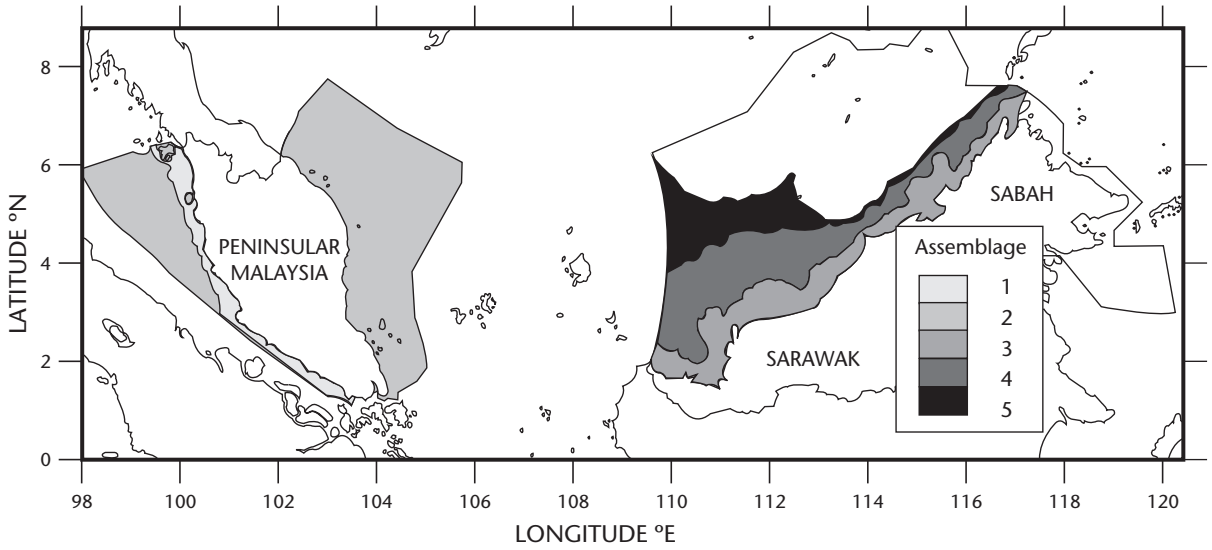

Fig. 9. Spatial delineation of fish assemblages in Malaysia (from Alias, this vol.).

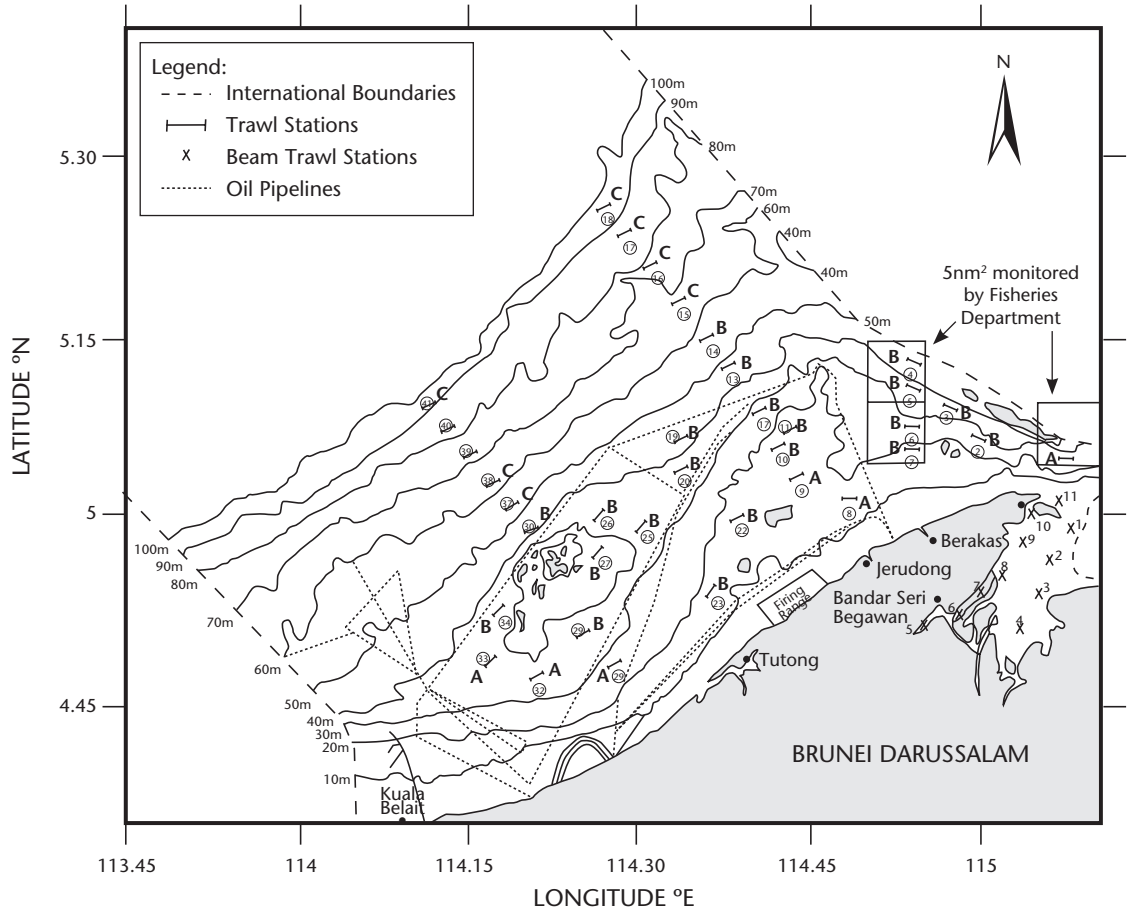

Fig. 10. Spatial distribution of fish assemblages in Brunei Darussalam. Note: A, B, C indicate fish assemblage groups. Source: Silverstre unpublished data.

Preliminary trophic models of coastal fishing systems were constructed for areas within each country (Table 9). These models were intended to assess the available information and provide a foundation for ecosystem-based approaches to fisheries assessment and management of fisheries in the future. Concededly, ecosystem-based approaches to fisheries assessment and management in the region (and worldwide) are still in their initial development stages. Project activities in this area have facilitated interest and the construction of preliminary models. It should be emphasized that the biomass values for the demersal groups were obtained from the compiled trawl research survey data, providing a comparatively robust input.

The production of the ecosystem models has been useful in identifying data or research gaps currently limiting the development of fisheries ecosystem modeling in the region. These include a systematic approach to assigning species to ecological groups, data on diet composition, and determination of system boundaries, among others. As these models are further developed and refined they may be useful in scenario building (i.e. anticipating or modeling the ecosystem impacts of fisheries management measures and decisions). Most importantly, the ecosystem analyses have allowed an initial attempt at modeling the trophic impact of the excess fishing effort, resource degradation and species composition trends noted above (Christensen et al. this vol.).

Overall, the resource analyses have quantified the biological extent of excessive fishing pressure in the focal areas. These results served as key inputs to the situational analysis activities of the project.

Socioeconomic Analysis and Bioeconomic Modeling

The thrust of this component was to assess the socioeconomic and bioeconomic status of the coastal fisheries. The scope of the analyses included socioeconomic profiling of coastal fishing and fisher populations, analysis of fleet operational dynamics, and bioeconomic modeling. The socioeconomic profiling provided an analysis of the importance of coastal fisheries in terms of earnings, employment,

Table 9. Summary information for the Ecopath models constructed for areas in South and Southeast Asia.

Area	Year	No. of Ecological Groups	Mean Trophic Level	Catch* ($t \cdot km^2 \cdot year^{-1}$)	Reference
BANGLADESH Bay of Bengal (up to 100 m depth)	1985	15	2.70	0.88	Mustafa (this vol.)
INDIA Southwest coast	1994 - 96	11	2.61	13.83	Vivekanandan et al. (this vol.)
INDONESIA North Coast of Central Java	1979	27	3.04	4.67	Subhat (this vol.)
MALAYSIA West coast peninsular Malaysia (up to 120 m)	1987 - 91	15	3.19	5.76	Alias (this vol.)
East coast peninsular Malaysia	1972	15	3.24	2.10	Christensen et al. (this vol.)
West coast Sabah, Malaysia (10 - 60 m depth)	1972	29	3.33	1.33	Garces et al. (this vol.)
Sarawak, Malaysia (10 - 60 m depth)	1972	29	3.38	0.21	Garces et al. (this vol.)
PHILIPPINES San Pedro Bay	1994 - 95	16	3.25	7.24	Campos (this vol.)
THAILAND Gulf of Thailand	1973	40	2.72	2.43	Vibunpant et al. (this vol.)
VIETNAM Southwest coast of Vietnam	1993 - 95	15	3.11	0.36	Christensen et al. (this vol.)

Note: * Estimate catch based on fished groups in the models.

trade and nutrition, and assessed their contribution to the economy. Fleet operational dynamics examined the microeconomic determinants of profitability and effort allocation, and included a description of operations such as costs, revenues and net profits. The bioeconomic modeling focused on assessing the extent of economic over-fishing (i.e. excessive effort that dissipates resource rent for the coastal fishery).

The socioeconomic profiles of the fisheries highlight the importance of the sector to the different countries. The fisheries sector contribution to the Gross Domestic Product (GDP) ranges between 1.3% for India (Immanuel this vol.) and 3.5% for the Philippines (Cruz-Trinidad this vol.). The sector provides employment to as many as 2 million people in Indonesia, 1.55 million in Bangladesh and 1.4 million in Vietnam (Table 1). The share of the fisheries sector in total employment varies between 4% in Vietnam and 1% in Malaysia. For countries such as the Philippines and Thailand, fish is a major export item creating a large positive trade balance (Cruz-Trinidad this vol.; Boonchowong and Dechboon this vol.). For most of the countries net export earnings from fish is considered as an important source of foreign exchange to pay the bills for food imports. For five countries out of the eight, the share of fish export to total agricultural export was more than 20% with the share reaching as high as 56% in Bangladesh in 1995 - 96.

The analyses of costs, earnings and profitability indicate that fishing is still a profitable enterprise in all countries particularly for the owners of commercial fishing vessels (Table 10). However, the ownership of the means of production (i.e. the vessels, gear or license) has substantial influence on the distribution of net profit among fishers. The major concern lies with sustaining the existing socioeconomic structure within the fisheries sector under the present mode of operation and distribution of proceeds from fishing operations. In general, owners of commercial craft and gear earn large sums while artisanal (small scale) fishers hardly earn a living. Commercial fishing fleets employ few crew, providing little opportunity for unemployed or under-employed small scale fishers. Even in the artisanal fishery, proceeds are not evenly distributed among owners of boat-gear and ordinary laborers. These issues have important implications for the sustainable management of coastal resources and sustenance of livelihood of the coastal fishers and their families in the region. It is a common belief that the tendency to over-exploit the coastal resources cannot be avoided until measures are taken to ameliorate the impoverished conditions of the vast majority of fishers.

The bioeconomic modeling, based on surplus production models, largely confirmed the widely accepted view that coastal fishery resources in most Asian countries are suffering from over-fishing,

Table 10. Profitability of fishing operations in selected countries.

Country/ Gear	(US$'000)				Profitability (%)
	Total Investment	Total Revenue	Total Cost	Total Profit	
Malaysia					
Trawl	36 - 50	69 - 80	55 - 64	13 - 16	24 - 25
Purse Seine	25 - 34	71 - 149	56 - 125	15 - 23	18 - 26
Drift nets	5	7.78	533	2.45	46
Thailand					
Small scale	1.8 - 4.4	2.0 - 6.2	1.8 - 5.6	0.19 - 0.59	11 - 22
Beam Trawl	7.7	3.1	2.6	0.47	17
Push net	20.87	5.87	5.7	0.15	2.5
Pair & otter trawl	53 - 97	8 - 15	6 - 13	1.26 - 1.36	9 - 22
Purse Seine	119	15	13	1.98	15
Vietnam					
Single Trawler	33.50	72.13	56.48	15.65	28
Pair Trawler	65.18	79.04	62.99	15.70	25
Purse Seine	41.99	34.48	26.79	7.73	29
Hooks and Lines	13.57	69.76	54.75	15.97	29

both biological and economic. The countries, for which historical data on catch and effort were available, showed a clear trend of declining CPUE. For instance, in the Gulf of Thailand, the CPUE (measured in standard hours) declined to 15.9 kg in the 1990s compared to 231.6 kg in the 1960s (Boonchowong & Dechboon this vol.). Huge rent dissipation and large excess capacity (both labor and capital) were also evident in Thailand (Table 11). These results provided some suggestions for policy measures and sector-specific interventions needed to correct over-fishing and related socioeconomic trends in coastal fisheries in Asia.

Fisheries Management (Policy/Planning)

The objective of the component was to examine the management and policy implications of the analyses. This involved elaboration of the issues outlined in Silvestre and Pauly (1997b), and detailed in the introduction. The process involved strategic action planning at the national and regional levels. This was supported by consultative workshops at the national and regional levels. Key national and regional stakeholders participated in identifying strategic directions and formulating action programs for the sustainable management of coastal fisheries.

National strategic planning activities reviewed and evaluated fisheries management at the country level. Activities within each country included:

a. formation of a National Policy and Planning Group from the planning/policy counterparts seconded by the collaborating institutions;
b. preparation of a National Fisheries Evaluation Guide that provided an assessment framework for marine fisheries in terms of goals, objectives, policies, programs, projects, etc;
c. evaluation of the national fisheries situation and review of fisheries management planning through a series of workshops and consultations (although the review focused on national fisheries plans, it also covered lower level plans such as provincial or municipal plans); and
d. production of a National Fisheries Situation Review and recommendations for Strategies and Action Plans.

From August to October 2000, eight national consultative workshops were conducted by the participating countries. The national workshops reviewed the analyses of the resource analysis and socioeconomic components and the draft "Strategic Review of National Fisheries Situation". The participants developed strategies for improved management of fisheries resources and discussed follow-up activities. The national strategic reviews were revised to incorporate the recommendations from the consultative workshops and form contributions to this volume (Abu Talib et al. Barut et al., Janekitkosol et al.; Purwanto; Rahman et al.; Samaranayake; Son and Vivekanandan et al.).

While the countries share the issue of over-fishing in their coastal fisheries, the complexity and intensity of the issues means that there can be no single strategy that will resolve all issues. Realistically, the eight countries can aim towards moving progressively closer to a state of sustainable exploitation through long-term resource management that repeatedly cycles through planning, implementation and evaluation. This strategic review makes a modest contribution to the planning aspect by analyzing current issues and opportunities and by suggesting management objectives and interventions. A simple planning framework (Fig. 11) was used to structure the presentations and working groups during the March 2001 workshop. The framework provided a logical sequence for discussion, begin-

Table 11. Comparison of the catch, revenues, costs and profits at different levels of effort based on a fixed price model and 1966 - 95 data, Gulf of Thailand.

State of fishery	Effort (Std. hr·10^6)	Catch (t·10^3)	Revenue (Bahts·10^6)	Cost (Bahts·10^6)	Profit (Bahts·10^6)
MSY	28.57	985	6 578	1 992	4 586
MEY	21.75	952	6 359	1 517	4 842
Open Access	62.70	654	4 372	4 372	0
Actual (1995)	56.88	728	4 862	3 966	896

ning with "where are we right now", the issues and opportunities, then progressing to "where do we want to go", the management objectives. Finally, knowing where we want to go, we can propose interventions or means to get there.

Fisheries Management Issues

The issues that commonly occur in the coastal fisheries of South and Southeast Asia are numerous, interrelated (Fig. 12) and have been documented previously to some extent (Chua and Scura 1992; Hotta 1996; SEAFDEC 2001; Silvestre and Pauly 1997a). The national strategic reviews examined the issues in detail for each country (i.e. Rahman et al. - Bangladesh; Vivekanandan et al. - India; Purwanto - Indonesia; Abu Talib et al. - Malaysia; Barut et al. - Philiipines; Samaranayake - Sri Lanka; Janekitkosol et al. - Thailand; and Son - Vietnam). Here we briefly present an overview of the links among the issues and then details of the regional perspective.

The issue of the depleted state of coastal fisheries resources dominates the fisheries sector in South and Southeast Asia. This is due to the cumulative effect of excessive fishing effort, inappropriate exploitation patterns, destructive fishing and habitat degradation or destruction. As fishery resources decline, fishers turn to more efficient ways to fish, thus putting more pressure on the resource and locking the situation into a downward spiral.

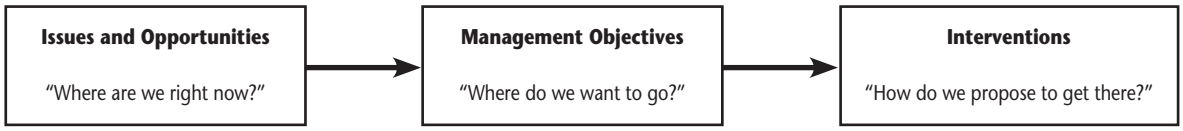

Fig. 11. A simple planning framework suggests a logical sequence for considering issues, opportunities, management objectives and interventions.

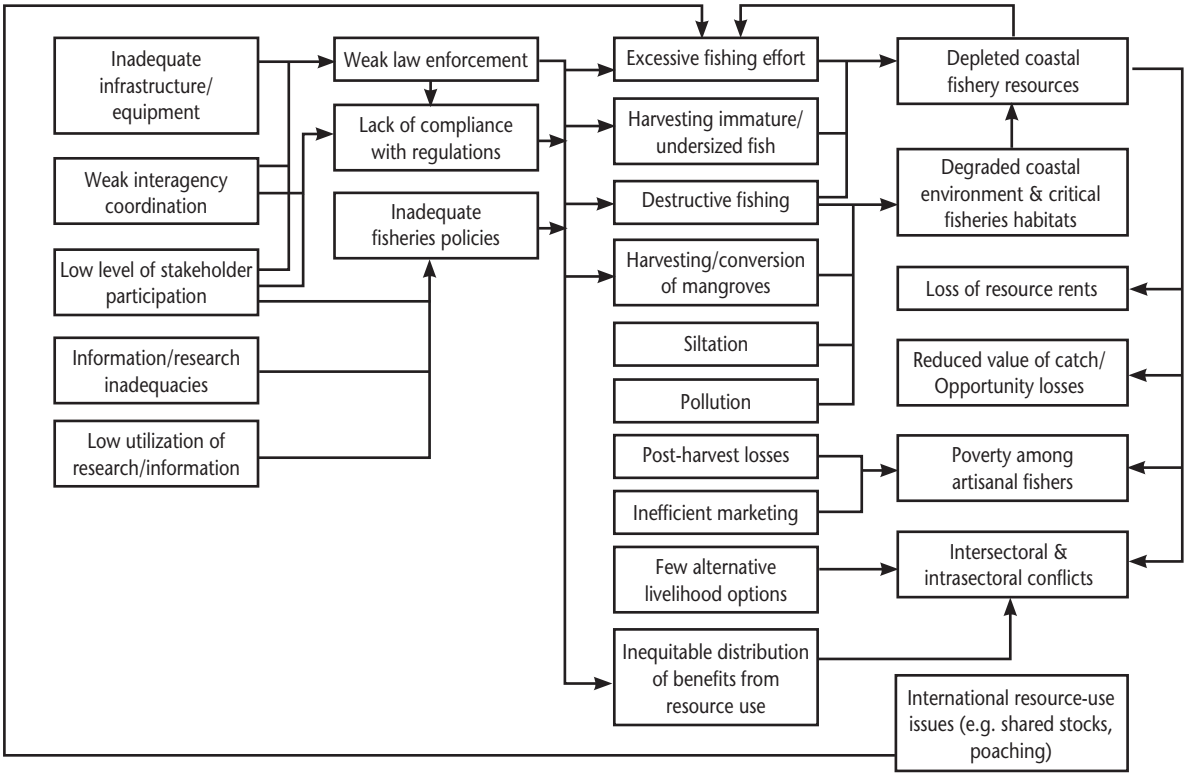

Fig. 12. Coastal fisheries issues in South and Southeast Asia.

The progressive decline of resources has severe social and economic impacts. Declining resources increase competition within and among fisheries and often leads to conflict. Also, the cost of fishing increases, thus reducing profits and resource rents. In addition, poor post-harvest practices reduce the value of catches. Other economic losses result from lost opportunities due to inefficient marketing, harvesting small sized fish and wastage from discards and by-catch. The impacts of the above are most strongly felt by artisanal fishers, the overwhelming majority of fishers in the region. The artisanal fisheries, generally, have few alternative means of livelihood, and have little choice but to adjust to reduced incomes. In addition, artisanal fishers are often engaged in a lopsided competition against commercial fishers. Given such circumstances, it is not surprising that so many artisanal fishers are mired in poverty.

The underlying causes of most resource-use problems can be traced to weak law enforcement and inadequate fisheries policies, which translate to a lack of effective fishing rights or open access to resources and minimal protection for the coastal environment. Weak law enforcement and inadequate policies, in turn, are caused by a number of institutional weaknesses and constraints (Fig. 12).

Excessive Fishing Effort

Over-exploitation of coastal fishery resources has been a regional concern for a significant time, starting in the 1980s (Pauly and Chua 1988; Silvestre and Pauly 1997a). This study quantified the extent of this issue in the eight countries all of which displayed symptoms (Tables 12 and 13) including: high exploitation ratios of species (as in the case of India), decreasing catch rates (e.g. Thailand), and changes in dominant species from high-valued to low-valued species (e.g. Malaysia and Thailand). Some countries display a range of symptoms.

The governments' inability to enforce effective property rights has resulted in open access to resources. This causes in individual fishers to attempt to maximize their fishing effort, resulting in excessive effort. In South and Southeast Asia, as mentioned earlier, other factors that contribute to excessive fishing include poverty or low incomes among artisanal fishers, few alternative livelihood options, and a host of institutional weaknesses and

Table 12. Symptoms of over-exploitation of fisheries in South and Southeast Asia.

Country (Reference)	Symptom
Bangladesh (Rahman et al. this vol.)	Over-exploitation noted in strategic review and during the national workshop. Decline in biomass noted in resource assessment.
India (Vivekanandan et al. this vol.)	Over-exploitation noted in strategic review.
Indonesia (Purwanto this vol.)	In the Java Sea, excess effort is estimated at 428 units of 25 GT trawlers.
Malaysia (Abu Talib et al. this vol.)	Density of demersal resources from 1987 to 1997 reduced by 67% in the west coast and 83% in the east coast of peninsular Malaysia. Changes in dominant species. Landings of small pelagics in the west coast have exceeded the potential yield by about 5 000 t. Landings of prawn have exceeded potential yields.
Philippines (Barut et al. this vol.)	Over-exploitation noted in national workshop. Reductions in biomass of demersal species and changes in species composition of catches.
Sri Lanka (Samaranayake this vol.)	Over-fishing noted in national workshop.
Thailand - Gulf of Thailand (Janekitkosol et al. this vol.)	In trawl fisheries, changes in catch composition of demersal resources towards smaller-sized fish and low- valued species. Trash fish constitute about 60 % of the catch. Average monthly catch rates of research vessels have decreased from 300 $kg \cdot hr^{-1}$ in 1961 to 18 $kg \cdot hr^{-1}$ in 1998.
Vietnam (Son this vol.)	During 1987 - 99, 3-fold increase in horsepower resulted in only 1.81 times increase in total catch. Increased amount of by-catch and smaller sizes of fish caught by trawl fisheries.

Table 13. Examples of over-exploited fishery resources in South and Southeast Asia.

Country (Reference)	Over-exploited resources
India (Vivekanandan et al. this vol.)	Demersals in the 0 - 50 m depth zone. Pelagics. Cephalopods along the southwest coast.
Indonesia (Purwanto this vol.)	Coastal demersals and small pelagics in the Java Sea.
Malaysia (Abu Talib et al. this vol.)	Demersals off Peninsular Malaysia. Small pelagics on the west coast. Prawns.
Thailand (Janekitkosol et al. this vol.)	Demersals in the Gulf of Thailand. Sardines (*Sardinella* spp.).
Vietnam (Son this vol.)	Most coastal fish resources (exploited at or above sustainable levels). Green mussel and pearl oyster in some areas.

constraints. The increasing fisher population is a major cause of excessive effort in countries such as Bangladesh, India and the Philippines (Rahman et al.; Vivekanandan et al.; Barut et al. this vol.). While this is clearly the case for these countries, high fisher population is not an unequivocal issue in the region. Malaysia actually has a declining fisher population (Abu Talib et al. this vol.). However, reducing the number of fishers alone may not address the excessive effort.

Harvesting Immature/under-sized Fish

Inappropriate exploitation patterns, primarily the harvesting of immature and under-sized fish is considered a serious issue in five countries (Table 14). Small mesh sizes in the cod end of trawls contribute significantly to this problem. In the Gulf of Thailand, where "trash fish" constitute about 60% of the catch, between 18% and 32 % of "trash fish" are juveniles of commercially important species. There is a high demand for "trash fish", which is processed into fishmeal and yet the economic loss is substantial. Juveniles of commercially important species, when sold as "trash fish", fetch about 2 Baht (US$0.05[4]) per kg. If allowed to mature, these species can be sold at 20 to 50 Baht per kg (Janekitkosol et al. this vol.). Malaysia has similar problems with trawls that use small mesh sizes and supply "trash fish" to fishmeal processors (Abu Talib et al. this vol.).

Some artisanal gear also catch immature fish, including: bag nets, beach seines and push nets (Table 14). In Bangladesh, the estuarine-set bag net, which accounts for 30% of the inshore landings, catches mostly juvenile fish (Khan et al. 1997; Rahman et al. this vol.). Inshore push nets specifically target fry and juveniles of cultured species such as shrimp and milkfish. In the Philippines, gathering of milkfish fry is considered traditional and is thus difficult to stop (Ahmed et al. 2001; Smith 1981). Heavy fishing on immature fish can result in growth and recruitment over-fishing (Pauly et al. 1989).

Destructive Fishing

Destructive fishing practices pose serious threats in Indonesia, the Philippines, Thailand, Sri Lanka and Vietnam. Destructive practices include blast fishing, the use of poisons and the use of trawls in reefs and seagrass areas (Table 15). Aside from their visible impacts on reefs and seagrasses, trawls may impact soft-bottom communities, with possible negative consequences on the aquatic food web (Jones 1992; Kaiser et al. 1998; Philippart 1998). Changes in species composition and diversity of the benthos in the Gulf of Thailand have been attributed to trawling (Christensen 1998; Pauly and Chua 1988). In Sri Lanka, destructive fishing occurs even in sites declared as marine protected areas (Samaranayake this vol.).

[4] 1 US$ = 40.20 Baht (2000 average value)

Table 14. Gear that harvest immature/undersized fish in South and Southeast Asia.

Bangladesh	India	Malaysia	Philippines	Thailand
Estuarine bag net Beach seine Push net	Trawl	Trawl Push net	Trawl Push net	Trawl Push net Drag net
Rahman et al. (this vol.)	Vivekanandan et al. (this vol.)	Abu Talib et al. (this vol.)	Barut et al. (this vol.)	Janekitkosol et al. (this vol.)

Table 15. Destructive fishing practices in South and Southeast Asia.

Country (Reference)	Destructive fishing practices
Indonesia (Purwanto this vol.)	Blast fishing and the use of poisons on coral reefs.
Sri Lanka (Samaranayake this vol.)	Existence noted; type of practice not specified.
Thailand (Janekitkosol et al. this vol.)	Use of trawls, push nets and drag-nets in seagrass areas. Blast fishing and the use of bottom-trawlers and drag nets in coral reefs.
Vietnam (Son this vol.)	Blast fishing.

Degradation of Critical Habitats

There is a range of coastal and marine habitats that are critical to maintaining productive fisheries resources. Mangroves trap silt and sediments from the land and stabilize shorelines (Birkeland and Grosenbaugh 1985; Snedaker and Getter 1985). They are often (but not always) crucial to the productivity of nearby fisheries because of their roles as nutrient exporters and providers of nursery areas (Fortes 1989; Paw and Chua 1991). Seagrass beds and estuaries also provide nursery grounds and important habitats for marine species (Fortes 1989). Coral reefs, which are among the most diverse and productive of ecosystems, contain far more resources than their size would suggest (Gomez 1988; White 1987).

In the South and Southeast Asian region, these critical habitats are at risk due to exploitation and coastal development. All countries report substantial losses of mangrove cover (Table 16). Six of the eight countries reported quantitative estimates of the losses, which are staggering in both spatial extent and speed of occurrence. All the countries with significant coral reef areas report widespread deterioration of coral reefs.

Uncontrolled land clearing, logging and development in catchments have lead to the siltation of rivers, waterways and coastal areas. Siltation is a major problem in all countries except India (Table 17). A survey in 1995 of 119 of Malaysian rivers and tributaries reported that 48 were "clean", 53 were "slightly polluted" and 14 were "polluted", with silt identified among the major pollutants (Abu Talib this vol.). The impact of siltation on coral reefs and seagrasses is often devastating, as observed in Thailand and the Philippines (Chou 1994; Yap and Gomez 1985).

Aside from siltation there are other types of pollution that are considered significant threats in particular countries (Table 17). With some exceptions, the notes on pollution in the national strategic reviews are mostly general and merely indicate the existence of certain polluting activities. Details on the specific nature, magnitude and extent of pollution are sparse. However, some accounts provide glimpses into the nature of pollution in the region (Talaue-MacManus 1999). For example, the Bangladesh strategic review notes that half of the 900 industrial firms identified as polluting belong to the leather and textile industries (Rahman et al. this vol). In Malaysia (Abu Talib et al. this vol.), a survey of coastal waters around the country indicated that almost all samples had values of lead, copper and cadmium that exceeded proposed standards. Heavy metal content in fish and shellfish, however, did not exceed public health thresholds.

Table 16. Mangrove areas lost and status of coral reefs in South and Southeast Asia.

Characteristics		Countries					
		Bangladesh	**India**	**Indonesia**	**Sri Lanka**	**Thailand**	**Vietnam**
Mangrove Areas Lost	Area (km^2)		700	1 760.8	3.3	101.8	2 430
	Percent of original cover	40 - 45% of the two major mangrove species*	50	41	28	75	61
	Period	1959 - 83	1980 - 2000	1982 - 93	1986 - 93	1961 - 96	1950 - 94
	Rate ($km^2 \cdot yr^{-1}$)		35	160.1	0.5	2.9	55.2
Status of Coral Reefs		Limited coral reef areas	Reefs are "destroyed to a large extent"	Some reefs have deteriorated due to exploitation for commercial and tourism purposes, and siltation caused by development projects	Only 2 out of 8 reefs surveyed had live coral cover > 50%	Over 60% of major reefs are in either poor (live-to-dead ratio = 1 : 2) or fair condition (1 : 1); less than 36% are good (2 : 1) or very good (> 3 : 1)	Most nearshore reefs are heavily exploited
		Rahman et al. (this vol.)	Vivekanandan et al. (this vol.)	Purwanto (this vol.)	Samaranayake (this vol.)	Janekitkosol et al. (this vol.)	Son (this vol.)

N.B. * Applies only to Khulna Sunderbans Reserve Forest.
**** Applies only to mangroves around the Gulf of Thailand.**

Table 17. Checklist of siltation and pollution issues in South and Southeast Asia.

Issues	Bangladesh	India	Indonesia	Malaysia	Philippines	Sri Lanka	Thailand	Vietnam
Siltation	✔		✔	✔	✔	✔	✔	✔
Industrial pollution	✔	✔		✔	✔		✔	✔
Agricultural pollution	✔			✔			✔	
Domestic/ sewage pollution	✔			✔			✔	✔
Marine-based oil pollution	✔	✔		✔				
	Rahman et al. (this vol.)	Vivekanandan et al. (this vol.)	Purwanto (this vol.)	Abu Talib et al. (this vol.)	Barut et al. (this vol.)	Samaranayake (this vol.)	Janekitkosol et al. (this vol.)	Son (this vol.)

International Resource-use Issues

All the countries are likely to share their marine resources with other countries. Various countries share the Bay of Bengal, the Andaman Sea, the Gulf of Thailand and the Celebes Sea. Among countries with contiguous EEZs, potential conflicts exist with regard to shared stocks, migratory stocks and unauthorized foreign fishing or poaching. If stocks are shared among countries, their management must be complementary to reduce the potential for over-fishing. The strategic reviews of Bangladesh and Malaysia cite poaching as an issue of concern. Fishing boats transiting other countries' EEZs to get to favored fishing grounds can also be an issue. Sri Lankan fishers must obtain prior approval from India and the Maldives to pass through their EEZs.

Inequitable Distribution of Benefits and Intersectoral and Intrasectoral Conflicts

Increasing competition between artisanal and commercial sectors for limited resources inevitably intensifies into conflicts. In the 1980s violent confrontations between these sectors prompted the Indonesian government to ban trawling (Sarjono 1980). The governments of Bangladesh, India and the Philippines have banned commercial operations in nearshore areas in an attempt to reduce conflict with artisanal fisheries. These areas are usually legally demarcated on the basis of depth or distance from the coastline (Table 18). In such cases conflicts continue when trawlers encroach into these demarcated areas.

Among the countries, Sri Lanka is the one country where the conflict between commercial and artisanal fishing sectors is not a significant issue (Samaramayake this vol.). The Sri Lankan strategic review attributes this to the absence of trawling in Sri Lanka. Intersectoral conflicts in Sri Lanka arise between fishers and other coastal users.

Intrasectoral conflicts occur mostly in the artisanal sector and involve spatial and gear conflicts (Pauly 1996b; Pauly and Chua 1988; Silvestre and Pauly, 1997c). Whether intersectoral or intrasectoral, conflicts essentially occur over rights to resources. As resources dwindle and/or provide lower returns, conflicts are likely to intensify. Governments will face increasing costs of managing these conflicts, unless proactive measures are taken.

Post-harvest Losses

Improper handling of fish onboard vessels and during distribution results in reduced quality and spoilage of the fishery products. About 30% of fish caught in Bangladesh end up spoiled and unfit for human consumption (Rahman et al. this vol.). In Sri Lanka, overall post-harvest losses are estimated at 22 - 25% and in the case of extended fishing, more than 50% of the landings are spoiled (Samanarayake this vol.). Spoiled fish in Thailand is sold as trash fish at greatly reduced values (Janekitkosol et al. this vol.). Lack of skill in handling and lack of facilities are the major causes of post-harvest losses (Alverson et al. 1994).

A related issue is the discarding of by-catch. The extent of this varies among the countries, but it is rarely documented. In Bangladesh, an estimated 30 000 t of by-catch are discarded annually, mostly by shrimp trawlers (Khan et al. 1997; Rahman et al. this vol.). The survival of this discarded by-catch is unknown, as is the impact on fisheries resources and the broader ecosystem.

Table 18. Intersectoral and intrasectoral conflicts in South and Southeast Asia noted during the project. (Abu Talib et al. this vol.; Barut et al. this vol.; Janekitkosol et al. this vol.; Purwanto this vol.; Rahman et al. this vol.; Samaranayake this vol.; Son this vol.; Vivekanandan et al. this vol.)

Conflict	Type	Countries
Intersector conflicts	Commercial vs. artisanal	Bangladesh, India, Indonesia, Malaysia, Philippines, Thailand, Vietnam
	Fishers vs. other coastal users	Sri Lanka
Intrasector conflicts	Conflicts among artisanal fishers from different locations	India
	Gear conflicts	Bangladesh, Thailand
	Intra-municipal conflicts (spatial and other types of conflict)	Philippines

Inefficient Marketing

Outputs of national workshops in the Philippines, Sri Lanka, Thailand stated that inefficient marketing is an issue in those countries (Samaranayake this vol.; Janekitkosol et al. this vol.; Barut et al. this vol.). However, no details were given on the exact nature of the inefficiencies. In India an inefficient distribution system, which includes cold storage and transportation systems, is blamed for the failure to supply fish to the interior parts of the country (Vivekanandan et al. this vol.). In order to address this, there are recommendations to introduce a compulsory licensing system for traders and for the government to supervise the fish auction system.

Inadequate Infrastructure/equipment

Fisheries infrastructure, which includes ports, municipal landings, post-harvest/cold storage facilities, processing facilities and fishing gear repair shops, are deemed inadequate in six countries (Table 19). In addition, related basic infrastructure and amenities such as roads, electricity and freshwater are often inadequate in rural areas. Estimates of the adequacy of fisheries facilities are available in Indonesia (Purwanto this vol.). For the country as a whole, infrastructure can only accommodate about 25% of the marine fishery production. In the western part of Indonesia where fisheries infrastructure can only accommodate 28.4% of production, ports and related facilities are operated at 120% higher than their optimum service capacity.

Inadequate fisheries infrastructure means wastage, decreased value of catches and higher operating costs for fishers. The provision of more infrastructure seems to be the obvious response to this issue. However, the situation is not always as simple and straightforward, particularly in the case of processing facilities. In India only 25% of the capacity of processing plants is currently used due to the lack of raw materials (Vivekanandan et al. this vol.). Similarly, in Bangladesh processing plants currently operate at 13 - 15% of capacity (Rahman et al. this vol.)

Poverty Among Artisanal Fishers

Earnings from fisheries are generally lower than those from other sectors. The average GDP per fisher in Vietnam is about US$160 per year, which places fishers among the country's poorest (Son this vol.). In Thailand, the per capita income and total household income of fishers are lower than national averages (Janekitkosol et al. this vol.). Within the fisheries sector, artisanal fishers as a group earn the lowest income s. In India, while laborers working in mechanized and motorized craft earn annual incomes of US$795 and US$350, respectively, fishers using artisanal craft earn only

Table 19. Checklist of institutional weaknesses and constraints in South and Southeast Asia.

Issues	Bangladesh	India	Indonesia	Malaysia	Philippines	Sri Lanka	Thailand	Vietnam
Inadequate infrastructure facilities/ equipment	✔		✔	✔	✔	✔	✔	
Information and research inadequacies	✔			✔	✔	✔	✔	✔
Inadequate fisheries policies	✔	✔		✔	✔		✔	
Weak law enforcement	✔	✔	✔	✔	✔	✔	✔	
Weak interagency coordination	✔	✔	✔		✔	✔	✔	
	Rahman et al. (this vol.)	Vivekanandan et al. (this vol.)	Purwanto (this vol.)	Abu Talib et al. (this vol.)	Barut et al. (this vol.)	Samaranayake (this vol.)	Janekitkosol et al. (this vol.)	Son (this vol.)

US$200 annually (Vivekanandan this vol.). Likewise, artisanal fishers in Sri Lanka, Thailand, Malaysia, the Philippines, and Indonesia live below poverty thresholds (Samaranayake this vol.; Janekitkosol et al. this vol.; Abu Talib et al. this vol.; Barut et al. this. vol.; Purwanto this vol.).

To completely understand the causes of poverty among artisanal fishers, one must not confine the analysis to the fisheries sector, but must look beyond it. However, it is still instructive to consider at factors within the fisheries sector. The obvious causes of poverty among artisanal fishers include dwindling fishery resources and the highly unequal distribution of the total catch in favor of the commercial sector, at least on a per capita basis (Pauly and Chua, 1988). Also, artisanal fishers are mired in poverty because they have few alternatives to fishing. This is the case in Sri Lanka, Thailand, the Philippines and Indonesia (Samaranayake this vol.; Janekitkosol et al. this vol.; Barut et al. this. vol; Purwanto this vol.).

Other factors are less well-known and may be confined to certain places. Some credit systems may increase the burden on artisanal fishers, as is the case in Bangladesh (Rahman et al. this vol.). In Indonesia a tendency among fishers, not to save, but to increase spending during periods of high catches has been observed (Purwanto this vol.).

Information and Research Inadequacies

In South and Southeast Asia, information needed to set appropriate levels of exploitation is generally insufficient (Silvestre and Pauly 1997c). Such information is available only for some major fisheries. In addition, the information may be outdated or irregularly collected. This project has contributed to ensuring the data available from trawl research surveys are accessible and analysed to assist mana-gement. The inadequacies of information and research are also often associated with low utilization of the research or information available (Silvestre and Pauly 1997c). The lack of or low utilization of data results in a weak basis for the development of fisheries and environmental policies.

Inadequate Fisheries and Environmental Policies

Most of the countries in the region have fisheries and environmental policies, to varying degrees. However, the inadequacy of these policies is clear when the degraded state of the resources is demonstrated. Table 20 contains examples of policy inadequacies identified during the national strategic reviews. For most examples the main factor that led to the inadequacy seems to be the lack of information. In some cases the lack of skill in policy analysis is apparently at the root of the problem, or at least a part of it.

Weak Inter-agency Coordination

Weak inter-agency coordination is noted in most countries in the region (Table 19). This factor can result in contradictory law enforcement or inefficient use of limited resources. For example, in Bangladesh while the Fisheries Department seeks to protect the nursery areas in the Sunderbans mangroves, the Forestry Department allows fishing in those areas (Rahman et al. this vol.). Given the limited resources available in these countries, efficient inter-agency coordination is needed to ensure the effective use of the resources.

Table 20. Examples of policy inadequacies in South and Southeast Asia.

Country	Policy inadequacy	Reference
Bangladesh	Unplanned development of shrimp culture	Rahman et al. (this vol.)
India	Lack of policies for managing particular fisheries	Vivekanandan et al. (this vol.)
Malaysia	No legislation to establish sea grass protected areas	Abu Talib et al. (this vol.)
Thailand	Fishing fees do not reflect value of resource rents Policies that unwittingly increase fishing effort: 1. Fuel subsidies for fishing boats 2. Allowing aliens to work as crews, thus increasing the number of fishers Tax on imported trash fish meal. This has increased demand for local trash fish. Juveniles of commercially important species may comprise up to 32% of local trash fish Subsidy to lower the price of tuna	Janekitkosol et al. (this vol.)

Weak Law Enforcement

In the region insufficient enforcement capabilities result in the proliferation of illegal activities, including: encroachment by commercial fishers into areas reserved for artisanal fishers, destructive fishing, violations of mesh size regulations, operation of unlicensed boats, and violations of regulations in mangrove reserves and marine protected areas. The weak law enforcement is linked to other institutional weaknesses such as the low level of stakeholder participation in management.

Lack of Compliance with Regulations

In South and Southeast Asia, the list of institutional weaknesses and constraints in Table 20 suggests that most problems in fisheries can be traced to the government's failure as a regulator. However, resource users are not without blame. In India, Malaysia, the Philippines and Indonesia, the resistance of fishers to regulatory measures is regarded as a significant constraint (Vivekanandan et al. this vol.; Abu Talib et al. this vol.; Barut et al. this. vol.; Purwanto this vol.). In Sri Lanka, the extent of public participation in resource management is said to be less than desired (Samaranayake this vol.).

Fisheries Management Opportunities

The National Strategic Reviews conducted by the participating countries identified potential management opportunities within each country. Increasing community and stakeholder participation in resource management, the presence of existing laws and regulations, and the potential existence of under-exploited fishery resources offshore were the most frequently identified opportunities.

There is growing evidence that increasing the levels of stakeholder participation in resource management may increase the effectiveness of the management (Berkes et al. 2001). This may be particularly important in situations where a "top-down" approach driven by the centralized government has failed to effectively manage the fisheries. This has been the case in many countries in the region. Increasingly, coastal communities, people's organizations, NGOs and other stakeholder groups in Malaysia and the Philippines are participating actively in the management of coastal resources (Abu Talib et al. this vol.; Barut et al. this vol.). It is hoped that the greater involvement of stakeholders will increase compliance and decrease enforcement costs. A related opportunity is the existence of traditional or indigenous resource management practices. For example, in Sri Lanka there is a rotational system governing the use of beach seines (Samaranayake this vol.). These traditional resource management practices provide a basis and a history for greater involvement of communities in resource management.

All the participating countries have existing laws and regulations that govern fisheries and the marine environment. These establish the right of the government to take lead in resource management. The existing laws and regulations also provide a basis for improvement. In some situations the laws are appropriate; it is the enforcement that is lacking.

All countries except the Philippines report the potential existence of under-exploited offshore stocks. However, this must be assessed rigorously. Economic and technological constraints presently limit access to these offshore resources. Thus, there are calls for governments to assist in overcoming some of these constraints and some governments are actively providing assistance to develop offshore fleets. An example is the suggestion to develop an offshore demersal fleet in Indonesia (Purwanto this vol.). Assuming that the technological and economic constraints can indeed be overcome (and this is debatable in particular cases), one must ask if it is wise to invest in and encourage such efforts without first addressing the inadequacies of a resource management system that failed to prevent the over-fishing of nearshore resources. In general, offshore resources are lower than nearshore (Marten and Polovina 1982; Pauly and Chua 1988), and without proper management may be rapidly depleted (Silvestre and Pauly 1997c). This can been seen in the stock assessment undertaken in Malaysia, where the catch rates and hence biomass, decrease with increasing depth or distance offshore (Abu Talib this vol.). If offshore resources are depleted, it is likely that the offshore vessels will then encroach on nearshore areas.

Fisheries Management Objectives and Interventions

Based on the recommendations from the multisectoral workshop, the objectives of coastal fisheries management in South and Southeast Asia are given in Fig 13. The management objectives relate to the issues documented previously (Fig. 13). In addi-

tion to considering the issues, the objectives were selected to reflect the resource management objectives stated in the national strategic reviews. An earlier version of this goal-objectives tree was presented at the March 2001 workshop and revised on the basis of suggestions from the conference participants, who were mostly from the countries. Thus, the objectives in Figure 14 are intended to represent aspirations of people in the region.

The overarching goal of sustainable utilization of coastal fishery resources is elaborated by environmental, socioeconomic and institutional objectives. The environmental objectives distinguish between fishery resources and the environment that sustains them. This distinction may seem unnecessary, since fishery resources are part of the environment, and therefore a single objective to protect the environment would cover fishery resources as well. However, the intent is to emphasize the need to broaden the scope of traditional fisheries management, to a "whole system" approach. This would acknowledge issues such as water quality, which were previously regarded as outside its scope.

The objective to maximize the economic benefits from the utilization of fishery resources is the single, all-encompassing economic objective. It implicitly incorporates objectives to minimize loss of resource rents and opportunity losses. The other socioeconomic objectives relate to the issues of poverty among artisanal fishers and resource-use conflicts, which are regarded as the most pervasive socioeconomic issues related to fisheries.

Finally, the institutional objectives call for strengthening national institutions at the domestic front and increasing cooperation and collaboration at the international level. These objectives are somewhat more specific than the environmental and socioeconomic objectives. They seem less of a description of "where do we want to go" and relate more to "how do we propose to get there." However, conference participants felt that building institutional capabilities is of such paramount importance that it must be emphasized as a fundamental objective.

To achieve the resource management objectives, the workshop recommended four specific interventions to be implemented by the respective countries and four support activities that would be more cost-effective if implemented at the regional level (Fig. 14). The workshop recognized that capacity building and institutional strengthening are sorely needed to overcome the institutional weaknesses and constraints that prevent the countries from effectively implementing resource management measures. In the countries the areas that should be strengthened vary from several agencies at various levels of government to the entire system for coastal fisheries management. Given the specific needs of each country, a general program of capacity building and institutional strengthening would be of little use. This strategy proposes the establishment of a regional Coastal Fisheries Research and Management Network, which will supply some of the training and information needs of the DMCs. Real capacity building and institutional strengthening, however, will have to be an ongoing, long-term concern.

The interventions are briefly described below.

Interventions for Implementation by Countries (Table 21)

Integrated Coastal Fisheries Management (ICFM)

This would involve the implementation of area- and/or fisheries-specific management plans to reduce or maintain fishing effort at sustainable levels and to protect coastal habitats. ICFM typically begins with interdisciplinary resource and social assessments to obtain an understanding of the resources, the environment, the resource users and the interconnections among these elements. This has commenced within the TrawlBase project, but needs to be undertaken at finer scales within countries, at scales appropriate to the management issues. A key feature of ICFM is stakeholder participation in planning and management to increase compliance with resource management measures. Greater stakeholder participation also creates opportunities for conflict resolution.

Supplemental/Alternative Livelihood for Artisanal Fishers

This program will provide artisanal fishers with skills to seek employment outside the fisheries sector or to engage in small businesses. Since artisanal fishers comprise the overwhelming majority of fishers, providing them with alternative sources of sustenance and income is potentially the most effective way to ease pressure on fish stocks.

System of Aquatic Protected Areas

In aquatic protected areas or marine reserves,

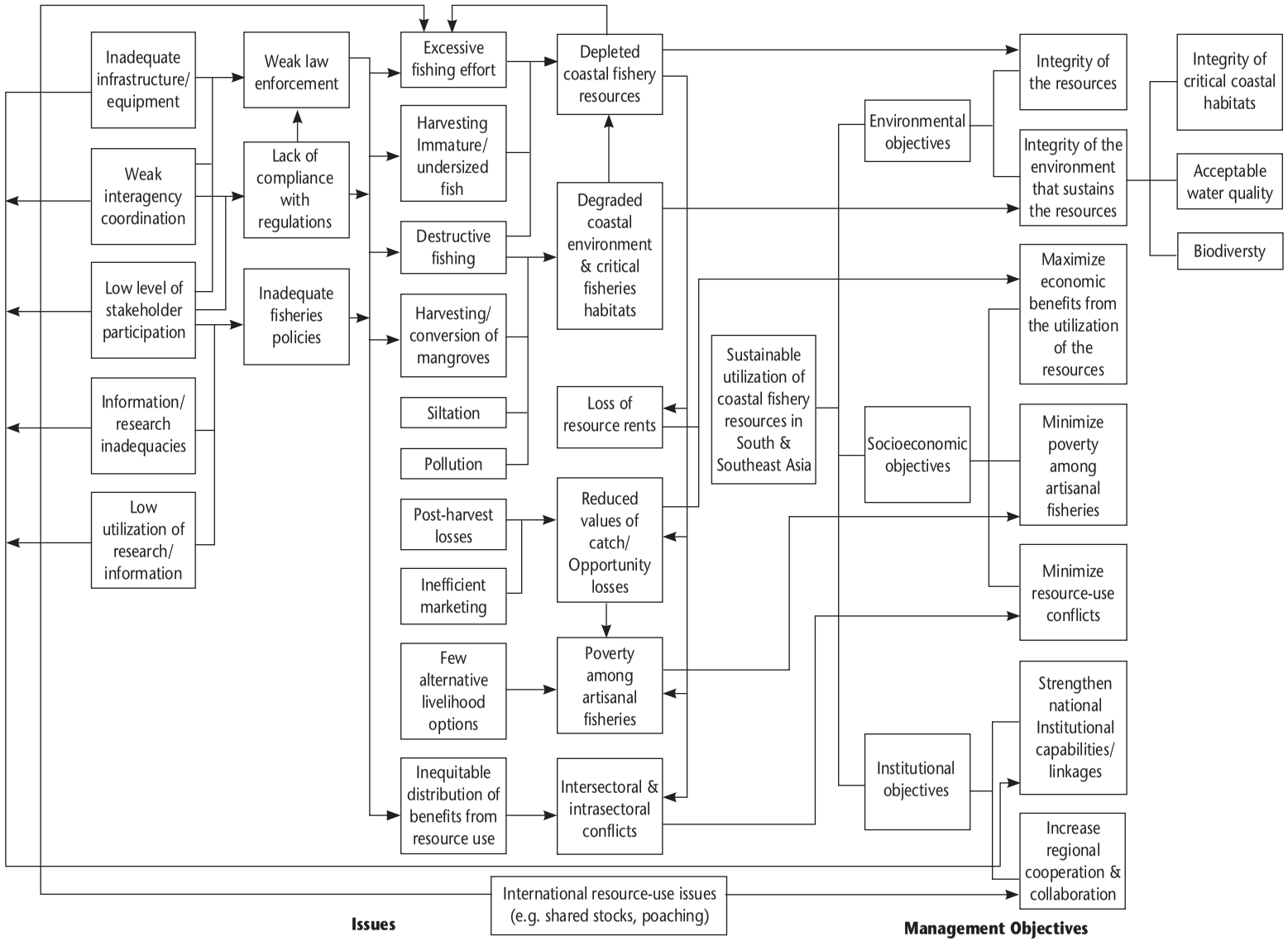

Fig. 13. Coastal fisheries management objectives to address the issues.

Table 21. The objectives pursued and issues addressed by the proposed interventions at the national level.

Intervention	Objective(s) Pursued	Issue(s) Addressed
Integrated Coastal Fisheries Management	Integrity of the resources	Depleted coastal fishery resources, loss of resource rents, excessive fishing effort, harvesting immature/undersized fish, destructive fishing
	Integrity of the environment that sustains the resources (Integrity of critical coastal habitats, biodiversity)	Degraded coastal environment and critical fisheries habitats, harvesting/conversion of mangroves
	Maximize economic benefits from the utilization of the resources	Intersectoral and intrasectoral conflicts, inequitable distribution of benefits from resource use
	Minimize resource-use conflicts	Lack of compliance with regulations, low level of stakeholder participation
Supplemental/Alternative Livelihood for Artisanal Fishers	Minimize poverty among artisanal fishers	Poverty among artisanal fishers, few alternative livelihood options
	Integrity of the resources	Depleted coastal fishery resources, loss of resource rents, excessive fishing effort, harvesting immature/undersized fish, destructive fishing
System of Aquatic Protected Areas	Integrity of the resources	Depleted coastal fishery resources, harvesting immature/undersized fish, destructive fishing
	Integrity of the environment that sustains the resources (Integrity of critical coastal habitats, biodiversity)	Degraded coastal environment and critical fisheries habitats, harvesting/conversion of mangroves
Minimizing By-catch and Post-harvest Losses	Maximize economic benefits from the utilization of the resources	Opportunity losses, post-harvest losses
Capacity building and institutional strengthening*	Strengthen national institutional capabilities/ linkages	Weak law enforcement, inadequate fisheries policies, inadequate infrastructure/equipment, information/research inadequacies, low utilization of research/information

Note: * Capacity building and institutional strengthening are suggested as a general recommendation. No specific activities have been specified.

human activities such as fishing may be strictly controlled or prohibited altogether to allow the replenishment and rehabilitation of fish stocks and other aquatic organisms. An aquatic protected area may be designed to achieve a variety of conservation objectives, including reducing fishing mortality, optimizing fishing patterns or spatio-temporal distribution of fishing effort, conserving biodiversity, protecting endangered species, and rehabilitating habitats or ecosystems. A system of aquatic protected areas should be planned from a national perspective to ensure the protection of the species or habitats that are most vulnerable and/or environmentally valuable.

Minimizing By-catch and Post-harvest Losses

This will involve: (1) extension work and training to improve fish handling; (2) education campaigns on minimizing by-catch; and (3) product development research on using by-catch as raw material.

Regional Support Activities (see Fig. 14)

Coastal Fisheries Research and Management Network

A regional network will provide information, training and advisory support to assist the countries in implementing the above interventions and other

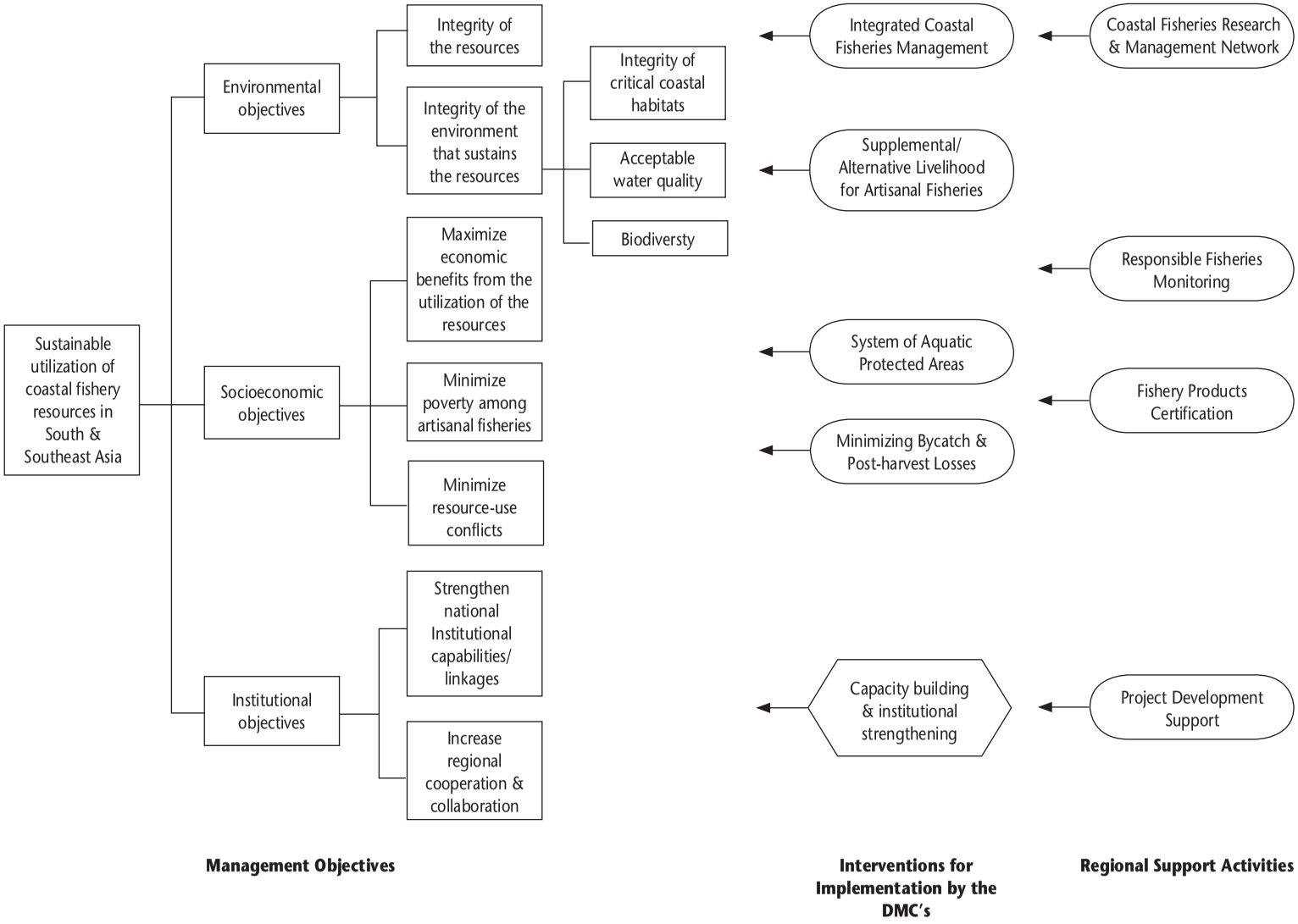

Fig. 14. The interventions to achieve the objectives.

action programs toward responsible fisheries. The network will promote research collaboration and institutional exchanges, thus supporting the capacity building efforts of countries. It would also facilitate the elaboration, implementation and review of regional and national agendas for responsible fisheries.

Responsible Fisheries Monitoring Network or Program

This program will establish an independent system of monitoring and reporting on compliance with principles, standards, norms and guidelines of responsible fisheries. It will involve the development of an objective, independent, credible set of indicators and monitoring tools, which will be used to increase public awareness of the performance of national fisheries towards responsible fisheries.

Fishery Products Certification Program

This program will establish an independent, non-governmental certification system on responsibly produced fishery products (e.g. Marine Stewardship Council certification, "dolphin-friendly" tuna and "turtle-friendly" shrimp).

Project Development Support

The strategic reviews prepared by the National Project Teams contain three major elements, namely, (1) an analysis of the issues; (2) recommendations; and (3) project proposal summaries intended to translate the more important recommendations into projects worthy of funding. All strategic reviews contain a thorough analysis of issues and appropriate recommendations. Unfortunately, the project proposal summaries comprise the weakest section in most strategic reviews. In some cases the set of projects address the more important issues inadequately. In other cases the quality of individual projects could be substantially improved. Some countries only require small grants to allow team members or local experts to properly develop and package projects. Others require technical assistance in order to develop projects to address the issues identified.

The Scope of the Interventions: Achieving A Balance Between Comprehensiveness and Practicality

The four national and the four regional interventions together comprise a comprehensive program that will address almost all resource management objectives and issues. There are reasons why the interventions will not address or only partly address certain issues and objectives.

There is no intervention that deals specifically with water quality, siltation and pollution. Integrated Coastal Fisheries Management can partly address these issues. Yet the real solution to these issues lies in controlling human activities in the catchments and minimizing externalities from other sectors such as forestry, agriculture and industry. When the interactions among these other sectors and fisheries must be taken into account, ICFM can be subsumed under a larger Integrated Coastal Area Management Program or an Integrated Coastal Area and River Basin Management Program (UNEP 2000).

This strategy focuses on activities that are closer to the fisheries domain because those who will lead its implementation are likely to come from fisheries organizations. It is also practical to start with a few, focused activities, which can be expanded later as experience is gained and when the need arises.

From Recommendations to Action

The interventions proposed by this strategy will help realize many provisions in the Code of Conduct for Responsible Fisheries and in Agenda 21 of the UN Conference on Environment and Development. Thus, the strategy deserves the support of the countries and the international community.

The first step to implement the strategy is to organize a Project Development Support group consisting of persons who are knowledgeable about the proposed interventions and the institutional aspects of their implementation. This group will work with the countries to develop the interventions into projects, which will be submitted to funding agencies. The WorldFish Center, having worked with the countries, would be a suitable base for the Project Development Support group.

Next, an international meeting or a series of such meetings should be organized to establish the Coastal Fisheries Research and Management Network, the Fishery Products Certification Program, and the Responsible Fisheries Monitoring Network/ Program. The participants of the meeting should include high-level representatives from the countries and from international organizations that are active in coastal fisheries management in the region, such as the WorldFish Center, Food and Agriculture Organization (FAO) - Asia-Pacific Commission (APFIC), Southeast Asian Fisheries Development Center (SEAFDEC), and the World Wildlife Fund. Thus, resource management activities can proceed simultaneously at national and regional levels.

Summary and Conclusion

The result of over-fishing in South and Southeast Asia is that coastal fish stocks have been severely depleted. Resources have been fished down to 5 - 30% of their unexploited levels. Such declines have increased poverty among coastal fishers who are already among the poorest of the poor in developing Asian countries. Over-fishing has also reduced the contribution of coastal fisheries to employment, export revenue, food security and rural social stability in these nations. The trends (resource decline, increasing poverty and impaired contribution to national development) are expected to worsen as coastal populations increase, unless remedial action is undertaken.

Measures to reduce poverty among coastal fishers and fishing communities cannot be divorced from the need to address the downward spiral in coastal fisheries resources. As recognized at the 2002 World Summit on Sustainable Development (WSSD), the restoration and improved management of stocks is urgently required to reduce poverty among fishers and sustain the contribution of coastal fisheries to the economies of developing countries. Owing to the technical, personnel and financial constraints faced by many Asian countries, however, the rehabilitation and improved management efforts needed to rebuild fish stocks to more productive levels will depend on catalytic interventions to identify and implement the measures. Sustaining the gains over the long-term will also depend on increasing national capacity in coastal fisheries assessment, rehabilitation, planning, management and policy reform.

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