East-West Environment and Policy Institute

Research Report No. 13

Indonesian Marine Fisheries Development and Strategy under Extended Maritime Jurisdiction

by Salvatore Comitini
Sutanto Hardjolukito

East-West Center
Honolulu, Hawaii

THE EAST-WEST CENTER is an educational institution established in Hawaii in 1960 by the United States Congress. The Center's mandate is "to promote better relations and understanding among the nations of Asia, the Pacific, and the United States through cooperative study, training, and research."

Each year more than 1,500 graduate students, scholars, professionals in business and government, and visiting specialists engage in research with the Center's international staff on major issues and problems facing the Asian and Pacific region. Since 1960, more than 30,000 men and women from the region have participated in the Center's cooperative programs.

The Center's research and educational activities are conducted in five institutes—Communication, Culture Learning, Environment and Policy, Population, and Resource Systems—and in its Pacific Islands Development Program, Open Grants, and Center-wide programs.

Although principal funding continues to come from the U.S. Congress, more than 20 Asian and Pacific governments, as well as private agencies and corporations, have provided contributions for program support. The East-West Center is a public, nonprofit corporation with an international board of governors.

THE EAST-WEST ENVIRONMENT AND POLICY INSTITUTE was established in October 1977 to increase understanding of the interrelationships among policies designed to meet a broad range of human and societal needs over time and the natural systems and resources on which these policies depend or impact. Through interdisciplinary and multinational programs of research, study, and training, the Institute seeks to develop and apply concepts and approaches useful in identifying alternatives available to decision makers and in assessing the implications of such choices. Progress and results of Institute programs are disseminated in the East-West Center region through research reports, books, workshop reports, working papers, newsletters, and other educational and informational materials.

William H. Matthews, Director
East-West Environment and Policy Institute
East-West Center
1777 East-West Road
Honolulu, Hawaii 96848

Indonesian Marine Fisheries Development and Strategy under Extended Maritime Jurisdiction

by
Salvatore Comitini
and
Sutanto Hardjolukito

Research Report No. 13 • July 1983
East-West Environment and Policy Institute

SALVATORE COMITINI, an Associate Professor of economics and agricultural economics at the University of Hawaii, was an Adjunct Research Associate at the East-West Environment and Policy Institute in 1981 and 1982.

SUTANTO HARDJOLUKITO, Officer, Directorate General of Fisheries, Indonesia, is a Ph.D. candidate in Agricultural Economics at the University of Hawaii, on award from the East-West Environment and Policy Institute.

Library of Congress Cataloging in Publication Data

Comitini, Salvatore.
Indonesian marine fisheries development and strategy under extended maritime jurisdiction.

(Research report / East-West Environment and Policy Institute; no. 13)
Bibliography: p.
1. Fishery policy—Indonesia. 2. Fisheries—Indonesia—Planning. I. Hardjolukito, Sutanto, 1946- . II. Title. III. Series: Research report (East-West Environment and Policy Institute (Honolulu, Hawaii)); no. 13.
HD9466.I56C65 1983 338.3'7709598 83-14208
ISBN 0-86638-048-5

CONTENTS

Figures

Tables

FOREWORD

Changing national perceptions of the ocean are resulting in the unilateral extension of national claims to ownership of resources in the seabed and the water column up to 200 nautical miles from national baselines. Nevertheless, many marine resources such as fish, oil, and environmental quality are transnational in distribution; the ocean, a continuous fluid system, transmits environmental pollutants and their impacts; and maritime activities such as scientific research, fishing, oil and gas exploration, and transportation often transcend the new national marine jurisdictional boundaries. Management policies for these national zones of extended jurisdiction may be developed and implemented with insufficient scientific and technical understanding of the transnational character of the ocean environment. Such policies may thus produce an increase in international tensions, misunderstandings, and conflicts concerning marine activities, resources, and environmental quality.

These issues form the conceptual framework for the EAPI Program Area "Marine Environment and Extended Maritime Jurisdictions: Transnational Environment and Resource Management in Southeast Asian Seas." The goals of the program area are to provide an independent, informal forum for the specific identification and exchange of views on evolving Asia-Pacific ocean management issues, and to undertake subsequent research designed to provide a knowledge base to aid in the international understanding of these issues.

With the near-universal promulgation of 200-nautical-mile fishing zones, access of distant-water fishing fleets to stocks within many of these zones is undergoing an abrupt or phased reduction, or an alteration of operational terms. As a result, distant-water fishing efforts are becoming concentrated in jurisdictional zones of nations permitting favorable concessionary access. Such a concentration of highly efficient effort endangers maintenance of optimum sustainable yield of stocks, especially if their distribution and population dynamics are poorly understood. For species that migrate between national zones, intensified distant-water and/or coastal state efforts within a particular national zone could have implications for other nations that have interests in and/or claims upon these migratory stocks.

The objectives of this part of the Program Area are to compare the advantages and disadvantages of various cooperative arrangements for distant-water fishing for tuna from the perspectives of the resource owner and the resource exploiter. This EAPI Research Report is one of a series on the subject. The others are:

Research Report No. 3, *A Strategic Goal Analysis of Options for Tuna Longline Joint Ventures in Southeast Asia: Indonesia-Japan Case Study* by Gerald Mar-

ten, Yoshiaki Matsuda, John Bardach, Salvatore Comitini, and Sutanto Hardjolukito, 1981.

Research Report No. 4, *Fishery Management and Extended Maritime Jurisdiction: The Philippine Tuna Fishery Situation* by Virginia L. Aprieto, 1981.

Legal, Political and Economic Constraints on Japanese Strategies for Distant-Water Tuna Fisheries in Southeast Asian Seas and the Southwestern Pacific by Yoshiaki Matsuda and Kazoumi Ouchi, 1983. (unpublished draft)

The Environment and Policy Institute was fortunate to attract Salvatore Comitini, Associate Professor of Agricultural Economics and of Economics at the University of Hawaii, and Sutanto Hardjolukito, Officer, Directorate General of Fisheries, Indonesia, to provide this Indonesian perspective on cooperative arrangements for development of tuna fisheries.

Dr. Mark J. Valencia
Program Area Coordinator

Indonesian Marine Fisheries Development and Strategy under Extended Maritime Jurisdiction

by
Salvatore Comitini and Sutanto Hardjolukito

ABSTRACT

Historically, early fisheries development occurred in the western part of Indonesia, i.e., the east coasts of Sumatra and the Riau Islands, and in parts of east Java. A large part of the fish catch supplied Java, either directly or through Singapore.

During Dutch times and after independence, but prior to the first of the five-year development plans, there was a lack of coordination in programs and actions on the part of the government to improve and assist the fisheries sector. Yet, there was substantial development of the industry after 1951, especially around the Malacca Strait and the Riau Islands. It is not clear what spurred development between 1951 and 1968, which was largely small scale. Productivity, however, did not improve but in fact declined.

Rapid development of fisheries in Indonesia occurred essentially after the inauguration of the five-year development plans that forced the government to undertake fisheries planning with definite goals and objectives. Various strategies were attempted to attain these goals and objectives.

The two main programs for fisheries development during the first five-year development plan (1969–1974) were aimed at improving the small-scale fisheries and also stimulating the commercial fisheries. For small-scale fisheries development, the government provided mainly infrastructure, e.g., landing piers, auction halls, and market facilities. As a result, there was a significant increase in the motorization of fishing vessels. Commercial fisheries were given a boost through the Foreign Investment Law (1967) and the Domestic Investment Law (1968) and also through various bilateral and multilateral loan agreements. Joint ventures were established, mainly directed at eastern Indonesia waters, which were tied in with regional development. Domestic private capital flowed mainly into the shrimp fishery, which developed rapidly. The international loan agreements for fisheries development were largely directed at skipjack and the large tunas.

In the second five-year development plan (1974–1979) greater attention was given to small-scale fisheries development, especially in terms of providing production and marketing facilities, infrastructure, education and training, and vessel financing. Yet, most of the development continued to occur in the shrimp sector through capital investment and the so-called "demonstration effect." This was especially evident in the rate of growth of shrimp exports. New government regulations were issued during this period to protect fish stocks, to

retain trawler by-catches, and to establish restricted trawl fishing areas within coastal waters. These regulations were aimed mainly at protecting small-scale fishermen.

For comparing past fisheries development with potential development, marine fisheries in Indonesia are divided into four main regions. Analysis reveals that development in the four regions has been irregular and primarily related to the relative abundance of coastal fishery resources and to proximity to markets. An optimal fisheries management policy would require reallocation of fishing effort from overfished areas such as the Malacca Strait and the Java Sea to relatively underfished areas such as the South China Sea and the Makassar Strait. Major additions to fishery resources under Indonesian extended maritime jurisdiction are in the eastern part of Indonesia and the areas west of Sumatra and south of Java and Bali-Nusa Tenggara.

With extended jurisdiction comes responsibility for fisheries planning over areas well beyond traditional fishing limits. In the case of Indonesia, the government will seek to determine alternative arrangements for harvesting the resources within its newly acquired exclusive economic zone (EEZ), given the well-known contraints of capital, technology, and optimal utilization of the resources.

The viable management options for fisheries development in the EEZ of Indonesia are described. Japan is considered a foreign fishing nation likely to wish to operate in the EEZ of Indonesia. By assigning weights to certain objectives on the basis of their relative desirability in meeting the broad goals of Indonesia and Japan, together with their respective capabilities to fulfill these objectives, it is possible to develop a ranking of alternative strategies on the basis of the relative importance of decision criteria. If each country gave approximately equal consideration to each of the broad goals, a compatibility of interests might result, and both countries might prefer a joint venture strategy. It is not apparent, however, that there would necessarily occur a mutual preference for one type of strategy or another, or even that these preferences would be stable over time.

HISTORICAL DEVELOPMENT OF MARINE FISHERIES IN INDONESIA

Fisheries Development and Policy before 1968

Fish harvesting in Indonesia was a paramount activity long before independence of the country in 1945. However, it typically involved traditional fishing using sailboats and canoes either for line or trap fishing. A study of fishermen in Malaya (Firth, 1966) indicated that the islands adjacent to Malacca and Singapore (lying within Netherlands territory in early 1900) played an important role in supplying fresh fish to this particular Southeast Asian region. Of the fresh fish sold in Singapore municipal markets in 1924 (amounting to over 6400 tons), 73 percent was supplied from nearby islands.

From Bagansiapiapi (on the east coast of Sumatra) came additional heavy supplies of shrimp paste. Most of the fish supply to Malacca came from the

islands of Bengkalis, Rupat, and across the strait from Medan. These were mainly dried and cured fish but also chilled fish.

Fish supply to the dense agricultural population in Java came primarily from Singapore. Much of the dried fish, prawn, and shrimp paste was reexported from Singapore to meet this heavy demand. Fishing in other parts of Indonesia in the colonial period was not as active, except in east Java. According to Bottemanne (1959), the most important fishing operations in Java were with lampara net *(payang)*. In 1940 this fishery landed an estimated 30,000 tons of fish in east Java.

During the colonial period between 1904 and 1941 the Dutch undertook a number of programs designed to assist the development of the fishing sector, including the establishment of fisheries research stations. Several experiments were conducted with modern trawlers beginning around 1910. Also, fish markets (located mostly on Java) and an open auction system were established during this period (Krisnandhi, 1969).

The fisheries policy of the Dutch established the basis for some improvement in several facets of the fisheries including production, marketing, and processing. Modernization, however, was regarded as secondary in importance, and primary attention was given to improving the performance and welfare of the traditional fishermen. Since independence in 1945 fisheries policy has been more wide ranging. Programs begun by the Dutch to improve the performance of the traditional fisheries were continued, but there were other developments, e.g., the construction of processing facilities and ice plants and auction halls to support the fish marketing system. However, many of these programs were not as successful as expected. Fish canning factories, for example, suffered from a shortage of tinplate and a short supply of fish as well (Krisnandhi, 1969).

The fishing sector expanded significantly after 1951 in terms of both total production and consumption per capita. Between 1951 and 1967 marine fisheries production rose from 324,000 tons to 638,000 tons, a rate of 4.3 percent per year (Table 1). During this time the number of fishermen increased from 315,000 to 836,000, a rate of 6.3 percent per year. In the same period the number of vessels increased from 80,400 to 245,200, or 7.2 percent per year (Table 2). Fish consumption per capita rose from 8.4 kg per year in 1940 to 11.4 kg in 1966 (Table 1). Reflecting the above rates, the average catch per vessel fell from 4.0 tons to 2.6 tons between 1951 and 1967 (Table 2), and the catch per fisherman fell from 1.0 ton to 0.8 ton during the same period (Table 1).

The region that includes the Malacca Strait and the Riau Islands had always been more commercially advanced. In this region use of motorized fishing vessels developed rapidly. Between 1959 and 1963, when the number of motorized vessels rose from 1460 to 2990 in the whole country, the proportion of total motorized vessels registered in this region rose from 49 to 78 per-

Table 1. Fish Production, Number of Fishermen, and Production per Fisherman, 1951-1967

Year	Total Marine Fish Production (000 tons)	Total Fishermen (000 persons)	Production/Fisherman (000 tons/person)	Consumption* per Capita (kg)
1940	320	na	na	8.4
1951	324	315	1.0	7.7
1952	365	356	1.0	8.6
1953	374	393	1.0	8.4
1954	401	430	0.9	8.4
1955	412	452	0.9	8.4
1956	418	464	0.9	9.0
1957	406	478	0.8	8.8
1958	431	671	0.6	8.0
1959	400	735	0.5	8.4
1960	412	747	0.6	8.3
1961	525	804	0.7	9.6
1962	538	874	0.6	9.3
1963	559	852	0.7	9.1
1964	590	873	0.7	9.1
1965	661	892	0.7	na
1966	721	897	0.8	11.4
1967	638	836	0.8	na

*Includes net imports and fish from inland fisheries. The figures represent the equivalent in fresh fish.

Source: Krisnandhi (1969).

cent. In other areas of Indonesia lack of investment in modern processing facilities, inefficiencies in interisland shipping and the marketing system, and obstacles imposed by government regulations were considered reasons for the low overall development in the fisheries sector (Krisnandhi, 1969).

During 1936-1940 recorded fishery exports were about 6200 tons annually. However, exports declined to about 1800 tons by 1952 and continued to decline until the mid-1960s. According to one study (Sigit, 1968) the decrease of exports in general resulted from a lack of incentives and from administrative impediments. Regulation of exports became quite complicated while at the same time foreign capital investment was discouraged by official government policy.

In the period 1936-1940 fishery imports averaged 69,200 tons annually. By 1952 this figure had decreased only slightly to about 61,300 tons. After 1952 fishery imports fell steadily from an average of 41,000 tons during the period 1956-1960 to an average of only 3000 tons in the period 1961-1966. According to Krisnandhi (1969) this was related to the government policy of promoting self-sufficiency in fishery production. After the mid-1960s greater atten-

Table 2. Fish Production,[a] Vessels, and Production per Vessel, 1951–1979

Year	Total Fish Production (000 tons)	Number of Vessels (000)			Production per Vessel (tons)
		Motorized	Nonmotorized	Total	
1951	324	0.1	80.3	80.4	4.0
1952	365	0.3	90.4	90.7	4.0
1953	374	0.7	92.6	93.3	4.0
1954	401	0.8	96.8	97.6	4.1
1955	412	0.7	123.9	124.6	3.3
1956	418	0.8	129.2	130.0	3.2
1957	406	0.9	138.0	138.9	2.9
1958	431	1.4	154.3	155.7	2.8
1959	400	1.5	175.6	177.1	2.3
1960	412	1.5	168.0	169.1	2.4
1961	525	2.2	195.4	197.6	2.7
1962	538	2.9	206.8	209.7	2.6
1963	559	3.0	212.7	215.7	2.6
1964	590	3.2	235.0	238.2	2.5
1965	661	3.3	235.2	238.5	2.8
1966	721	3.4	236.2	239.6	3.0
1967	638	3.3	241.8	245.1	2.6
1968	722	5.7	278.2	283.9	2.5
1969	785	5.3	275.3	280.6	2.8
1970	807	6.0	289.4	295.4	2.7
1971	820	7.2	277.6	284.8	2.9
1972	836	8.8	286.5	295.3	2.8
1973	888	12.3	230.6	242.9	3.7
1974	949	13.2	257.2	270.4	3.5
1975	997	14.9	242.2	257.1	3.9
1976	1,082	17.5	228.2	245.7	4.4
1977	1,158	20.3	228.2	248.5	4.7
1978	1,227	26.0	222.1	248.1	4.9
1979	1,318	32.1	193.7	225.8	5.8

[a]Marine fisheries only.

Sources: Krisnandhi (1969); Directorate General of Fisheries (1977a, 1978a, 1979a, 1980a, 1981).

tion was paid to the fisheries sector in Indonesia. According to Minister of Fisheries Atmohandoyo, the main objectives of government policy were: to increase fisheries production so as to fulfill the protein requirement of the people; to increase fisheries research; to create skills in fisheries management; and to plan and develop fisheries laws and regulations (Departemen Perikanan Darat dan Laut, 1965).

Between 1964 and 1968 total production increased from 590,000 tons to 722,000 tons, or about 5.2 percent per year. The total number of fishing vessels (motorized and nonmotorized) increased from 238,200 to 283,900, or about 4.5 percent per year. However, since there were no extensive improve-

ments in fishing technology, average production per vessel remained relatively stable at 2.5 tons (see Table 2).

Shrimp had been caught mainly in coastal waters using traditional gears such as bottom gill nets, beach seines, push nets, and tidal traps. After 1965 fisheries development in Indonesia rapidly took off, especially following the introduction of commercial shrimp trawling (Pownall, 1975).

The government became aware of the need for foreign capital to hasten the development of the fisheries sector. There were two options: direct foreign investment, i.e., joint ventures, and foreign loans. The first option was not feasible because of the political situation at that time. With respect to the second, a plan was drawn up to establish a project that was to be financed by a foreign country in the form of a production sharing arrangement. (The payment of the loan was to be a percentage of the fisheries production resulting from the project.) However, this plan was never implemented because new investment policies were enacted in Indonesia in 1967.

Fisheries Development and Policy: 1969–1974

During the first five-year development plan (1969–1974), the government instituted a new policy and strategy for fisheries development. According to Zachman (1973), the main objectives were to improve the economic and marketing conditions in the fisheries sector of Indonesia. Experience in prior years indicated that this approach was critical, especially the goal of improving fish marketing. The general objectives were:

1. to increase fish production for domestic consumption and to increase national income by increasing foreign exchange earnings from fishery exports;
2. to increase, and distribute more evenly, the income of small fishermen and fish farmers;
3. to increase employment opportunities for fishermen; and
4. to promote rational management of fisheries resources in order to maintain their maximum potential

To meet these objectives, the new policy focused simultaneously on development of the small-scale fisheries; development of commercial fisheries; and improvement of the government fisheries service. The problems related to small-scale fisheries were low incomes and lack of entrepreneurship. The objectives of development, therefore, were to increase per capita income and to stimulate the training of entrepreneurs. This program consisted of two phases: increasing fish production and improving fish marketing.

The objectives for commercial fisheries were to produce commodities for export and to increase foreign exchange earnings. Fish species in high demand on the international market such as shrimps and tunas are found in abundance in Indonesian waters. Development of commercial fisheries was directed mainly at these species. Three policies were instituted to assist commercial fisheries development: (1) to encourage private foreign investment through the Foreign Investment Law No. 1 (1967); (2) to attract domestic investment in fisheries through the Domestic Private Investment Law No. 6 (1968); and (3) to stimulate bilateral and multilateral fisheries loan agreements, e.g., with the Overseas Economic Cooperation Fund (OECF, Japanese Government), the Asian Development Bank and the World Bank.

According to Sigit (1968), under these laws the following incentives were offered:

1. Exemption from the corporate tax on profits for a period of up to five years and exemption from dividend taxes on profits during those years.
2. Full authority to select management and to recruit foreign technicians and experts for positions that Indonesian manpower was not yet capable of filling.
3. Exemption from import duties for equipment, machinery, tools, and initial plant supplies.
4. Exemption from the capital stamp tax on the introduction of foreign capital investment.

During 1969–1973 ten joint venture companies were established with investments totaling $18.7 million.* By 1975 the number increased to fourteen, with a total investment of about $38 million (Table 3). Government policy decreed that foreign investment had to be arranged as a joint venture with local enterprises and had to operate in waters not intensively exploited by local fishermen or domestic enterprises. These areas were primarily in eastern Indonesian waters, which were underexploited and where fishing efforts were relatively low. In these areas (mainly in the waters off the south coast of Irian Jaya) the companies were required to construct onshore facilities for freezing and cold storage,† e.g., at Ambon, Sorong, and Ternate. The plan, therefore, envisaged the regional economic development of Maluku and Irian Jaya through "demonstration effects" generated from these activities.

*All dollar amounts in U.S. dollars.

†In later stages of development, when freezing and cold storage capacity were considered more than adequate, new companies were permitted to engage in fishing operations without the obligation to construct onshore facilities.

Table 3. Fishery Joint Venture Companies,[a] 1975

Name of Company	Activities	Location
P. T. Tofico	Shrimp fishing and processing	Irian Jaya
P. T. Misaja Mitra	Shrimp fishing & processing	East Kalimantan South Kalimantan
P. T. West Irian Fishing Industries	Shrimp fishing & processing	Irian Jaya
P. T. Irian Marine Products Development.	Shrimp fishing & processing	Irian Jaya
P. T. Nusantara Fishery	Shrimp fishing & processing	Irian Jaya
P. T. Mina Kartika	Shrimp fishing & processing	Maluku/Irian
P. T. Central Java Marine Company	Processing & freezing	Semarang
P. T. Maluku Pearl Development	Pearl culture	Kei, Aru and Tanimbar islands
P. T. East Indonesian Fishery	Skipjack fishing & processing	Halmahera
P. T. Alfa Kurnia Fishery Enterprise	Shrimp fishing & processing	Irian Jaya
P. T. Dwi Bina Utama	Shrimp fishing & processing	Irian Jaya
P. T. Karmi Arafura Fisheries	Shrimp fishing & processing	Irian Jaya
P. T. Tri Daya Kartika	Cold storage/ shrimp & fish processing	South Sulawesi
P. T. Nishin Samudra Mutiara	Pearl culture	Banggai Island
Totals	Shrimp fishing & processing	9
	Processing & cold storage (shrimp & fish)	2
	Pearl culture	2
	Skipjack fishing & processing	1

[a]Companies established under the Foreign Capital Investment Law, 1967.
Source: Sidarto (1975).

Total Vessels (100-300 GT)	Cold Storage Capacity (tons) & Location	Beginning Activity (year)	Investment (000 $)
14	100 (Jakarta) 50 (Ambon)	1969	5,700
19	420 (Kota Baru)	1969	3,589
19	100 (Sorong)	1970	5,729
10	100 (Sorong)	1970	3,641
7	100 (Ambon)	1970	2,175
13	100 (Ambon)	1971	4,431
—	380 (Semarang)	1970	1,167
1	—	1972	327
6	300 (Ternate)	1973	1,927
7	100 (Sorong)	1974	3,100
5	100 (Sorong)	1975	2,743
2	100 (Kaimana)	1975	2,054
—	140 (Ujung Pandang)	1975	1,418
—	—	1975	29.5
103 vessels	2,090		38,031

Table 4. Domestic Fishery Companies,* September 1975

Name of Company	Activities	Location of Operations	Total Vessels (15-100 GT)	Cold Storage Capacity (tons) & Location	Beginning Activity (year)	Investment (000 Rp)	Investment (000 $)
P. T. Surya Sakti	Shrimp fishing & processing	North Sumatra	23	250 (Belawan)	1969	274,000	660.2
P. T. Pumar	Shrimp fishing & processing	South Sumatra, Lampung, west Java, central Java, east Java	18	200 (Jakarta)	1969	368,000	886.7
P. T. Bonecom	Shrimp fishing & processing	Irian Jaya	5	40 (Ujung Pandang)	1969	336,496	810.8
P. T. Semarang Cold Storage & Industry	Shrimp fishing & processing	Irian Jaya, central Java, west Kalimantan	6	600 (Semarang)	1969	372,928	898.6
P. T. Maprodin	Shrimp fishing & processing	Irian Jaya	10	100 (Ambon)	1971	894,904	2,156.4
C. V. Dharma Mulia	Shrimp & fish processing/cold storage	West Kalimantan, south Sumatra, west Java, Jakarta, south Kalimantan	—	200 (Jakarta) 100 (Banjarmasin)	1973	252,993	609.6
P. T. Sari Samodra	Shrimp fishing & processing	Kalimantan, central Java, Irian Jaya	10	—	1973	633,909	1,527.5
P. T. Surya Aceh	Shrimp fishing & processing	Aceh	19	200 (Lhok Seumawe)	1973	1,069,534	2,577.2
P. T. Kalimantan Fishery	Shrimp fishing & processing	Central Kalimantan, east Kalimantan, south Kalimantan	11	100 (Banjarmasin)	1973	307,207	740.3
P. T. First Metropolitan Fisheries Company.	Shrimp fishing & processing	Jakarta	1	—	1973	10,000	24.1
P. T. Hidup Tunas Abadi	Shrimp fishing & processing	West Java, Jakarta, Lampung	4	—	1973	80,000	192.8
P. T. Serdid	Fish & shrimp processing cold storage	South Sulawesi	—	200 (Ujung Pandang)	1979	116,295	280.2
P. T. Tanjung Jati	Shrimp fishing & processing	Lampung	14	25 (Lampung)	1974	234,475	565.0

P. T. Central Java Cold Storage	Shrimp & fish processing/cold storage	Central Java	—	50 (Cilacap)	1974	na	—
P. T. Piffi[b]	Shrimp & fish culture (brackish water pond)	West Java, Jakarta					
P. T. Surya Irian[b]	Shrimp fishing & processing	Irian Jaya					
P. T. Harapan Murni[b]	Shrimp & fish culture (brackish water pond)	Madura					
P. T. Paniar Marine Product[b]	Shrimp fishing	Jakarta, south Sumatra, central Java, south Kalimantan					
P. T. Nabor[b]	Fish culture	West Java (Sukabumi)					
P. T. Sekarbumi Sidoardjo[b]	Shrimp & fish processing/cold storage	East Java (Surabaya, Sidoardjo)					
C. V. Harapan[b]	Shrimp & fish culture (brackish water pond)	Bali					
P. T. Surya Sumatra[b]	Shrimp fishing & processing	North Sumatra (Sibolga)					
P. T. Hasikin Jaya	Shrimp fishing & processing	Irian Jaya	6	100 (Bitung)	1970	310,000	746.9
C. V. Cakrawala Semesta	Shrimp fishing & processing	Irian Jaya	2	—	1972	26,460	63.8
P. T. Wenas Frozen Prawns	Shrimp fishing & processing	Irian Jaya	3	—	1972	100,296	241.0
P. T. Corimex	Shrimp & fish processing/cold storage	South Sulawesi	—	100 (Ujung Pandang)	1975	187,354	451.4
Totals			132	2,265			13,432.5
	Shrimp fishing	= 17					
	Shrimp & fish processing	= 5					
	Shrimp & fish culture	= 3					

[a]Companies established under the Domestic Capital Investment Law, 1968.
[b]Still in the process of establishment.
Source: Sidarto (1975).

Table 5. Fishery State Enterprises, 1969–1974

Company	Type of Operation	Capital (million $)			
		International Loan	Domestic Loan	Government Equity	Total
P. N. Perikani Sulut/Tengah	Skipjack pole and line	3.5[a]	3.25	1.8	8.55
Perum Perikanan Maluku	Skipjack pole and line	2.4[a] (World Bank)	4.26	3.8	10.46
P. T. Usaha Mina	Skipjack pole and line	7.9[b]	0.58	5.65	14.13
P. T. Perikanan Samodra Besar	Tuna longline	9.9[c]	1.55	1.72	13.17
P. T. Karya Mina	Trawl and gill net	2.5[b]	0.87	1.74	5.11

[a]World Bank.
[b]Asian Development Bank.
[c]Overseas Economic Cooperation Fund.
Sources: Directorate General of Fisheries (1977b); Comitini (1979a,b,c)

In 1975 twenty-six domestic fishing companies were established under the Domestic Investment Law, and eight of those were still in the process of establishment. Total investment in these companies was more than $13.4 million (Table 4). The largest investments were in integrated shrimp fishing and processing totaling $47.2 million ($35.1 million under the Foreign Investment Law and $12.1 million under the Domestic Investment Law). The next largest investments were in shrimp processing (cold storage and marketing) totaling $3.9 million ($2.6 million under the Foreign Investment Law and $1.3 million under the Domestic Investment Law).

Items of Investment	Year Legal Establishment of Company	Main Purpose	Location
30 vessels (pole and line) each 30 GT 600 t. cold storage ice plant fishing harbor	1961 (Loan agreement with World Bank in 1970)	Export	North Sulawesi (Aer Tembaga)
20 vessels (pole and line) each 30 GT 500 t. cold storage ice plant fishing harbor	1961 (Loan agreement with World Bank in 1973)	Export	Maluku (Ambon)
30 vessels (pole and line) each 30 GT 1300 t. cold storage ice plant fishing harbor fish carriers (2 vessels of 600 GT each)	1973	Export	West Irian (Sorong)
18 vessels (longline) each 100 GT 2 cold storages of 900 t. each 2 fishing harbors	1972	Export	Bali (Benoa) Aceh (Sabang)
60 vessels (gill net) each 8 GT 40 vessels (trawl) each 15 GT 4 cold storages of 50 t. each 4 fish carriers of 70 GT each 4 fishing harbors	1972	Export and domestic market	Riau (Tanjung Pinang)

The government also arranged loan agreements for financing fisheries development with the World Bank, the Asian Development Bank, and the Overseas Economic Cooperation Fund (OECF). Although the agreements were signed during this period, a lack of managerial expertise delayed implementation of actual project operations.

In this period a total of $33.1 million was invested in skipjack pole-and-line fisheries development; $13.8 million, or 41.7 percent, came from international bank loans and the remainder from domestic sources. A total of $13.2 million was invested in tuna longline fisheries development, 75 percent of which came from an OECF loan. A total of $5.1 million was invested in shrimp gill-net fisheries, 49 percent of which came from an Asian Development Bank loan (Table 5). Only one state enterprise was able to operate com-

mercially during this period, P. T. Perikanan Samodra Besar. The others, because of additional capital requirements and a lack of managerial talent, had to be delayed. Even P. T. Perikanan Samodra Besar, however, could not operate efficiently because of a lack of knowledge of the fishing grounds and experience in fishing operations.

Indonesia also received financial assistance for fisheries development from a number of foreign countries, e.g., Japan, West Germany, the Netherlands, and France, and from the U.N. Food and Agricultural Organization (FAO) (Pownall, 1975). This was mainly in the form of technical assistance and generally designated for research, education, training, and management. In addition, the government of Indonesia in its annual budget provided funds for constructing landing piers, auction halls, and storage and market facilities, and for research, education, training, extension, and fisheries administration.

During the 1969–1974 five-year development program there was no apparent increase in the total number of fishing vessels in Indonesia (Table 2). However, the number of motorized vessels increased steadily from 5300 in 1969 to 13,200 in 1974, or about 20.5 percent per year. The average production per vessel rose from 2.5 tons in 1968 to 2.8 tons in 1969 and to 3.7 tons in 1973. Thus, the steadily decreasing catch per vessel between 1951 and 1967 was halted during 1969 to 1973 and even began to show signs of attaining levels of earlier years.

An increase in fishery export commodities was one of the notable achievements of the government policy. Between 1968 and 1973 total exports increased from 19,720 tons to 52,180 tons, a rate of 21.5 percent per year (Table 6). The value of exports (nondeflated) increased from about $2.8 million to $68.2 million, or an average annual rate of 89.3 percent per year (Table 7). The relative value rose as a result of an increasing average price of shrimp and an increasing proportion of shrimp in fishery exports. Between 1968 and 1973 the proportion of frozen shrimp in the total volume of fishery exports increased from 12 to 54 percent. Frozen shrimp increased in total value from 25 to 84 percent.

Capital (nondeflated) invested in large fishery enterprises* increased from $1.97 million in 1969 to $44.36 million in 1974 (Table 8). The rate of increase of new investment was about 53.9 percent per year during this period. These investments, especially in the shrimp sector, had an impressive economic impact. The volume as well as the value of fisheries production increased rapidly during 1968–1973 (Tables 6 and 7).

*Large fishery enterprises are companies established under the provisions of the Foreign Capital Investment Law (1967) and the Domestic Capital Investment Law (1968).

Table 6. Volume of Fishery Exports, 1968–1979 (000 tons)

	Fresh/Frozen Fish				Crustaceans and Molluscs						
Year	Tuna and Skipjack	Other Marine Fish	Other Frozen Products	Subtotal[a]	Fresh/ Frozen Shrimp[a]	Dried/ Processed Shrimp	Other	Subtotal	Other Species[b]	Total	Incremental Change per Year
1968	na	3.42	0.02	3.44 (17)	2.46 (12)	0.44	0.39	3.29	12.99	19.72	—
1969	na	2.33	0.08	2.41 (11)	5.13 (24)	0.51	0.77	6.41	12.61	21.43	1.71
1970	na	1.25	0.22	1.47 (7)	6.87 (31)	0.46	0.92	8.25	12.34	22.06	0.63
1971	na	4.12	0.26	4.38 (14)	14.98 (48)	0.33	1.24	16.55	9.83	30.76	8.7
1972	na	3.86	0.35	4.21 (10)	22.62 (55)	0.79	1.73	25.14	11.80	41.15	10.39
1973	na	5.87	0.42	6.29 (12)	28.14 (54)	0.64	3.59	32.37	13.52	52.18	11.03
1974	na	7.10	0.52	7.62 (14)	32.11 (58)	0.61	4.24	36.96	10.37	54.95	2.77
1975	0.42	4.26	0.35	5.03 (12)	24.08 (59)	0.97	3.57	28.62	7.08	40.73	-14.22
1976	0.62	6.35	0.42	7.39 (14)	30.99 (57)	1.19	3.79	35.97	11.75	55.11	13.65
1977	1.89	9.08	0.44	11.41 (20)	30.26 (53)	1.35	3.30	34.91	11.19	57.51	3.13
1978	9.43	4.20	0.64	14.27 (22)	32.06 (50)	0.55	4.23	36.84	12.73	63.84	6.33
1979	9.80	6.71	0.70	17.21 (25)	34.24 (50)	0.50	4.26	39.00	4.49	60.70	4.42

[a]Parentheses denote percentage of total.

[b]Other species are ornamental fish, froglegs, and jellyfish.

Source: Directorate General of Fisheries (1979a, 1980b).

Table 7. Value of Fishery Exports, 1968–1979 (million$,FOB)[a]

Year	Fresh/Frozen Fish				Crustaceans and Molluscs				Other Species[c]	Total	Incremental Change per Year (%)
	Tuna and Skipjack	Other Marine Fish	Other Frozen Products	Subtotal[b]	Fresh/ Frozen Shrimp[b]	Dried/ Processed Shrimp	Other	Subtotal			
1968	na	0.51	0.04	0.55 (19)	0.72 (25)	0.11	0.03	0.86	1.41	2.82	—
1969	na	0.33	0.02	0.35 (14)	0.87 (36)	0.10	0.05	1.02	1.07	2.44	-0.38
1970	na	0.17	0.28	0.45 (6)	4.22 (60)	0.06	0.29	4.57	1.94	6.96	4.52
1971	na	0.89	0.59	1.48 (7)	14.66 (77)	0.04	0.99	15.69	1.82	18.99	12.03
1972	na	0.47	0.63	1.10 (3)	29.71 (85)	0.10	0.77	30.58	3.26	34.94	15.95
1973	na	0.68	1.01	1.69 (2)	57.47 (84)	0.09	1.98	59.54	6.95	68.18	33.24
1974	na	1.14	1.08	2.22 (2)	84.43 (91)	0.14	1.19	85.76	4.36	92.34	24.16
1975	0.26	1.24	0.26	1.76 (2)	77.95 (88)	0.19	2.74	80.89	5.54	88.19	-4.15
1976	0.41	1.93	0.10	2.44 (2)	116.57 (89)	0.37	3.16	120.10	8.65	131.19	43.00
1977	1.32	3.81	0.09	5.22 (3)	139.74 (86)	0.49	2.45	142.68	15.12	163.02	31.83
1978	6.19	1.57	0.19	7.95 (4)	161.73 (81)	0.22	5.55	167.50	22.97	198.42	35.40
1979	8.00	2.23	0.10	10.33 (4)	200.28 (85)	0.20	4.92	205.40	9.95	225.68	38.41

[a]Dollar amounts do not take account of inflation.

[b]Parentheses denote percentage of total.

[c]Other species are ornamental fish, froglegs, and jellyfish.

Source: Directorate General of Fisheries (1979a, 1980b).

Table 8. Investment by Large Fishery Enterprises,* 1969–1976 (million $)

Year	Annual Investment	Cumulative Investment
1969	1.97	1.97
1970	4.32	6.29
1971	6.50	12.79
1972	4.51	17.30
1973	10.07	27.37
1974	16.99	44.36
1975	14.68	59.04
1976	5.29	64.33

*Enterprise established under the provisions of the Foreign and Domestic Capital Investment Laws.

Source: Sidarto (1979).

Fisheries Development and Policy: 1974–1979

During the second five-year development plan for 1974–1979 the government projected increases in both marine and inland fisheries production of 4 percent per year (Sidarto, 1979). This projection assumed significant improvements in fisheries infrastructure and in fishermen's skills. During this period fishery production increased at an annual rate of 5.5 percent (from 1,337,000 to 1,749,000 tons), slightly above the target (Table 9).

Realizing that fisheries development encompassed interrelated aspects of production, processing, and marketing, the government planners adopted an integrated approach involving the following actions.

1. Creation of "nonphysical infrastructure" such as training, education, marine fisheries research, management, and administration. Fishery skills were to be developed through education and practical training in the subjects of navigation, seamanship, nautics, fishing techniques, and fish processing. Schools related to fisheries were established, including a Fisheries Academy in Jakarta, marine vocational schools in Tegal and Manado, and a Fisheries Training Center under the supervision of the United Nations Development Programme/Food and Agriculture Organization (UNDP/FAO). In addition, five regional marine fisheries training centers were established in Manado, Ambon, Sorong, Singaraja, and Belawan.

2. Establishment of "physical infrastructure" such as fishing ports, piers, breakwaters, market halls, dockyards, and slipways. The construction of fishing ports and landing piers was viewed as one of the most important programs to promote marine fisheries development. These facilities were constructed on Java and on Sumatra, Kalimantan, and Sulawesi. During 1974–1979 the gov-

Table 9. Fish Production, 1974–1979 (000 tons)

Year	Marine Fishery	Inland Fishery	Total
1974	949	388	1,337
1975	997	393	1,390
1976	1,082	401	1,483
1977	1,158	414	1,572
1978	1,227	420	1,647
1979	1,318	431	1,749
Percent increase	6.8	2.1	5.5

Source: Directorate General of Fisheries (1981).

ernment constructed twenty-two new fishing ports for coastal and offshore fishing vessels based in Java, Sumatra, Kalimantan, Maluku, and Nusa Tenggara Timur. A total of 133 landing piers along the north coast of Java, the east coast of Sumatra, and the coasts of Kalimantan and south Sulawesi were also constructed. The government also proposed to construct a large distant-water fishing port in Jakarta. Selected fishing ports and landing piers are shown in Figure 1.

3. Creation of production, processing, and marketing facilities such as fishing boats, fishing gears, engines, cold storage, and credit and extension services. The traditional source of capital for small-scale fishermen is from private lenders who charge a high interest rate. To cope with this problem the government adopted a small-holder credit scheme that provided feasible financing for construction of vessels between 5 and 7 tons (see Comitini, 1978d).

In line with national objectives the government continued its policy regarding the development of large-scale fisheries. By September 1975 fourteen foreign investment projects were approved. The total capital investment of these joint venture companies was $38 million. Nine joint venture companies were vertically integrated shrimp operations, two companies were engaged in pearl culture, two companies operated shrimp processing plants, and one joint venture was engaged in skipjack fishing (Table 3).

With the rapid development of shrimp joint ventures, local entrepreneurs recognized opportunities for establishing freezing and cold storage plants for collecting shrimp for export. Under the provisions of the Domestic Investment Law, local shrimp processing enterprises sprang up in Java (Jakarta, Semarang, and Cilacap); south Sulawesi (Ujung Pandang); Sumatra (Lhok Seumawe, Belawan, Teluk Betung); Kalimantan (Banjarmasin); and Maluku (Ambon) (Table 4).

According to Sidarto (1977), the steadily increasing capacity for collecting and processing shrimp sparked the development of domestic trawlers for har-

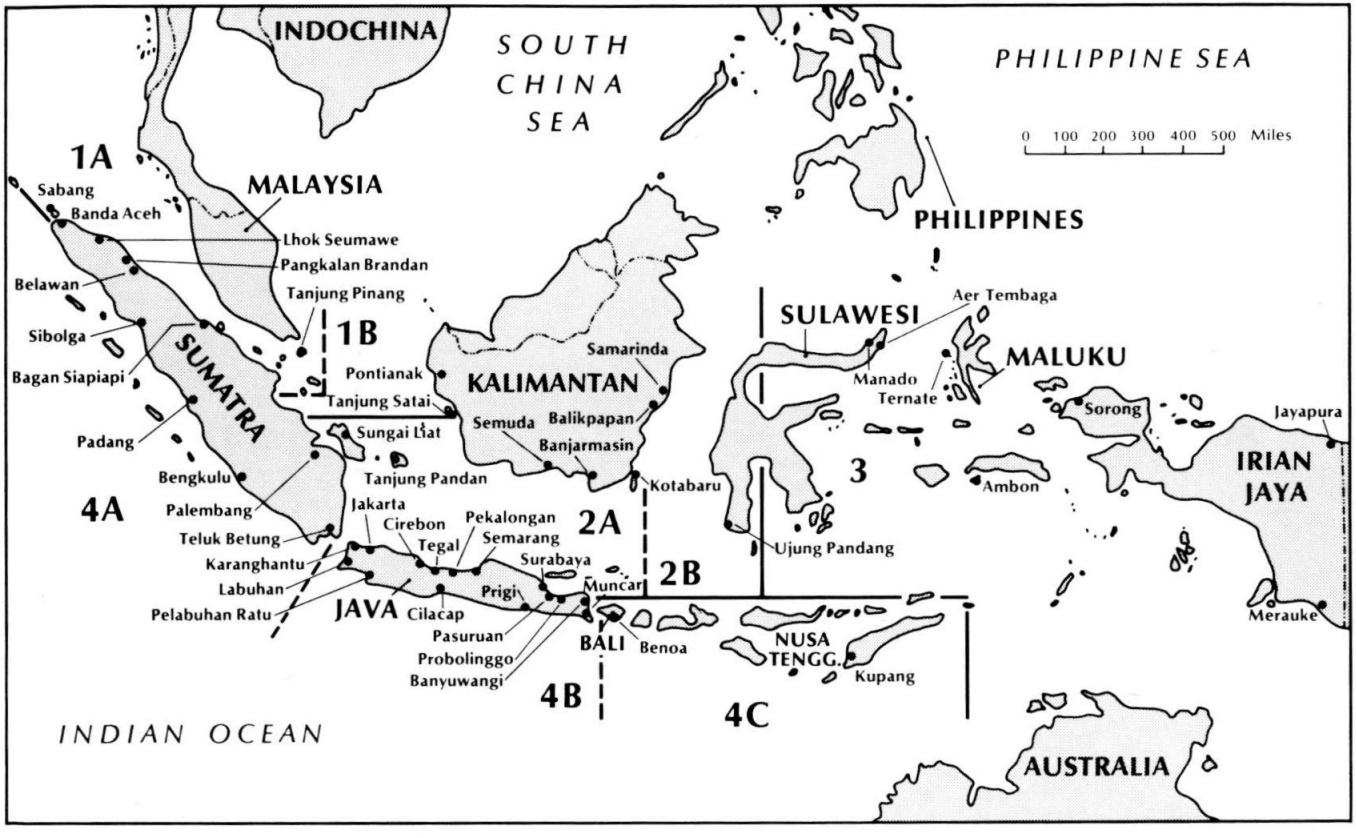

Figure 1. Fishing regions and selected fishing bases in Indonesia, 1977. (Source: Directorate General of Fisheries [1979a, 1979b].)

Table 10. Location and Capacity of Cold Storage Plants, 1975 (tons)

Region/Location	Private	Government (State Enterprises)	Total
Malacca Strait			
Lhok Seumawe	200		200
Belawan	250		250
Riau Islands		200	200
Subtotal			650
Java Sea			
Teluk Betung	25		25
Jakarta	500		500
Semarang	980		980
Banjarmasin	200		200
Kotabaru	420		420
Ujung Pandang	480		480
Subtotal			2,605
East Indonesia			
Ambon	350	600	950
Ternate	300		300
Bitung and Aertembaga	100	600	700
Sorong	400	1,300	1,700
Kaimana	100		100
Subtotal			3,750
Indian Ocean			
Sabang		900	900
Benoa		900	900
Cilacap	50		50
Subtotal			1,850
Total	4,355	4,500	8,855

Source: Sidarto (1975).

vesting shrimp, especially in the aforementioned areas. Thus, success in exporting shrimp by the joint venture companies had a catalytic effect in stimulating the development of local shrimp trawlers and shrimp processing operations throughout Indonesia. By the end of 1976 cold storage plants in Indonesia numbered fifty-one, with a total capacity of 12,588 tons. The distribution of cold storage facilities in 1975, which is illustrated in Figure 2, shows that the largest capacity is in eastern Indonesia (3750 tons), followed by the Java Sea region (2605 tons), the Indian Ocean region (1850 tons), and the Malacca Strait region (650 tons) (see Table 10).

In the period 1974–1979 two additional agreements were signed to establish fisheries projects in Indonesia. One was the Java Fisheries Development Project, established by the government in 1974. This project planned a chain of operations starting with catches of pelagic species by fifty offshore purse

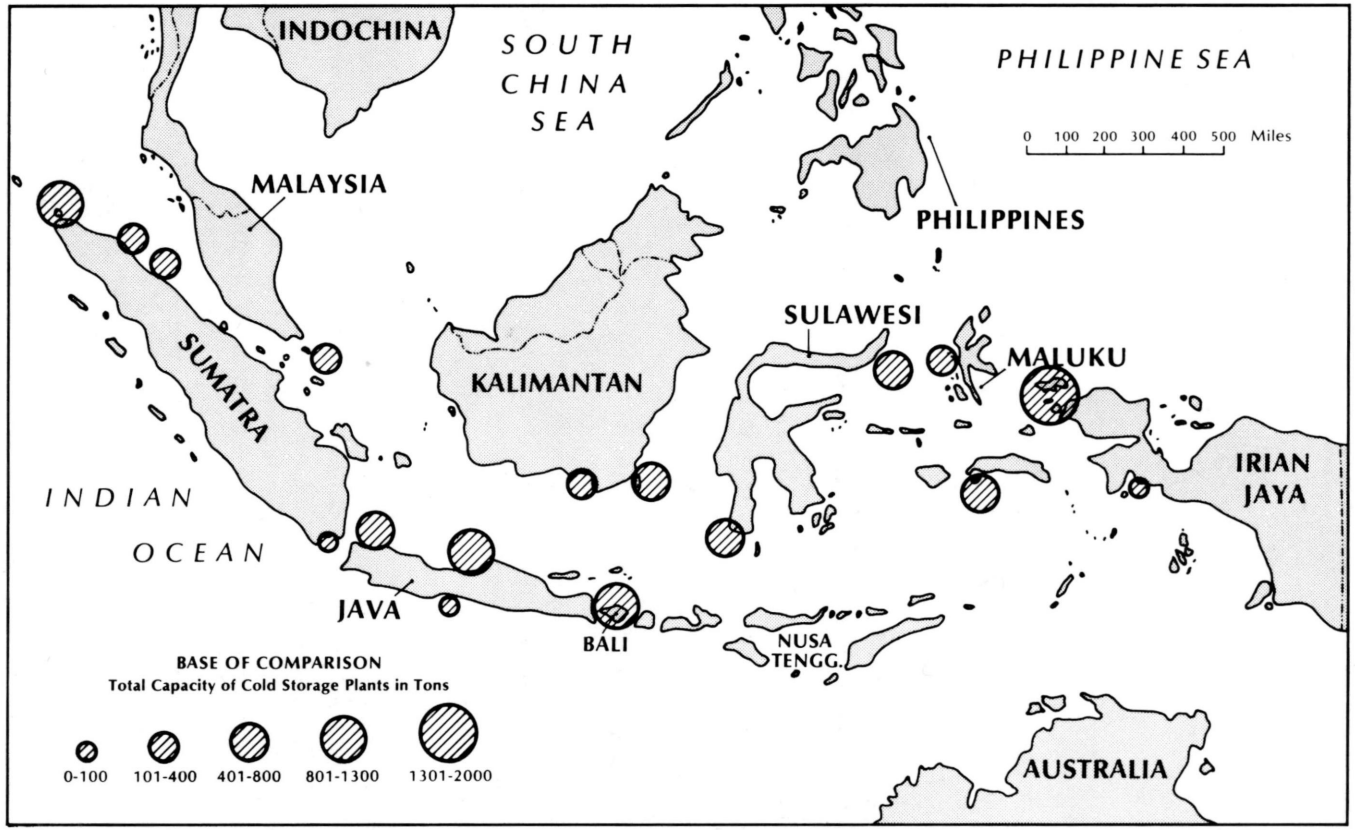

Figure 2. Location and size of cold storage plants, 1977. (Source: Sidarto [1975].)

Table 11. Fisheries State Enterprise/Project, 1974–1978

Enterprise	Type of operation	Capital (million $)			
		International Loan	Domestic Loan	Government Equity	Total
P. T. Tirta Raya Mina	Purse seine	$13.2 (Asian Development Bank)	$1.73	$6.39	$21.32
Project Perintis Padang	Fish distribution	$0.43 (New Zealand Government's Grant)	—	—	$0.43

Source: Directorate General of Fisheries (1977b).

seiners operating in the Java Sea and marketing operations in Jakarta and west Java (Asian Development Bank, 1974). Its main purpose was to support small-scale fisheries in central Java by providing collection, transportation, and marketing services for the fishermen. It was jointly financed through loans from the Asian Development Bank ($13.2 million), government-owned banks ($1.7 million), and equity by the government of Indonesia ($6.4 million).

The second project was a fresh-fish-marketing pilot project in Padang (west Sumatra) with the assistance of the government of New Zealand. The New Zealand government provided plans, machinery, equipment, and technical know-how, while the Indonesian government provided land, buildings, and local labor. An ice plant with a capacity of 20 tons and a coolroom with a holding capacity of 15 tons were constructed in Padang (Directorate General of Fisheries, 1977b; Turvey and Neil, 1978) (Table 11).

The relative operating performances of the state fishing enterprises between 1973 and 1980 is shown in Table 12. Lack of experience and poor management made implementation of most of these projects fall behind the original schedule. A financial and economic appraisal of the performance of these companies revealed that production was far below projections, especially in light of the substantial capital investments involved (Comitini, 1978a,b,c). Practically all of the companies were unable to attain breakeven levels. Consequently, government subsidies had to be extended to continue the operation of these companies. The same situation existed for P. T. Perikanan Samodra Besar. This company incurred losses all through 1973–1977 as a result of an imbalance between capital investment and production results (P. T. Perikanan Samodra Besar, 1978).

Another problem during this period was the heavy exploitation of the

Items of Investment	Year Legal Establishment of Company	Main Purpose	Location
50 purse seiners of 60 GT 1 cold storage of 600 t. fishing harbor refrigerated carrier (3 vessels of 120 GT) marketing facilities	1974	Domestic marketing	Central Java (Pekalongan)
icemaking plant chill room marketing facilities	1975	Fish distribution	West Sumatra (Padang)

shrimp fisheries, which threatened to endanger the stability of the resources. Experience showed that the fish by-catch of trawlers was 80 to 90 percent of the total catch. Most of these species, particularly those caught by joint venture companies in eastern Indonesia, were not utilized. Although they could have been consumed in western Indonesia, these species were simply thrown back into the sea.

To offset this apparent waste of a resource, the government enacted a fisheries regulation in 1973 that obligated all trawl fishing companies to utilize their incidental catches (Ministry of Agriculture Decree No. 501/Kpts/Um/11/1973). However, because of a lack of demand for these fish species in eastern Indonesia and because of the high cost of processing and transportation, the regulation could not be effectively implemented.

According to Haryono (1975) and Soeroyo (1975), directors of two shrimp joint venture companies, utilization of the fish by-catch of trawlers in Irian Jaya was not profitable because of the limited freezer space in the vessels, sorting costs, and limited fish holds while operating several months at sea. Eastern Indonesia has distinctly different conditions compared to other areas of Indonesia, such as Sumatra, Java, and Sulawesi, where these species are highly in demand, especially by low-income people.

Another regulation enacted for the purpose of sustaining the fishery resources was regulation of the mesh size of purse seine nets catching pelagic species. This regulation, enacted in 1975, prohibited the use of a purse seine net with a mesh size of less than one inch in the pocket and less than two inches in the wings (Ministry of Agriculture Decree No. 123/Kpts/Um/3/1975).

The rapid development of the fisheries sector, especially in the denser areas of the country, created many social problems. Small-scale fishermen using traditional methods frequently claimed that fishermen using more modern gear

Table 12. Target and Actual Production of State Fishery Enterprises, 1973–1980

Enterprise	Type of Fishing	Effective Date of Loan Agreement	Target Production (tons/year)	Actual production							
				1973	1974	1975	1976	1977	1978	1979	1980
P. N. Perikani Sulut/Tengah	Pole and line (30 boats)	1970	9,600	(a)	(a)	(a)	408	350	266	2,149	3,912
Perum Perikanan Maluku	Pole and line (10 boats)	1973	2,600	(a)	(a)	(a)	686	501	944	1,125	994
P. T. Usaha Mina	Pole and line (30 boats)	1973	7,800	(a)	(a)	68.4	884	1,694	4,827	4,130	4,201
P. T. Karya Mina	Trawl (40 boats)	1972	8,640	(a)	(a)	1,720	1,709	na	na	na	na
	Gill net (60 boats)		2,592	(a)	(a)	1,044	891	na	na	na	na
P. T. Perikanan Samodra Besar	Longline (18 boats)	1972	5,400	174	680	1,310	1,494	1,781	2,004	2,104	2,239

[a]The company was not in operation.

Sources: Comitini (1978a,b,c); Directorate General of Fisheries (1977b); P. T. Perikanan Samodra Besar, et al. (1981); Unar (1981).

were responsible for decreasing catches. These conflicts became serious, especially where trawl fisheries were dominant. The many incidents during this period included violence and demonstrations by small-scale fishermen's groups.

Faced with this competition problem, in 1976 the government enacted a regulation establishing fishing zones for different classes of vessels and types of fishing gear (Ministry of Agriculture Decree No. 607/Kpts/Um/9/1967). Under this regulation, Indonesian waters were divided by area into four fishing zones (see Figure 3).

Zone 1: the area within 0–3 miles offshore. This zone is closed for fishing operations using:

1. inboard motorized boats greater than 5 GT or 10 hp;
2. trawl net;
3. purse seine;
4. encircling gill net and drift net for species of little tuna; and
5. lampara net *(payang)* having a wing length over 120 m.

Zone 2: the area within 4–7 miles offshore. This zone is closed for fishing operations using:

1. inboard motorized vessels greater than 25 GT or 50 hp;
2. bottom trawl with a width at the mouth greater than 12 m;
3. midwater trawl and pair (bull) trawling; and
4. purse seine with a length over 300 m.

Zone 3: the area within 7–12 miles offshore. This zone is closed for fishing operations using:

1. inboard motorized vessels greater than 100 GT or 200 hp;
2. midwater trawl and bottom trawl with a width at the mouth greater than 20 m;
3. pair (bull) trawling; and
4. purse seine with a length over 600 m.

Zone 4: the area beyond 12 miles offshore. This zone is closed for fishing operations using pair (bull) trawling except in the Indian Ocean.

In order to better control and distribute trawler operations among fishing areas in Indonesia, the government also enacted a regulation in 1976 that divided Indonesian waters into four trawl fishing regions (Ministry of Agriculture Decree No. 609/Kpts/Um/9/1976) (see Figure 4):

Figure 3. Regulated fishing areas. (Source: Directorate General of Fisheries [1978a].)

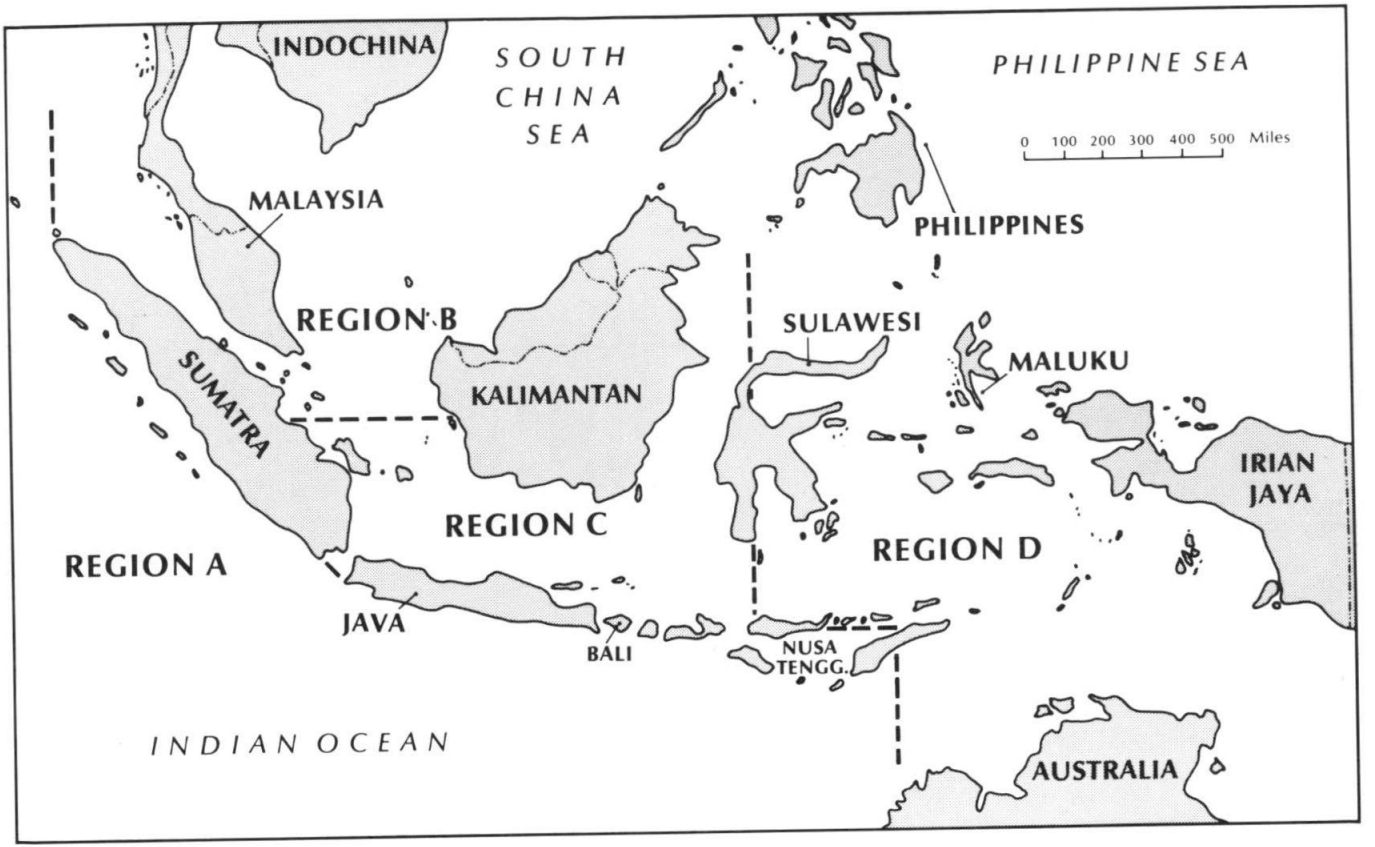

Figure 4. Division of trawl fishing regions. (Source: Jasamina [1978].)

Table 13. Fish Consumption per Capita in Indonesia, 1973–1977

Year	Consumption per Capita (kg)	Percent Change
1973	9.7	—
1974	9.9	2.0
1975	10.2	2.8
1976	10.5	2.1
1977	10.8	2.8

Source: Sidarto (1977).

Region A, the Indian Ocean, west coast of Sumatra, south coast of Java, and south coast of Nusa Tenggura;
Region B, Malacca Strait and the southern part of the South China Sea;
Region C, Karimata Strait, Java Sea, and Makassar Strait; and
Region D, eastern Indonesian waters.

Under this regulation, a trawler registered in one region is prohibited from operating in another region. The purpose is to minimize competition and social conflicts within and between regions that might result from the sharp increases in capital investment in the form of mechanized vessels in the shrimp fisheries.*

In this period the number of fishing vessels declined from 270,400 in 1974 to 225,800 in 1979 (Table 2). On the other hand, total fisheries production increased from 949,000 tons in 1974 to about 1,318,000 tons in 1979, about 6.8 percent per year. This undoubtedly was a result of the increase in number of motorized vessels relative to nonmotorized ones. The number of motorized fishing vessels actually increased from 13,200 to 32,100, a rate of about 19.4 percent per year.

The overall production per vessel in Indonesia increased from 3.5 tons in 1974 to 5.8 tons in 1979, or about 10.6 percent per year (Table 2). Per capita fish consumption also increased from 9.9 kg in 1974 to 10.8 kg in 1977, an average of about 2.9 percent per year (Table 13).

For a graphic depiction of shrimp and tuna production by region and of motorized vessels and their tonnage by region in 1977 see Appendix (Figures A1–A5 and Tables A1 and A2).

In foreign trade the value of fishery exports (nondeflated) increased from about $92.3 million in 1974 to about $236.8 million in 1979, approximately

*Recently (early 1980) the government enacted a regulation (Presidential Decree No. 3, 1980) that bans all trawler operations in Indonesia. This was because of the social conflicts resulting from overexploitation of the coastal resources (Asiaweek, 1980).

20.7 percent per year. The contribution of frozen shrimp exports was about $84.4 million in 1974 (91 percent) and about $200.3 million in 1979 (85 percent) (Table 7). In terms of volume, in 1974 fishery exports totalled 54,950 tons, of which 32,100 tons (58 percent) was from frozen shrimp; in 1979 the volume of fishery exports was 68,260 tons, of which 34,240 tons (50 percent) was frozen shrimp (Table 6).

EVALUATION OF MARINE FISHERIES POTENTIAL IN INDONESIA

This section covers the geographical distribution of fisheries development and fisheries potential in Indonesia. As previously shown, the fisheries sector in Indonesia was modernized quite rapidly during the period from the mid-1960s through the 1970s, particularly in Java, Sumatra, Kalimantan, and Sulawesi. However, fisheries development was unevenly distributed in terms of geographical location. Most development occurred around areas that were densely populated, namely, Java and Sumatra. The development of large-scale fisheries using modern equipment, processing, and marketing facilities was also thought to be an effective way to develop the small-scale fisheries. There were also cases of real social problems resulting from heavy exploitation of fish resources by the modernized sector, especially in the shrimp fisheries.

Division of Marine Fishing Regions in Indonesia

Based on the geographical location of fishing grounds and considering the national statistical system, in this study fishing in Indonesian waters is divided into four major regions (Figure 1).

Region 1. This region consists of subregion 1A (Malacca Strait) and subregion 1B (South China Sea). Subregion 1A covers the eastern waters of Aceh and north Sumatra and the waters of the Riau Islands. This subregion has relatively abundant fisheries resources of both pelagic and demersal species. The sea bottom is gently sloping, reaching a depth of 100 m (Figure 5). However, northeast of Aceh the sea is up to 1000 m deep, which makes it practically impossible to use small boats for demersal fishing. Small-scale fishermen, using nonmotorized boats with traditional gear, operate in the coastal areas within 3 to 7 miles.

The total area of subregion 1A from Aceh to Riau, under the Archipelagic

*Indonesian Declaration of December 13, 1975, later enacted into Law No. 4, 1960 (Djalal, 1978).

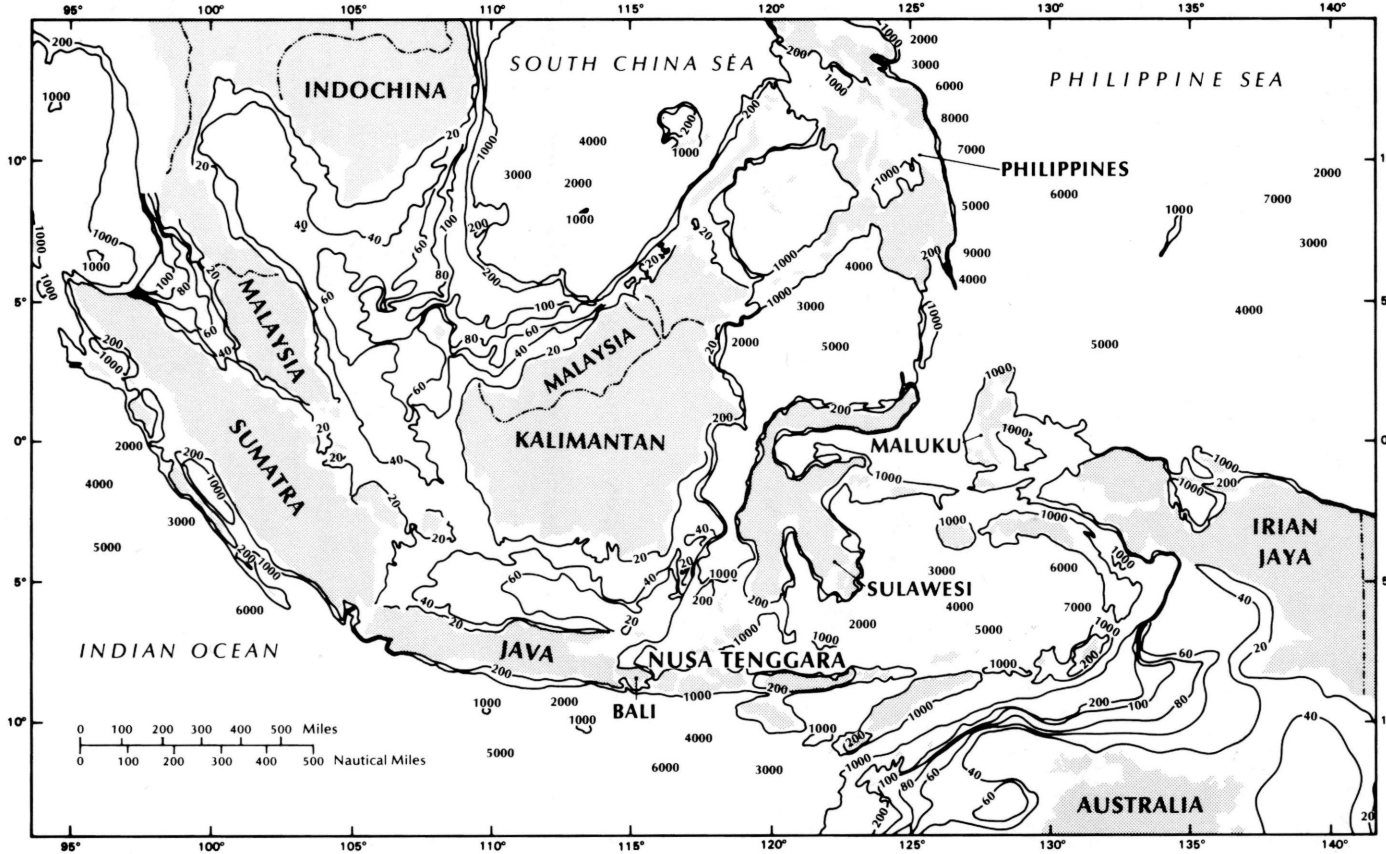

Figure 5. Topography of Southeast Asian waters. (Source: Defense Mapping Agency Hydrographic-Topographic Center [1980].)

Table 14. Jurisdictional Fishing Regions (000 square miles)

Regional Jurisdiction	Archipelagic Jurisdiction	Extended Jurisdiction[a]	Total
Region 1			
1A (Malacca Strait)	30.1	36.5	66.6
1B (South China Sea)	105.0	66.0	171.0
Subtotal	135.1	102.5	237.6
Region 2			
2A (Java Sea)	186.4	30.0	216.4
2B (Makassar Strait)	141.5	23.6	165.1
Subtotal	327.9	53.6	381.5
Region 3			
(East Indonesia)	539.7	371.5	911.2
Region 4			
4A (West of Sumatra)	81.4	214.7	296.1
4B (South of Java)	17.1	112.1	129.2
4C (Bali and Nusa Tenggara)	106.2	126.7	232.9
Subtotal	204.7	453.5	658.2
Total	1,207.4	981.1	2,188.5

[a]Based on authors' calculations.
Source: Prescott (1981).

Principle,* is approximately 30,100 square miles (Table 14). However, this area has been extended to about 66,600 square miles under the new Law of the Sea (extended maritime jurisdiction), which was adopted by the Indonesian government in 1980 (Government Decree of Indonesian Exclusive Economic Zone, March 21, 1980). The extended area is mostly to the north and east of Sumatra (Figure 6). The most important fishing bases in subregion 1A are: Tanjung Pinang, Bagan Siapaiapi, Belawan, Sabang, and Banda Aceh (Figure 1).

Subregion 1B, which covers the area between Jambi Province on the island of Sumatra and West Kalimantan Province (including the islands of Pulau Tujuh), has a similar topography. The depth of the sea is about 40 m between Jambi and west Kalimantan and about 60 m around the Pulau Tujuh islands. In terms of economic geography, this subregion is different from the former, especially with respect to proximity to consuming areas and market outlets.

This subregion has vast potential for both pelagic and demersal species. Currently, however, the level of fisheries exploitation is relatively low, especially around Pulau Tujuh, resulting primarily from a lack of markets for the catches. Small-scale and medium-scale fishermen are quite active off the coasts of Jambi and west Kalimantan.

The total extent of this area under the Archipelagic Principle is approxi-

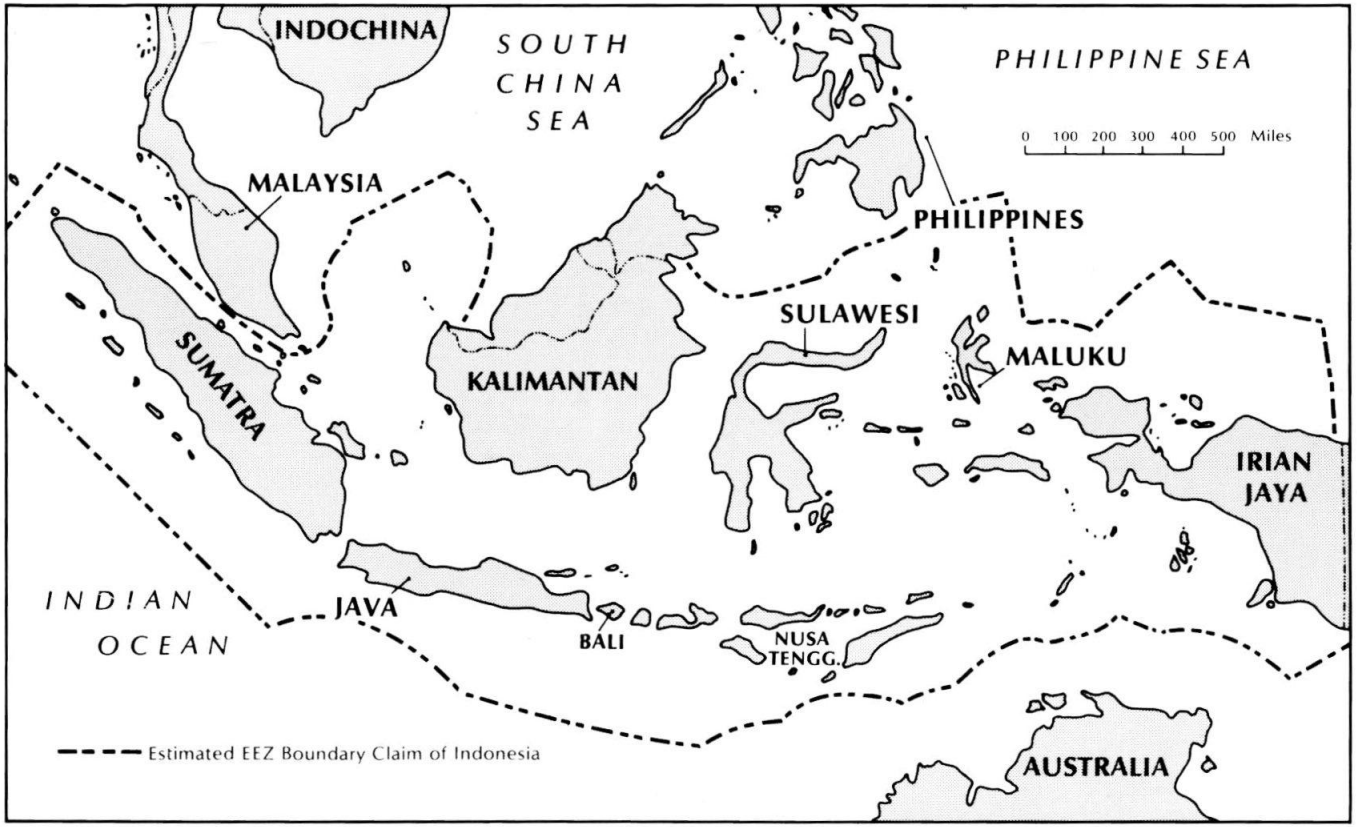

Figure 6. Exclusive Economic Zone (EEZ) of Indonesia. (Source: Prescott [1981].)

mately 105,000 square miles (mi²); under the new Law of the Sea it has been extended to about 171,000 mi² (Table 14). The most important landing bases in this subregion are Pontianak and Tanjung Satai (in Kalimantan) and Jambi (in Sumatra) (Figure 1).

Region 2. This region consists of subregions 2A (Java Sea) and 2B (Makassar Strait). Topographically these areas are different. In the Makassar Strait the depth is over 200 m. The Java Sea, however, is not more than 60 m deep with a gently sloping bottom. Demersal fishermen are, therefore, more active in the Java Sea than in Makassar Strait. In addition, the Java Sea is closer to the major consuming centers on Java.

The extent of subregion 2A under the Archipelagic Principle is 186,400 mi². Under the new Law of the Sea this area has been extended to embrace the area north of Bangka and Bilitung islands for a total of 216,400 mi². For subregion 2B the total area under the Archipelagic Principle is 141,500 mi², extended to over 165,100 mi² under the new law. The extension is in the northern part of Makassar Strait where there is a large potential for fishery of skipjack and the larger tunas.

The important landing bases in subregion 2A are (Figure 1): Jakarta, Cirebon, Tegal, Pekalongan, Semarang, Gresik, Surabaya, Probolinggo, and Pasuruan (in Java); Palembang, Sungai Liat, Tanjung Pandan, and Teluk Betung (in Sumatra); and Banjarmasin (in Kalimantan). In subregion 2B are Samarinda and Balikpapan (in Kalimantan) and Ujung Pandang (in Sulawesi).

Region 3. Region 3 covers the area between east Nusa Tenggara, Sulawesi, and Irian Jaya (including Maluku). Topographically this area is significantly different from the former two regions. The ocean depth is well over 200 m (5000–6000 m in some places). The exception is a small area off the north coast of Sulawesi and another area off the south coast of Irian Jaya (Figure 5).

Although the ocean depth off Irian Jaya could sustain small-scale demersal fishing, the lack of a market outlet has constrained any significant development. This area has been developed primarily by large-scale joint venture companies since 1968. Their operations use shrimp trawlers in the 200–300 GT range and skipjack pole-and-liners of about the same size.

On the local level, pelagic fishermen in this region use motorized and nonmotorized vessels ranging from 5 to 30 GT. Their operations are concentrated where there is a market potential either locally or for export. The important landing bases are Manado, Aer Tembaga, Bitung, Ambon, Ternate, Sorong, and Jayapura (Figure 1). Although there is potential for expanded operations by medium-scale pelagic fishermen, significant development has been hampered by capital and technological constraints.

The extent of this region under the Archipelagic Principle is 539,700 mi².

Under the new Law of the Sea, this region is extended to the north and south for a total of 911,200 mi². Despite the extent and potential of this region, fisheries development has been impeded by two factors: lack of capital (including technology) and lack of market outlets.

Region 4. This region is divided into three subregions: 4A (west coast of Sumatra), 4B (south coast of Java), and 4C (the area around Bali and Nusa Tenggara). Compared with subregions 4A and 4B, subregion 4C is less developed (except south of Bali). Again, the basic reason is lack of market outlets for fish catches.

Topographically these subregions are similar. Although the ocean bottom is generally steeply sloping, some areas can accommodate demersal fisheries operations. These are off the west coast of Aceh, north of Sumatra, Bengkulu, and Cilacap (south Java). Traditional small-scale fishing is limited because of generally rough sea conditions. Medium-scale fisheries in these areas have in fact developed quite rapidly, especially since 1973. The methods used are trawling, purse seining, and line fishing. In order to operate in this region, fishing vessels of at least 15 to 25 GT are required.

The extent of this region is approximately 204,700 mi², consisting of 81,400 mi² in subregion 4A (Sumatra), 17,100 mi² in subregion 4B (south of Java), and 106,200 mi² in subregion 4C (Bali and Nusa Tenggara). Under the new Law of the Sea subregion 4A has been extended to 296,100 mi², subregion 4B to 129,200 mi², and subregion 4C to 232,900 mi². The extent of Region 4 under the new law is thus 658,200 mi² (Table 14).

The most important landing bases in this region are (Figure 1): Sibolga, Padang, and Bengkulu (in Sumatra); Pelabuhan Ratu, Cilacap, Prigi, and Pancer (in Java); and Benoa and Kupang (in Bali-Nusa Tenggara).

Marine Fisheries Potential

According to the FAO (1980) there are over one hundred species of fish and other marine organisms contributing to sea fisheries production in Indonesian waters (see Appendix Table A3 for a list of important species). These are grouped into four categories: crustaceans (primarily shrimp); demersals (e.g., ponyfish, groupers, and snappers); small pelagics (e.g., mackerels, scads, pomfret, sardines, and anchovies); and large pelagics (e.g., tunas). For this study fish catches are grouped into two categories: demersal species (including shrimp) and pelagic species (including large tunas and skipjack). Figure 7 illustrates the location of the known fishing grounds in Indonesia.

Region 1: Demersal Fisheries. Throughout Indonesia the most valuable demersal fishery is shrimp. In subregion 1A (Malacca Strait) shrimp are caught by a

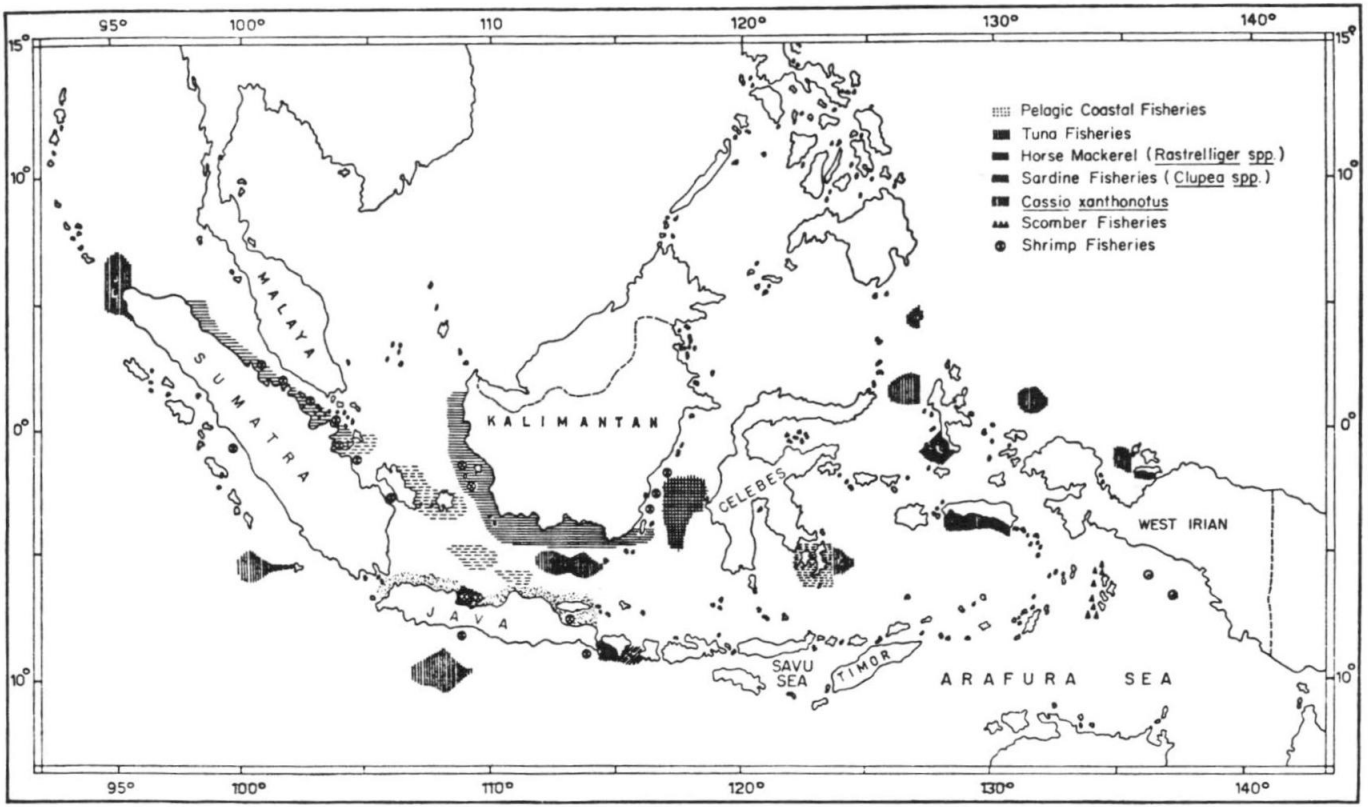

Figure 7. Location of known fishing grounds. (Source: Doty and Soegiarto [1970], reproduced from *Indonesia: Resources and Their Technological Development,* copyright © 1970 University Press of Kentucky.)

Table 15. Fisheries Production by Type of Gear and by Region, 1975–1977 (tons)

Type of Gear	Region 1				Region 2			
	Total Production			Average per Year	Total Production			Average per Year
	1975	1976	1977		1975	1976	1977	
Trawl[b]	58,812	53,353	50,590	54,252	48,505	59,974	64,848	57,776
Lampara net[a]	19,253	2,180	5,272	8,902	82,819	68,593	62,196	71,202
Purse seine[a]	12,401	25,781	23,051	20,411	30,599	36,903	53,977	40,493
Drift gill net[a]	23,865	28,015	29,730	27,203	62,433	79,845	99,725	79,001
Encircling gill net[a]	4,094	753	658	1,835	13,170	19,682	20,252	17,701
Shrimp gill net[b]	1,993	2,260	2,907	2,387	16,310	17,698	17,145	17,051
Set gill net[b]	2,479	3,128	6,357	3,988	17,963	27,058	17,168	20,729
Raft lift net[a]	—	—	—	—	7,025	10,014	19,140	12,059
Fixed lift net[a]	14,121	2,745	3,175	6,680	39,538	44,358	52,644	45,513
Tuna longline[a]	—	—	—	—	—	4,826	—	na
Drift longline[a]	—	2,400	2,550	2,475	7,945	3,694	4,300	5,313
Set longline[b]	2,853	625	2,343	1,940	6,936	4,637	8,019	6,530
Troll line[a]	1,076	3,991	3,722	2,930	4,748	4,447	61,433	23,543
Pole and line[a]	—	—	—	—	—	—	—	—
Stow line[ab]	51,507	21,857	22,856	32,073	32,627	9,351	4,206	15,395
Guiding barrier[ab]	3,538	22,543	21,161	15,747	16,490	13,342	9,963	13,265

[a]Pelagic fishing.

[b]Demersal fishing.

Source: Directorate General of Fisheries (1977a, 1978a, 1979a).

variety of gear types. These operations are carried out mainly by small-scale fishermen using nonmotorized vessels or small motorized vessels of less than 5 GT, and by medium-scale operations using larger vessels.

Although the demersal fishery, e.g., trawling, is directed mainly at catching shrimp, the volume of fish produced as by-catches far exceeds that of shrimp. In this area, these by-catch species have a market demand as processed (dried/salted) products, especially by lower-income people. The production of demersal fish in this region (except Pulau Tujuh islands) is concentrated within 10 to 15 miles from shore in depths of less than 40 m (FAO, 1980).

The average annual fish caught by trawlers during the period 1975–1977 in this region was 54,252 *tons* (Table 15). On the other hand, fish caught by shrimp gill nets was only 2387 tons. Other types of gear that are important for demersal fisheries are stow line *(kelong)* and guiding barrier *(sero)*, with average production during 1975–1977 of 32,073 tons and 15,747 tons, respectively.

In 1977 demersal fisheries production in subregion 1A was about 114,900 tons (Table 16). Maximum sustainable yield (MSY) of demersal fisheries in this subregion is estimated at 115,000 tons per year. Thus, demersal fisheries in this area could not be expanded to a higher level of sustained exploitation over the long term.

Region 3				Region 4			
Total Production			Average per	Total Production			Average per
1975	1976	1977	Year	1975	1976	1977	Year
4,556	33,717	7,108	15,127	16,881	21,376	28,699	22,319
3,199	4,028	4,988	4,071	16,971	13,169	17,228	15,789
7,727	10,961	11,501	10,063	11,860	15,318	27,646	18,275
5,598	9,132	7,951	7,560	8,969	17,083	20,136	15,396
1,847	3,073	2,786	2,568	881	569	1,764	1,071
77	—	—	na	6,615	2,519	1,761	3,632
4,702	4,549	9,303	6,185	4,643	11,747	8,257	8,216
10,722	12,350	12,417	11,829	7,306	12,931	9,404	9,880
5,280	1,163	2,460	2,968	2,949	9,058	14,788	8,932
—	—	—	—	939	1,473	1,906	1,439
6,231	1,819	2,518	3,523	40	830	1,252	707
1,090	506	680	759	3,199	1,805	599	1,868
4,437	12,056	15,723	10,738	6,945	11,120	9,970	9,345
10,998	14,965	15,365	13,776	—	—	—	—
—	—	—	—	83	—	—	na
4,934	3,655	3,366	3,985	1,475	1,510	1,382	1,456

On the other hand, the level of the demersal fish catch in subregion 1B (South China Sea) in 1977 was about 20,200 tons, far below the estimated MSY level of 318,000 tons (Table 16). Thus, it is possible to expand demersal fishing in this area, especially in deeper waters. However, this will require fishing vessels larger than those currently used in the inshore areas.

Figures 8 and 9 and Table 17 show the capital value of vessels in each region in 1977. Vessel capital investment per square mile in subregion 1A was $1.73 million while subregion 1B had a relatively small investment ($138,000). Thus, a reallocation of vessels from subregion 1A to 1B, especially for bottom fishing around the Natuna Islands in the South China Sea, may be considered desirable for an optimal allocation of demersal fisheries production capacity.

Region 1: Pelagic Fisheries. The largest catches of pelagic species in Region 1 are made by purse seiners and drift gill nets, averaging about 20,400 tons and 27,200 tons, respectively, during 1975-1977 (Table 15). These two gear types are different with respect to their scale of operations. Purse-seine fishing using motorized boats between 10 and 20 GT is considered a medium-scale operation. Drift gill nets are operated by small-scale fishermen using small motorized boats up to 5 GT or nonmotorized boats. Drift gill-net fishing units in this region averaged 5858, and there were only 168 units of purse seine during 1975-1977 (Table 18).

Table 16. Demersal Fisheries Potential and Level of Production, 1977 (tons)

Region	MSY Level	Level of Production
Region 1		
1A (Malacca Strait)	115,000	114,877
1B (South China Sea)	318,000	20,152
Subtotal	433,000	135,029
Region 2		
2A (Java Sea)	484,000	107,106
2B (Makassar Strait)	68,000	32,074
Subtotal	552,000	139,180
Region 3		
(East Indonesia)	680,000	18,077
Region 4		
4A (West of Sumatra)	78,000	14,527
4B & 4C (South of Java and Bali-Nusa Tenggara)	25,000	29,762
Subtotal	103,000	44,289
Total	1,768,000	336,575

Source: Directorate General of Fisheries (1979a, 1979b).

In 1977 pelagic fisheries production in subregion 1A was around 115,100 tons, exceeding the estimated MSY level of 70,000 tons (Table 19). On the other hand, pelagic fisheries production in subregion 1B was about 27,900 tons, far below the estimated MSY level of 495,000 tons. Thus, the level of pelagic fisheries exploitation in the Malacca Strait area may well be reduced in order to sustain the availability of the stocks for future use. This may be the desirable policy in a static framework, but as fish prices and production costs change over time, together with a rather high discount rate, Indonesia may prefer higher catch levels in the present rather than in the future (cf. Clark and Munro, 1975; Clark, 1976, ch. 3). One solution might be to reallocate fishing effort to the South China Sea area, which is considered underexploited. This, however, would involve employment of larger fishing vessels in order to overcome the relatively rough sea conditions and greater distances from the markets.

Region 2: Demersal Fisheries. The most important demersal fishing activities in this region are trawl fishing and gill-net fishing for shrimp and large bottom fish. These operations are the largest in terms of production (Table 15).

Production from the trawl fisheries averaged 57,775 tons during 1975–1977 (Table 15), slightly above that in Region 1 (54,252 tons). This is primarily a result of the higher average number of trawl units in Region 2 (1410 compared to 1085 in Region 1; Table 18).

Table 17. Estimated Value of Vessels[a] by Region, 1977 (000 $)

Region	Nonmotorized Vessels	Outboard Motor and Less Than 5 GT	5-10 GT	Greater Than 10 GT	Total
1A	13,945	16,092	29,250	55,310	114,597
1B	1,907	4,331	10,957	6,480	23,675
2A	35,567	14,098	14,872	88,630	153,167
2B	13,024	8,359	1,822	1,630	24,835
3	10,115	2,615	540	119,000	132,270
4A	4,177	2,399	6,255	7,210	20,041
4B	1,110	1,648	765	23,340	26,863
4C	3,895	839	22	8,800	13,556

Source: Directorate General of Fisheries (1976b, 1979a).

[a]Estimated investment cost: dugout canoe, $600/ton; sailing boat, $750/ton; outboard motor, $1,800/ton; less than 5 GT, $2,500/ton; 5-10 GT, $3,000/ton; 10-50 GT, $3,500/ton; greater than 50 GT, $5,000/ton.
Sources: Directorate General of Fisheries (1977a, 1976b).

Production of demersal fish in subregion 2A (Java Sea) in 1977 was about 107,100 tons, far below the estimated maximum sustainable yield (MSY) of 484,000 tons/year (Table 16). A similar condition exists in subregion 2B (Makassar Strait) where production in 1977 was about 32,100 tons, somewhat less than the estimated maximum sustainable yield in that area of 68,000 tons (Table 16). Thus, there is no apparent necessity to restrain the level of demersal fisheries exploitation in either of these subregions.

Region 2: Pelagic Fisheries. The largest pelagic fish catch in Region 2 is from drift gill-net fishing, averaging 79,000 tons during 1975-1977 (Table 15). This particular fishing is generally done by small-scale fishermen using small motorized vessels or nonmotorized vessels. The average number during 1975-1977 was 20,129 units (Table 18).

The second largest production is from lampara-net fishing *(payang),* also a small-scale operation. Total production during 1975-1977 averaged 71,200 tons, produced by 9229 units (Tables 15 and 18).

The third largest production is from fixed lift-net fishing *(bagan),* a traditional method using light to attract fish. Production during 1975-1977 averaged 45,500 tons, produced by 8120 units.

The fourth largest production is from purse-seine fishing. This activity is

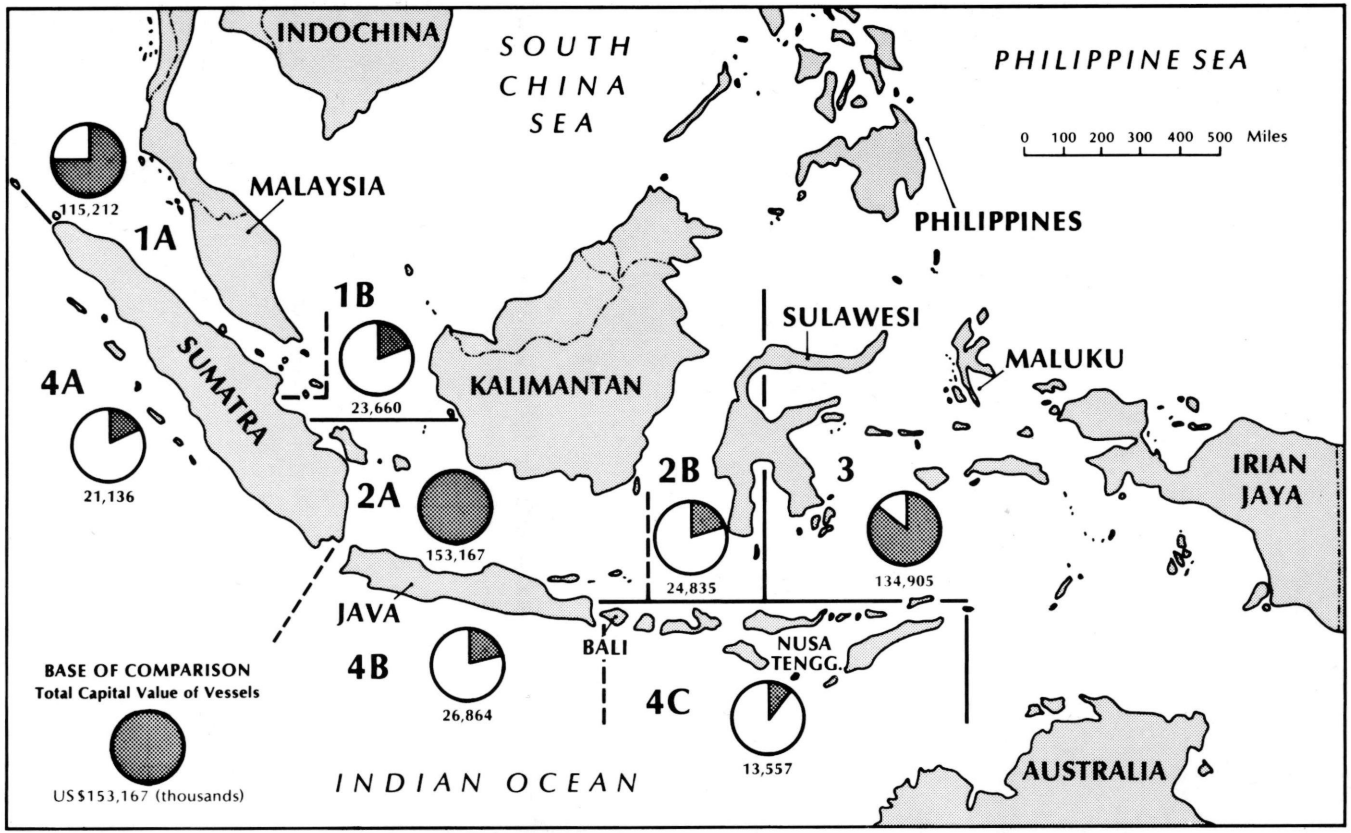

Figure 8. Estimated capital value of fishing vessels by region, 1977. (Source: Directorate General of Fisheries [1976b, 1979a].)

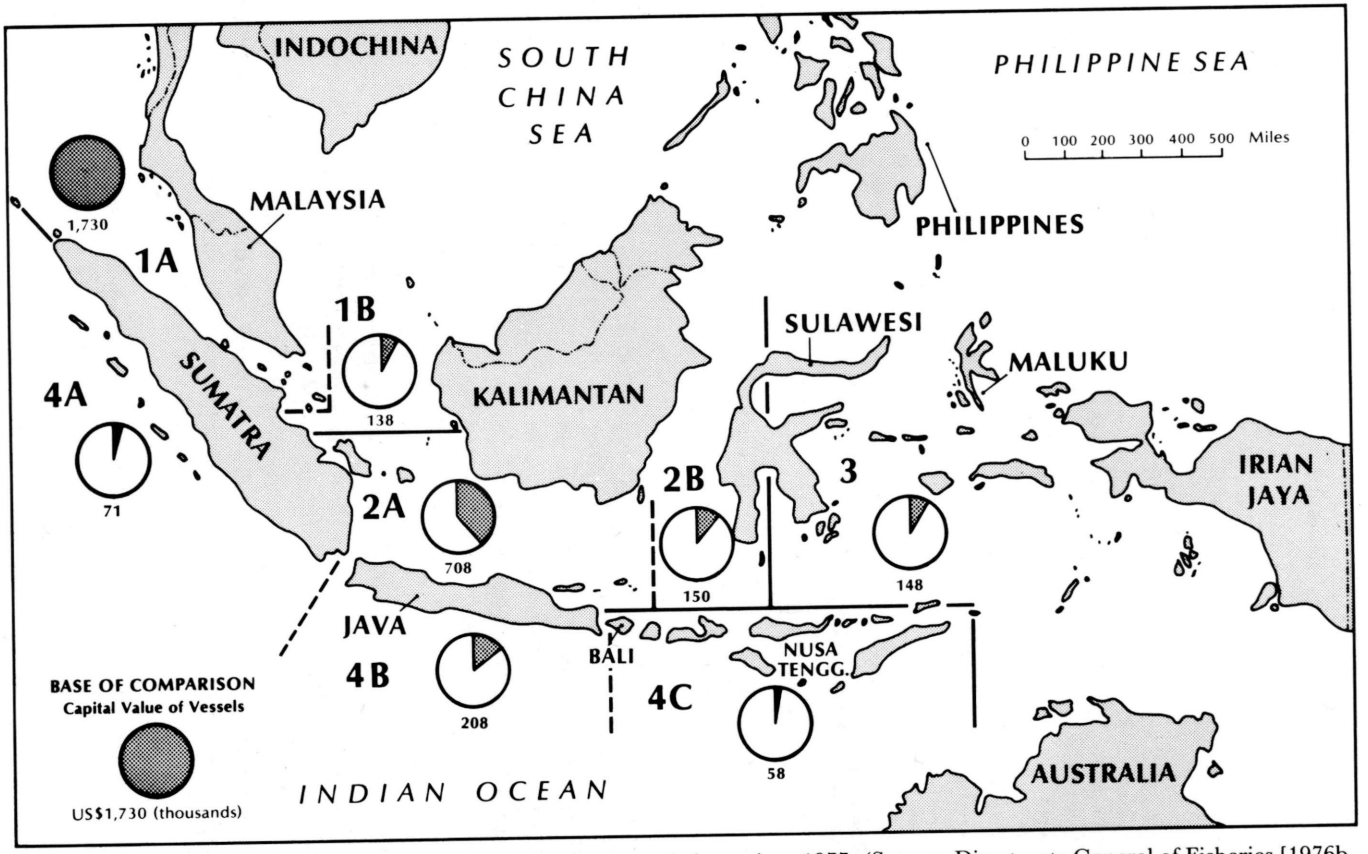

Figure 9. Estimated capital value of fishing vessels per square mile by region, 1977. (Source: Directorate General of Fisheries [1976b, 1979a].)

Table 18. Number of Units of Fishing Gear by Region, 1975–1977

Item	Region 1				Region 2			
	Total units			Average per Year	Total units			Average per Year
	1975	1976	1977		1975	1976	1977	
Trawl	768	1,189	1,300	1,086	1,199	1,361	1,670	1,410
Lampara net	1,433	1,911	193	1,179	9,934	7,515	10,238	9,229
Purse seine	144	180	211	178	291	414	473	393
Drift gill net	5,112	5,754	6,697	5,854	17,576	17,396	25,417	20,130
Encircling gill net	521	136	151	269	2,631	1,446	3,060	2,379
Shrimp gill net	506	1,146	1,891	1,181	2,363	15,305	17,356	11,675
Set gill net (bottom)	534	217	175	309	16,624	7,957	8,179	10,920
Raft lift net	—	—	—	—	1,108	1,211	4,183	2,167
Fixed lift net	2,473	282	302	1,019	7,631	8,106	8,623	8,120
Tuna longline	—	—	—	—	—	2	—	—
Drift longline	—	1,278	1,243	1,260	6,424	1,621	2,903	3,649
Set longline	762	110	135	336	5,332	2,794	4,238	4,121
Troll line	917	766	298	660	2,494	4,543	5,711	4,249
Pole and line	—	—	—	—	—	—	—	—
Stow line (trap)	1,117	1,197	1,149	1,154	762	1,106	890	919
Guiding barrier (trap)	882	1,941	1,904	1,576	6,423	3,334	3,643	4,467

Source: Directorate General of Fisheries (1977a, 1978a, 1979a).

carried out by medium- and small-scale fishermen. Total production during 1975–1977 averaged 40,493 tons, utilizing 393 purse-seine units.

Total production of pelagic species in subregion 2A was about 296,800 tons, over the estimated maximum sustainable yield (MSY) of 221,000 tons per year (Table 19). Total production of pelagic species in subregion 2B was about 115,000 tons in 1977, below the estimated MSY level of 250,000 tons. Thus, expansion of fishing effort in subregion 2B is still possible without adversely affecting the stocks, but may not be desirable in subregion 2A.*

Figure 8 shows that subregion 2A has the largest aggregate vessel capital investment in Indonesia ($153.2 million), six times larger than that of subregion 2B and that of subregion 1B (South China Sea).

An optimal pelagic fisheries management policy in this region might be to reallocate fishing effort from subregion 2A to subregion 2B or to subregion 1B to the west (Figure 9). However, any management policy must be evaluated in terms of capital requirements and distances to markets.

Region 3: Demersal Fisheries. Demersal fisheries production in this region is carried out mainly by medium- and large-scale trawl fishing units using

*However, see the section on Region 1: Pelagic Fisheries.

Region 3				Region 4			
Total units			Average per	Total units			Average per
1975	1976	1977	Year	1975	1976	1977	Year
93	124	118	112	245	306	394	315
926	1,053	1,219	1,066	3,309	1,946	2,655	2,636
586	659	819	688	153	228	734	371
3,662	5,822	6,108	5,197	5,827	8,105	9,181	7,704
1,494	656	1,330	1,160	304	1,109	788	734
299	—	—	na	1,245	639	1,173	1,019
3,845	3,878	5,914	4,546	4,312	5,268	4,612	4,730
2,365	2,446	3,567	2,792	779	1,036	1,598	1,138
557	364	1,062	661	1,629	832	749	1,070
—	—	—	—	18	18	18	18
1,670	2,100	1,796	1,855	170	323	947	480
2,128	486	516	1,043	2,192	543	289	1,008
17,763	19,114	20,621	19,166	6,149	5,763	5,780	5,897
1,688	293	213	731	—	—	—	—
—	—	23	na	328	—	—	na
2,619	2,695	2,973	2,762	440	1,289	659	796

motorized vessels of more than 50 GT. Because of the great ocean depths in this area, there is no small-scale demersal fishing of any consequence except for line fishing. Most shrimp trawl catches are destined for export. In contrast to Regions 1 and 2, the fish by-catches of the trawlers in this region are not economical to process because of the limited local demand. Thus most of the fish by-catches (especially by joint ventures) are simply thrown back into the sea.

Total production of the trawl fisheries averaged 15,127 tons between 1975 and 1977, mostly shrimp (Table 15). However, the actual fish catch including the discarded by-catch is estimated at ten times this total, approximately 152,000 tons.*

Total recorded production of demersal species in 1977 in this region was about 18,100 tons, far below the estimated maximum sustainable yield of 680,000 tons per year (Table 16). For small-scale fishermen to actively participate in demersal fishing in this region, a substantial amount of capital would be required for construction of vessels and for infrastructure.

*This estimate is based on the experience that shrimp comprise 10 percent of the total trawler catch.

Table 19. Pelagic Fisheries Potential and Level of Production, 1977 (tons)

Region	MSY Level	Level of Production
Region 1		
1A (Malacca Strait)	70,000	115,120
1B (South China Sea)	495,000	27,885
Subtotal	565,000	143,005
Region 2		
2A (Java Sea)	221,000	296,800
2B (Makassar Strait)	250,000	115,049
Subtotal	471,000	411,849
Region 3		
(East Indonesia)	598,200	94,103
Region 4		
4A (West of Sumatra)	108,000	56,699
4B & 4C (South of Java and Bali-Nusa Tenggara)	64,260	93,093
Subtotal	172,260	149,792
Total	1,806,460	798,749

Source: Directorate General of Fisheries (1979a, 1979b)

Region 3: Pelagic Fisheries. The level of production of pelagic species in this region is greater than that of demersal species. The most significant pelagic fishing is carried out by pole-and-line fishing for skipjack tuna. This type of fishery is done by small-scale fishermen using small motorized vessels of more than 10 GT and by medium- and large-scale operators using motorized vessels between 100–300 GT.

Total production of the pole-and-line fisheries averaged about 13,800 tons during 1975–1977 (Table 15). Other important pelagic fisheries are troll fishing (small scale), raft lift-net fishing for baitfish to support the pole-and-line fisheries, and purse-seine fishing (small and medium scale). Average production during 1975–1977 was about 10,700 tons, 11,800 tons, and 10,000 tons, respectively. This region has the second largest vessel capital investment in Indonesia (Figure 8) comprising mostly larger vessels compared to the other regions (Appendix Table A2). The average size of vessel in this region was 15.7 GT, relatively much larger compared to the other regions. The biggest investment was from joint venture companies in this region.

Total production of pelagic species in this region was 94,100 tons in 1977. This is well below the estimated maximum sustainable yield of 598,200 tons per year (Table 19). Thus, it is possible to expand pelagic fisheries in this region over the long term, although it would require substantial amounts of additional capital.

Region 4: Demersal Fisheries. The most important demersal fisheries in this region are trawling (medium scale), and gill net (small scale). The level of production from these fisheries in Region 4 is less than those in Regions 1 and 2, primarily because of the limited fishing area for the scale of these particular operations.

Total production of demersal fisheries in subregion 4A (west of Sumatra) in 1977 was 14,527 tons, significantly below the maximum sustainable yield of 78,000 tons per year (Table 16). Thus, there are expansion opportunities in this area, primarily for coral reef species. The level of production in subregions 4B and 4C (south of Java and Bali-Nusa Tenggara) was about 29,800 tons in 1977, exceeding the estimated maximum sustainable yield in these areas of 25,000 tons per year.

Region 4: Pelagic Fisheries. The most important pelagic fishery in this region for medium-scale operations is troll-line fishing, using motorized vessels of 5–20 GT. These fisheries exist mainly in subregion 4A. Total production averaged about 93,100 tons during 1975–1977. In the small-scale sector the important fisheries are drift gill net, purse seine, and lampara net (Table 15).

For large-scale operations, the most important is tuna longline fishing, which has good potential. Currently there are eighteen vessels of 100 GT in subregion 4C operating in the offshore area.

Total production in subregion 4A was about 56,700 tons in 1977, significantly below the estimated maximum sustainable yield (MSY) of 108,000 tons per year in the coastal area (Table 19). On the other hand, production in subregions 4B and 4C has reached 93,100 tons, which exceeds the estimated MSY of 64,260 tons of the nearby coastal area. This estimated MSY should definitely increase with the inclusion of the exclusive economic zone of Indonesia, particularly with respect to tuna resources.

In Region 4 expansion of fisheries exploitation possibly can be attained in the far offshore fisheries. This, however, cannot be undertaken in the immediate short run because of limited capital and the need for more sophisticated technology of fishing in the open sea.

MANAGEMENT OPTIONS FOR MARINE FISHERIES DEVELOPMENT IN THE EEZ

The concept of extended fishery jurisdiction is not new. There has been international and regional regulation of fisheries along the coasts of mainly developed countries with the objective of protecting certain fish stocks from overfishing. Management has been basically biological in nature and has

taken the course of reducing effort to maximize the sustainable yield of certain fish stocks (Gulland, 1974).

What is new under an EEZ regime is national jurisdiction over all fish stocks, collectively, out to 200 nautical miles (nmi) from shore. The objective, of course, is still conservation of the fishery resources. But management can aim at any level of fish catch from a particular stock, or combination of catches from multiple stocks, in order to satisfy certain socioeconomic objectives of a country (Roedel, 1975). One must recognize, however, that in the case of transnational migratory species such as the tunas, extension of jurisdiction to 200 nmi does not necessarily mean exclusive management control over these fish stocks, and, thus, their maximum development may be overriding among the various objectives of a nation (see Valencia, 1978).

With extended jurisdiction comes responsibility for fisheries planning over areas well beyond traditional fishing limits. In the case of Indonesia, the government will seek to determine alternative arrangements for harvesting the resources within its newly acquired EEZ, given the well-known constraints of capital, technology, and optimum utilization of the resources.* It will also seek to weigh the spillover benefits to traditional fisheries, or the linkages to related activities† in a particular region of the country from any particular arrangement in developing the fishery resources in the EEZ.

Major Alternatives

The viable options for fisheries development in the EEZ of Indonesia are outlined in Table 20‡. Each alternative strategy is briefly described, and the implied degree of international interaction is indicated.

Licensing is a form of leasing fishing rights in the EEZ to foreign fishing fleets that may wish to exploit certain fish species. In return for these rights, the foreign user pays a fee or rental charge for the use of the resources. Some precedent has already been established by Indonesia for this type of arrangement under the Archipelagic Declaration in the Banda Sea agreement with Japan (Marten, Matsuda, et al., 1981, 1982; Marten, Comitini, et al., 1982). The degree of international interaction implied under this arrangement is considered low, since only enforcement and surveillance activities would be carried out by Indonesia.

---

*For an analysis of these constraints with respect to skipjack tuna fisheries development, see Comitini (1974b).

†For linkages related to fisheries development, see Roemer (1970).

‡This format is suggested by Tomlinson and Vertinsky (1975).

Table 20. Major Strategies for Indonesian Fisheries Development in the EEZ

Strategies	Description	Degree of International Interaction
Licensing	Allocation of fishing rights to foreigners on a fee or contractual basis	Low (enforcement & surveillance)
Joint venture	Encouraging (or insisting) on joint (local and foreign) participation in utilization of fishery resources	High (joint commitment of investment and management)
State fishing enterprise	Government-directed participation in utilization of fishery resources	Low (enforcement of EEZ sovereignty, some foreign consultants)
Domestic (private) fishing enterprise	Encouraging local (private) participation in utilization of fishery resources	Low (enforcement of EEZ sovereignty, possibly some purchase of technology)

A joint venture arrangement, which, as previously noted, has to some extent been used in recent years, especially in eastern Indonesia, implies a higher degree of international interaction. Specifically, it involves a sharing of investment (in the form of equity capital) and management between foreign and local Indonesian partners. Other than an outright leasing arrangement, this would appear to be the only alternative by which a foreign fishing firm or investment group could be directly involved in fishing, or processing, or both, in the 200-nmi EEZ of Indonesia.

The two other strategies, state and domestic fishing enterprises, involve pretty much a "go-it-alone" indigenous policy by Indonesia in developing the fisheries in the EEZ waters; therefore, they both imply a low degree of international interaction. Again, as previously noted, Indonesia has established state fishing enterprises through project loans by international lending agencies such as the World Bank and the Asian Development Bank. These projects are primarily aimed at developing latent fishery resources, especially the skipjack tuna resources, in the eastern part of the country. The results to date have been mixed and suggest that with better planning and management, operations of this type could be successful. It would probably require using some foreign consultants for management and technical aspects.

To date there have not been what might be called "large-scale" operations by domestic fishing enterprises in Indonesia. Whatever development has occurred has been confined primarily to the coastal areas, both for demersal and pelagic species. This is not to say that, given proper incentives, together with capital and advanced technology, combined with the resourceful entrepreneurship that exists throughout these fishing communities in Indonesia, this is not a viable strategy for fisheries development in the EEZ.

Since each of the latter three strategies provides for direct fishing participation in the EEZ by domestic fishing enterprises, each strategy should at the same time result in costs of policing and enforcing the EEZ sovereignty of Indonesia that to a greater or lesser degree are lower than those of leasing fishing rights to foreign fishing fleets.

Goals, Objectives, and Technological Capability

The broad goals of tuna fisheries development in the EEZ for Indonesia are listed in Table 21 as macroeconomic, sociopolitical, and microeconomic. In this section we include Japan as a foreign fishing nation that may likely wish to operate in the EEZ of Indonesia. Under macroeconomic goals are listed those factors leading to improvements in income or employment. Under sociopolitical goals are listed those factors leading to consolidation and internal cohesion of the country—politically and as a society. Microeconomic goals, on the other hand, relate to factors affecting incentives for investment of capital and efficiency of operations by business enterprises that may view the profitability of prospects for fishing in the EEZ. (This listing is somewhat broader than the strictly economic objectives typically presented in the conventional economics literature. For an excellent summary see Copes, 1972, and Munro, 1981.)

A subjective ranking in terms of three criteria—critical, important, and indifferent/unimportant—are indicated for both Indonesia and Japan, reflecting the relative desirability of each objective listed within the three broad goals.

Naturally, the choice of one of the three rankings for any particular objective depends upon both the ownership of or control over the resources within the EEZ and the potential fulfillment of the goals that utilization of the fishery resources within this zone could realize for either or both nations.

Each nation would also have to consider its respective capabilities in achieving the listed goals or objectives it seeks in exploiting the fishery resources in the EEZ. These are given in the form of a technology matrix for each country in Tables 22 and 23. It is somewhat apparent that each nation's capabilities would depend to a significant degree on the policy or policies adopted by the host country in the case of a go-it-alone, or independent, approach, or policies mutually agreed upon with a foreign fishing entity in the case of a fee fishing (licensing) arrangement or a joint venture partnership between Indonesia and, in this case, Japanese nationals. For the case of a go-it-alone indigenous policy, state fishing enterprises and private fishing enterprises are considered equally capable, in terms of domestic abilities and opportunities, of achieving the prescribed goals in developing the fishery resources in the EEZ. In the case of Japan, an independent policy is not applicable since open access to the fishery resources in the EEZ of Indonesia would not be a viable option.

Table 21. Importance to Indonesia and Japan of Objectives for Tuna Fisheries Development

Objective	Indonesia	Japan
Macroeconomic		
Economic development and growth	Critical	Important
Employment (primary level)	Important	Critical
Employment (fishing-linked)	Important	Important
Foreign exchange earnings	Critical	Unimportant
Sociopolitical		
Domestic food supply	Unimportant	Critical
Sovereign control of resources	Critical	Unimportant
Internal political support	Critical	Important
International status	Important	Important
Strengthen national security	Critical	Unimportant
Microeconomic		
Technology transfer	Critical	Important
Security of investment and access to earnings	Important	Critical
Efficiency of operations and satisfactory ROI	Important	Important

Technical capabilities to fulfill the objectives related to exploitation of the fishery resources within the EEZ are combined in four general groupings, ranging from broad economic capabilities, to political legitimacy and control over the resources in the EEZ, surveillance and enforcement capability, and the business management, marketing, and technology of successfully operating a fishing enterprise geared to operations in the EEZ.

A subjective ranking of high, medium, or low is indicated for each capability within the technology matrix associated with each of the alternative fishing entities or arrangements for both Indonesia and Japan. In the case of Indonesia, one is immediately struck by the perverse, or opposite, relative capabilities under a licensing arrangement versus an independent arrangement. In effect, there is a trade-off between economic and business capabilities and the ability to control and regulate access to the resources within the EEZ in choosing between the two policies of developing the fishery resources in the EEZ. In the case of a joint venture arrangement, however, these opposing tendencies are ameliorated; thus, the capabilities are shown to strike a balance and therefore are ranked medium for each capability. (For a discussion of the economic trade-offs between joint ventures and indigenous fisheries development, see Comitini, 1974a.) This is also the result in the technology matrix of Japan when considering either the joint venture or the licensing arrangement.

Alternative Strategies and Decision Criteria

By giving weights to each of the objectives on the basis of its relative desirability in meeting the broad goals of Indonesia and Japan, together with the respective capabilities to fulfill these objectives, it is possible to develop a ranking of alternative strategies on the basis of the relative importance of decision-making criteria as shown in Table 24. The relative importance of each of the broad goals (subdivided into specific objectives as described previously) is shown on a scale of zero to one for each alternative arrangement.

In the case of Indonesia, for example, a joint venture arrangement would give greater weight to macroeconomic objectives than to sociopolitical or microeconomic ones, specifically, rankings of 0.44, 0.31, and 0.25, respec-

Table 22. Indonesia's Technology Matrix

Capabilities	State-Private Enterprise	Joint Venture	Licensing
Economic resources, infrastructure, resource assessment	Low	Medium	High
Political legitimacy, stability, control	High	Medium	Low
Surveillance and enforcement capability	High	Medium	Low
Fishing management and marketing capability	Low	Medium	High
Fishing technology and R & D capability	Low	Medium	High

Table 23. Japan's Technology Matrix

Capabilities	Independent	Joint Venture	Licensing
Economic resources, infrastructure, resource assessment	na	Medium	High
Political legitimacy, stability, control	na	Medium	Low
Surveillance and enforcement capability	na	Medium	High
Fishing management and marketing capability	na	Medium	High
Fishing technology and R & D capability	na	Medium	High

Table 24. Ranking of Alternative Strategies and Relative Importance of Decision (scale: 0–1.0)

Ranking	Macroeconomic	Sociopolitical	Microeconomic
Indonesia			
Joint venture	.44	.31	.25
State-private enterprise	.31	.53	.16
Licensing	.44	.18	.38
Japan			
Licensing	.41	.33	.26
Joint venture	.39	.36	.25

tively. A licensing strategy would provide greater means for meeting microeconomic rather than sociopolitical objectives. A state-private enterprise strategy would fulfill sociopolitical objectives to a higher degree than either of the other two strategies, but less than the other two on macro- and microeconomic objectives. If Indonesia sought a balanced approach in developing the fishery resources in the EEZ, then it would choose the strategy that would yield the minimum deviations among the three broad goals of national policy; in which case, a joint venture strategy would be selected. If sociopolitical goals are paramount, then a policy that promotes state-private enterprise development should be pursued.

In the case of Japan, minimizing the total deviations among the three broad goals would give a slight edge to pursuing a joint venture arrangement, although this would be at some sacrifice to fulfilling strictly economic (macro and micro) goals. It would appear, then, that if each country were to give approximately equal consideration to each of the broad goals, a compatibility of interests might result and both countries might then prefer a joint venture strategy. It is not apparent, however, that a mutual preference for one type of strategy or another would necessarily occur, or even that these preferences would be stable over time. For example, under the original Banda Sea agreement between Indonesia and Japan, the preference was for Indonesia to lease fishing rights to Japan, and Japan in return would pay an annual rental fee to Indonesia (Marten, Matsuda, et al., 1981, 1982; Marten, Comitini, et al., 1982). After several years of operations under this type of licensing arrangement, the agreement was not renewed in 1980. Japan preferred the existing licensing arrangement while Indonesia pressed for a joint venture arrangement. After repeated negotiations failed to come to a resolution of the matter, Japanese tuna longline vessels are now excluded from fishing in the Banda Sea. As a consequence, the Indonesian government is currently supporting the state fishing enterprise, P. T. Perikanan Samodra Besar (Persero), as an alternative strategy for developing the tuna resources in the Banda Sea and in the EEZ along the southern coast of the archipelago.

APPENDIX

Table A1. Fisheries Production by Region, 1975–1977 (tons)

		Demersal			Pelagic				
Region	Year	Shrimp	Others	Sub-total	Tuna	Skip-jack	Others	Sub-total	Total
	1975	23,504	44,115	67,619	—	1,256	215,219	216,475	284,094
1A	1976	64,895	45,025	109,920	—	1,594	112,306	113,900	223,820
	1977	68,111	45,766	114,877	554	947	113,619	115,120	229,997
	1975	7,808	7,144	14,952	—	—	34,921	34,921	49,873
1B	1976	9,406	8,114	17,520	—	—	29,204	29,204	46,724
	1977	12,082	8,070	20,152	—	—	27,885	27,885	48,037
	1975	10,589	44,326	54,915	254	193	211,908	212,355	315,307
2A	1976	14,071	62,085	76,156	330	169	247,527	248,026	324,182
	1977	24,147	62,807	86,954	403	84	268,428	268,915	355,869
	1975	5,830	16,378	22,208	6,121	5,887	100,550	112,558	134,766
2B	1976	7,830	19,371	27,201	615	4,058	105,072	109,745	136,946
	1977	9,121	22,953	32,074	1,975	5,340	107,734	115,049	147,123
	1975	10,403	9,744	20,147	3,547	14,156	55,922	73,625	93,772
3A	1976	9,339	11,171	20,510	5,058	17,602	68,183	90,843	111,353
	1977	5,596	12,481	18,077	5,532	16,423	72,148	94,103	112,180
	1975	1,577	10,449	12,025	869	3,438	38,887	43,194	55,219
4A	1976	1,227	11,523	12,750	1,251	4,617	45,741	51,609	64,359
	1977	1,178	13,349	14,527	2,177	2,243	52,279	56,699	71,226
	1975	3,111	2,852	5,963	—	487	10,490	10,977	16,940
4B	1976	6,060	9,293	15,353	66	896	26,562	27,524	42,877
	1977	6,397	14,580	20,977	168	1,791	35,050	27,009	57,986
	1975	363	8,969	9,695	1,210	1,702	36,621	39,533	49,228
4C	1976	201	8,051	8,252	1,585	4,083	45,175	50,843	59,095
	1977	370	8,415	8,785	2,373	1,904	51,807	56,084	64,869

Source: Directorate General of Fisheries (1977a, 1978a, 1979a).

Table A2. Number of Motorized Vessels and Estimated Tonnage (in parentheses) by Region, 1977

Region	Outboard Motor and Less Than 5 GT	5-10 GT	Over 10 GT	Total	Average Size per Vessel (GT)[a]
1A	3,031 (6,818)	1,300 (9,750)	588 (14,560)	4,919 (31,128)	6.33
1B	918 (1,821)	487 (3,652)	90 (1,830)	1,495 (7,303)	4.88
2A	3,857 (6,269)	661 (4,957)	1,160 (25,130)	5,678 (36,356)	6.40
2B	3,790 (4,310)	81 (607)	13 (380)	3,890 (5,298)	1.36
3	1,453 (1,453)	24 (180)	210 (24,840)	1,687 (26,473)	15.69
4A	799 (1,123)	278 (2,085)	103 (2,060)	1,180 (5,268)	4.46
4B	649 (811)	34 (255)	328 (6,630)	1,011 (7,690)	7.61
4C	429 (451)	1 (7)	28 (1,820)	458 (2,279)	4.98

[a]Estimated size per vessel: Outboard motor (1 GT); less than 5 ton (2.5 GT); 5-10 ton (7.5 GT); 10-20 ton (20 GT); 30-50 ton (40 GT); over 50 ton (50 GT in Regions 1A, 1B, 2A, 2B; 200 GT in Region 3; 90 GT in Regions 4A, 4B, 4C).

Source: Directorate General of Fisheries (1976b, 1979a).

Table A3. Fish Categories in Indonesia[a]

Indonesian Name	International Name
Demersal Fish (A)	
Ikan sebelah	Indian halibuts
Ikan lidah	Tongue soles
Ikan nomei	Bombay duck
Peperek	Ponyfish/slipmouth
Manyung	Marine catfishes
Beloso	Lizard fishes
Biji nangka	Goat fishes
Ikan gerot	Grunters/sweetlips
Ikan merah/bambangan	Red snappers
Kerapu	Groupers
Lencam	Emperors
Kakap	Barramundi breams
Kurisi	Threadfin breams
Swanggi	Big eyes
Ekor kuning	Yellowtail fusiliers
Gulamah/tigawaja	Croakers drums
Cucut	Sharks
Pari	Rays
Crustaceans (B)	
Rajungan	Swimming crab
Kepiting	Mangrove crab
Udang barong	Spiny lobster
Udang windu	Tiger prawn
Udang putih/jerbung	Banana prawn
Udang dogol	Endeavour
Molluscs (C)	
Tiram	Cupped oyster
Simping	Scallops
Remis	Clams
Kerang darah	Blood cockles
Cumi-cumi	Commons squids
Sotong	Cuttlefishes
Gurita	Octopuses

Table A3. *continued*

Indonesian Name	International Name
Pelagic Fish (D)	
Bawal hitam	Black pomfret
Bawal putih	Silver pomfret
Alu-alu	Barracudas
Ikan layang	Scads
Selar	Trevallies/yellowstrip trevallies
Kuwe	Jacks trevallies
Tetengkek	Hardtail scad
Daun bambu/talang	Queen fishes
Sunglir	Rainbow runner
Ikan Terbang	Flying fishes
Belanak	Mullets
Kuro	Threadfins
Julung	Garfish and halfbeak
Teri	Anchovies
Japuh	Sardine
Tembang	Fringescale sardinella
Lemuru	Indian Oil sardinella
Golok	Wolf herrings
Terubuk	Tolishad
Kembung	Indo-Pacific mackerels
Tenggiri Papan	Indo-Pacific spanish mackerel
Tenggiri	Narrow barred/Spanish mackerel
Layur	Hairtails
Tuna	Tunas
Cakalang	Skipjack tuna
Tongkol	Eastern little tunas

•In this particular study, A and B are grouped in demersal fish category.
Source: Directorate General of Fisheries, 1976a.

Table A4. Popular[a] Species Caught in Each Region and Level of Production by Region[b]

Species	Region							
	1A	1B	2A	2B	3	4A	4B	4C
Marine catfishes	4	1	4	2	1	1	2	1
Ponyfish	2	1	7	2	1	2	3	2
Red snapper	2	1	5	2	2	2	2	2
Grouper	2	0	2	1	2	2	0	1
Barramundi & threadfin breams	2	1	3	2	2	3	2	2
Yellowtail fusiliers	3	0	3	0	2	1	2	2
Croakers drums	6	1	3	2	0	1	1	1
Sharks & rays	2	2	6	1	2	2	2	2
Black & silver pomfret	3	1	2	2	1	1	2	1
Scad	2	0	8	2	6	2	2	3
Yellowstrip trevallies	3	0	6	2	6	3	2	2
Jacks trevallies	1	0	1	2	3	2	1	0
Flying fish	0	0	6	1	2	1	0	1
Mullets	2	1	2	2	2	1	1	2
Threadfins	3	1	2	3	1	1	1	0
Anchovy	5	1	8	2	6	5	5	5
Fringescale sardinella	5	1	7	2	4	2	2	2
Indian oil sardinella	4	0	7	1	2	2	3	6
Wolf herrings	5	1	3	1	1	1	1	1
Indo-Pacific mackerels	6	2	7	2	3	6	2	2
Spanish mackerel	5	1	5	2	2	2	2	2
Hairtails	2	1	4	1	1	1	1	1
Tunas	1	0	0	1	4	2	1	2
Skipjack	2	0	1	1	7	2	2	2
Eastern little tunas	6	2	6	1	5	5	5	4
Tiger prawn	3	0	2	2	2	1	1	0
Banana prawn	6	0	4	2	2	1	2	1
Endeavour	3	0	2	1	2	1	2	0
Blood cockles	8	0	2	1	1	0	0	1
Common squid	2	0	3	1	1	1	2	2

[a]In terms of the quantity caught.

[b]the numbers indicate the level of production per year

0 = less than 15 ton
1 = 15-500 ton
2 = 500-2,500 ton
3 = 2,500-4,500 ton
4 = 4,500-6,500 ton
5 = 6,500-8,500 ton
6 = 8,500-15,000 ton
7 = 19,000-30,000 ton
8 = greater than 30,000 ton

Source: Directorate General of Fisheries, 1977a.

Table A5. Average Units of Gear, Average Production, and Weighted Average Production per Unit by Region, 1975–1977

Region	Data	Trawl	Lampara net	Purse seine	Drift gill net	Encircling gill net	Shrimp gill net	Set gill net	Raft lift net	Fixed lift net	Tuna longline	Drift longline	Set longline	Troll line	Pole and line	Stow line	Guiding barrier
	Units	1,085	1,179	168	5,858	269	1,181	309	—	1,019	—	1,260	336	660	—	1,154	1,576
1	Tons	54,252	8,902	20,411	27,203	1,835	2,387	3,988	—	6,680	—	2,475	1,940	2,930	—	32,073	15,747
	Tons/unit	50	7.6	121.5	4.6	6.8	2.0	12.9	—	6.5	—	1.9	5.8	4.4	—	27.8	10.0
	Units	1,410	9,229	393	20,129	2,379	11,674	10,920	2,167	8,120	—	3,640	4,121	4,249	—	919	4,467
2	Tons	57,775	71,202	40,495	79,001	17,701	17,051	20,729	12,059	45,513	—	5,313	6,530	23,542	—	15,395	13,265
	Tons/unit	40.9	7.7	103.0	3.9	7.4	1.5	1.9	5.6	5.6	—	1.5	1.6	5.5	—	16.7	3.0
	Units	112	1,066	688	5,197	1,160	—	4,546	2,792	661	—	1,855	1,043	19,166	na	—	2,762
3	Tons	15,127	4,071	10,063	7,560	2,568	—	6,185	11,829	2,968	—	3,523	759	10,738	13,776	—	3,985
	Tons/unit	135.1	3.8	14.6	1.5	2.2	—	1.4	4.2	4.5	—	1.9	0.7	0.6	—	—	1.4
	Units	315	2,636	371	7,704	733	1,019	4,730	1,138	1,070	18	480	1,008	5,897	—	na	796
4	Tons	22,319	15,789	18,775	15,396	1,071	3,632	8,216	9,880	8,952	1,439	707	1,868	9,345	—	8.3	1,456
	Tons/unit	70.8	5.9	49.2	1.9	1.5	3.6	1.7	8.7	8.3	79.9	1.5	1.8	1.6	—	—	1.8

Source: Directorate General of Fisheries (1977a, 1978a, 1979a).

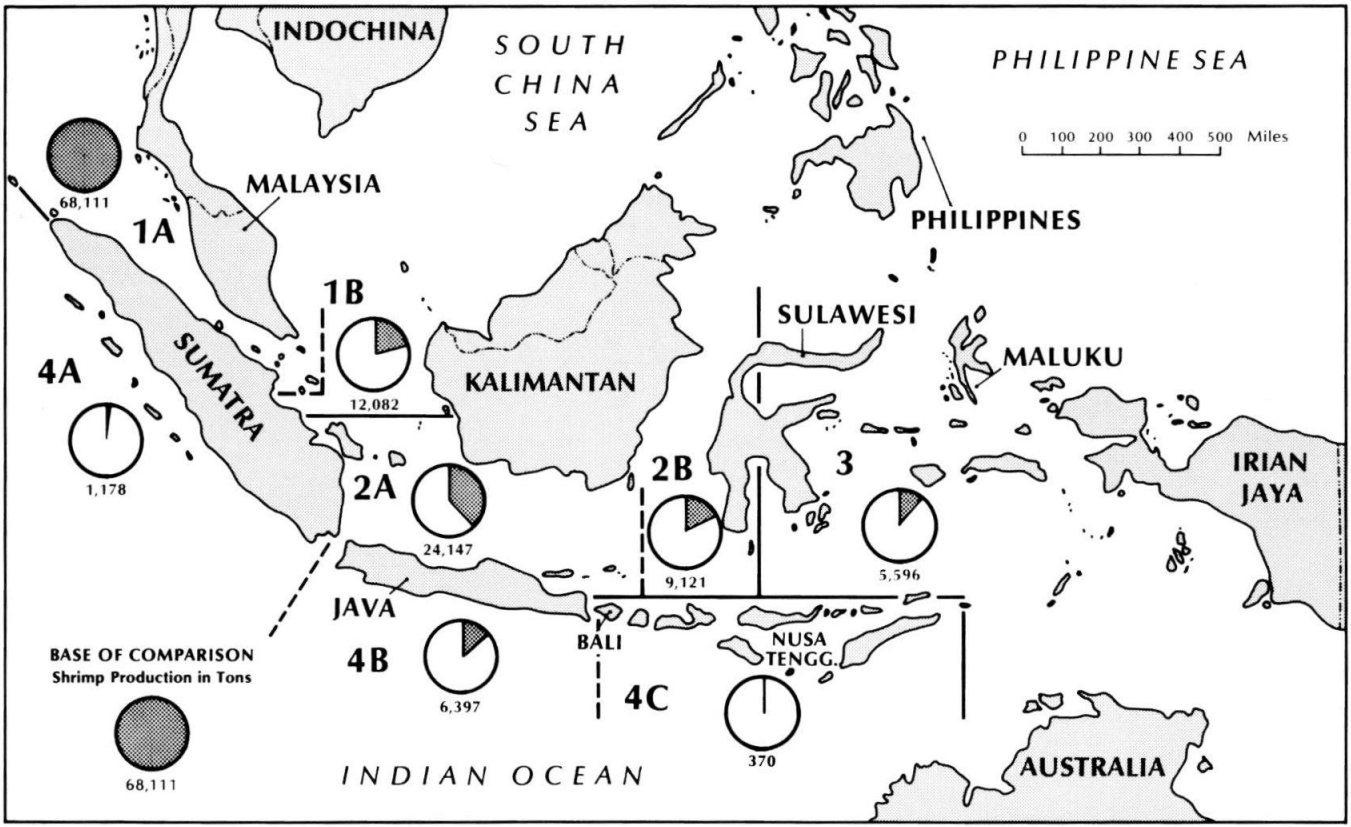

Figure A1. Shrimp production by region, 1977. (Source: Directorate General of Fisheries [1979a].)

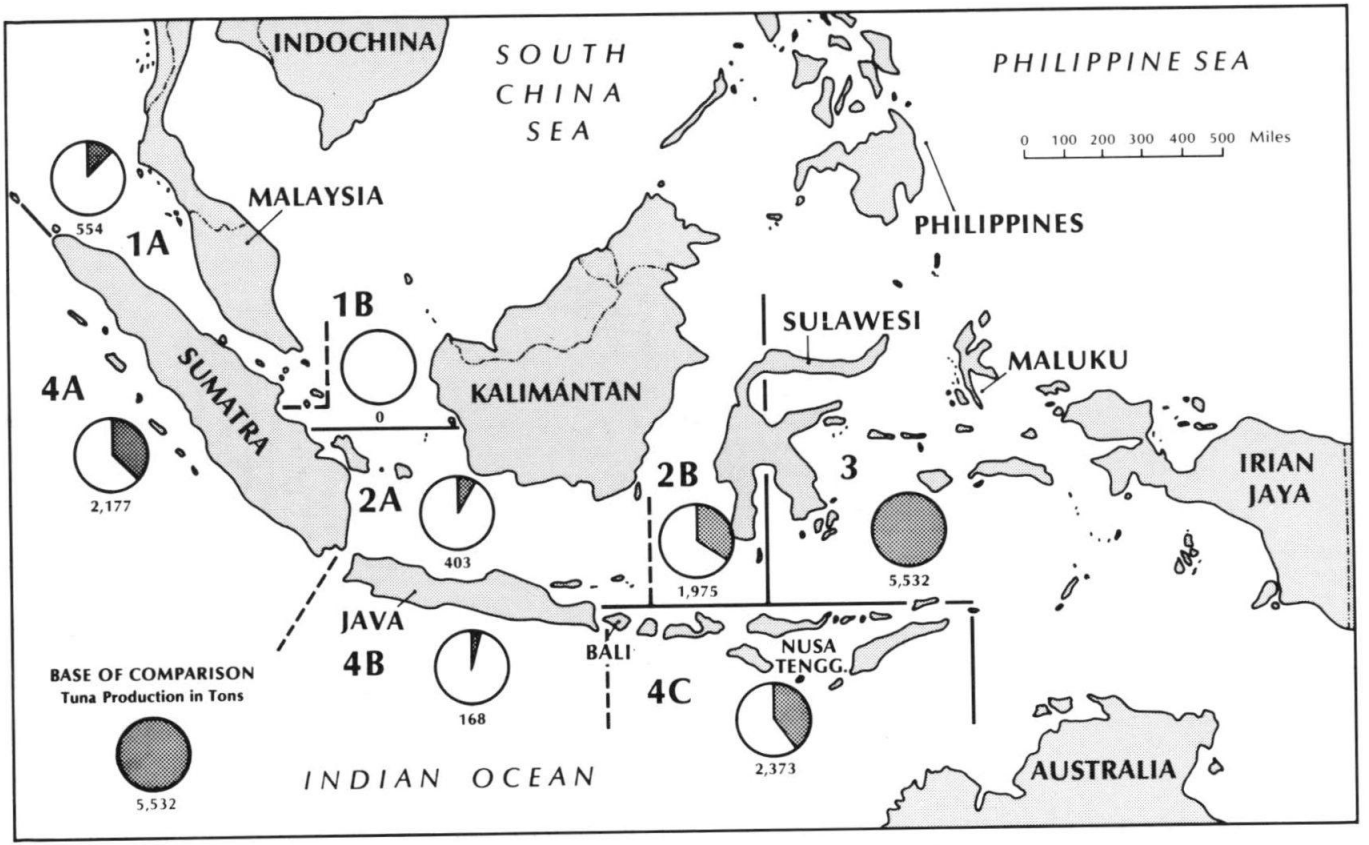

Figure A2. Tuna production by region, 1977. (Source: Directorate General of Fisheries [1979a].)

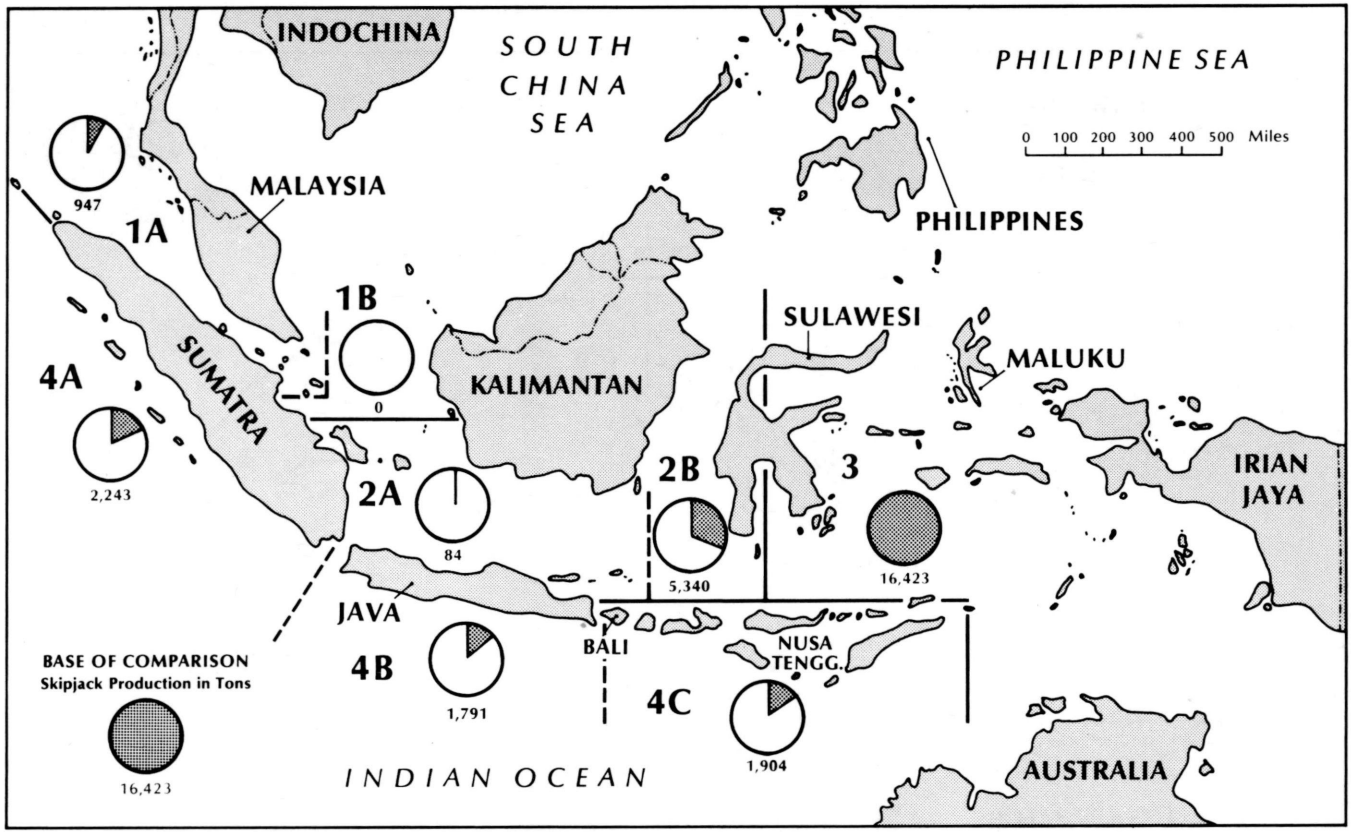

Figure A3. Skipjack production by region, 1977. (Source: Directorate General of Fisheries [1979a].)

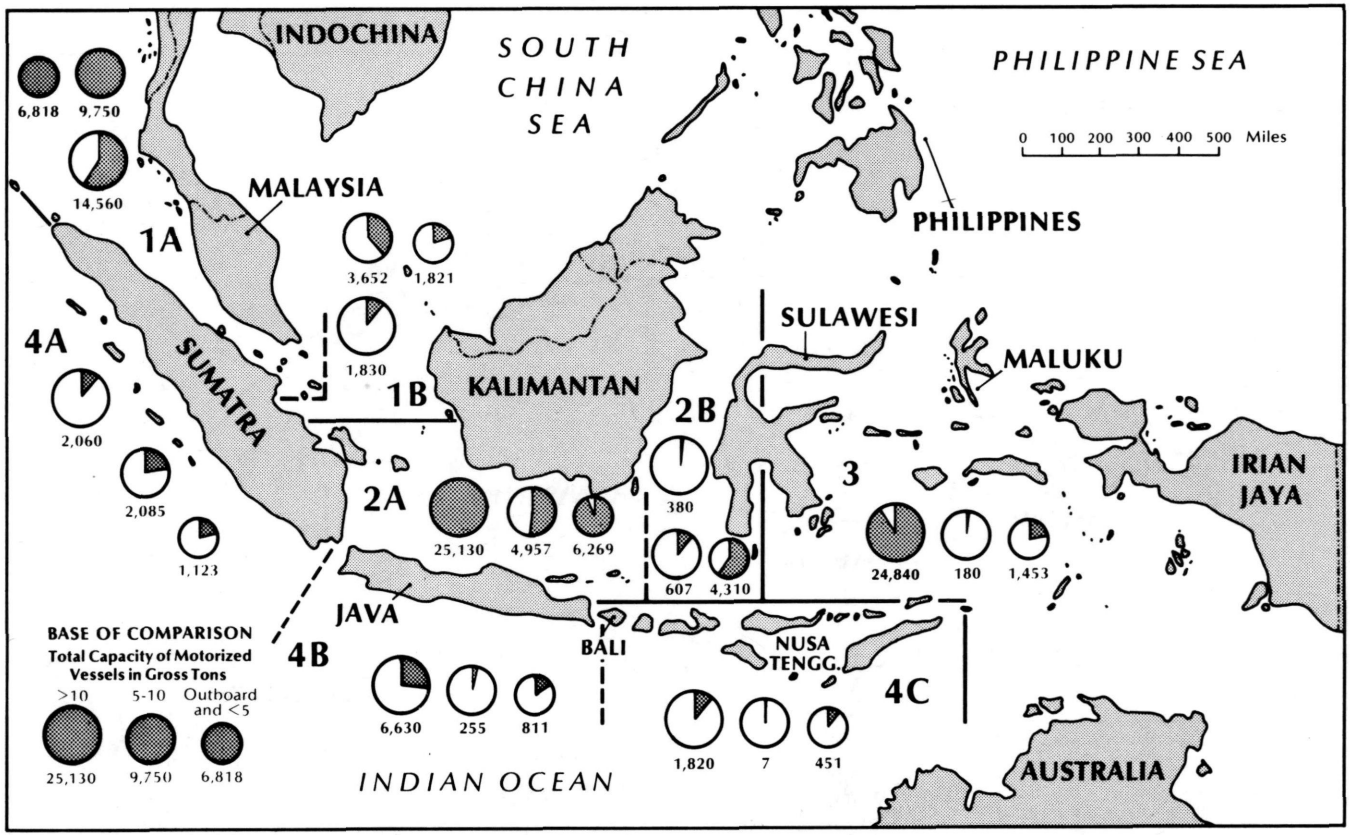

Figure A4. Motorized fishing vessels by size and region, 1977. (Source: Directorate General of Fisheries [1979a].)

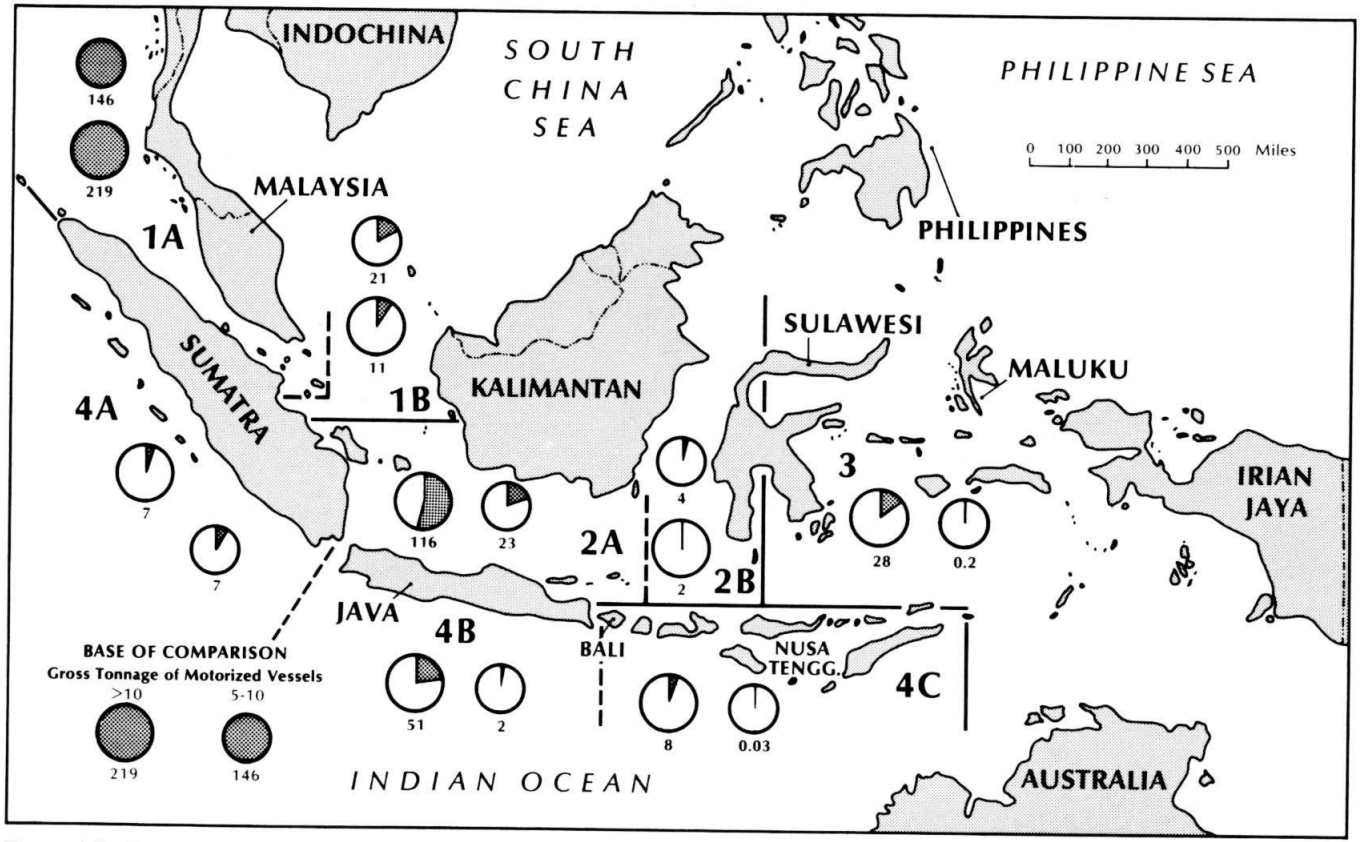

Figure A5. Gross tonnage of motorized vessels per square mile by region, 1977. (Source: Directorate General of Fisheries [1979a].)

REFERENCES

Asian Development Bank (ADB).

1974 *Java Fisheries Development Project.* Manila: The Asian Development Bank.

Asiaweek

1980 Two Steps Backwards in Indonesia (A report on the trawler ban in Indonesia). *Asiaweek,* 3 October.

Bottemanne, C. J.

1959 *Principles of Fisheries Development.* Amsterdam: North-Holland Publishing Company.

Clark, C. W.

1976 *Mathematical Bioeconomics: The Optimal Management of Renewable Resources.* New York: Johns Wiley & Sons.

Clark, C. W., and G. R. Munro

1975 The Economics of Fishing and Modern Capital Theory: A Simplified Approach. *Journal of Environmental Economics and Management,* vol. 2. 2 (February):92-106

Comitini, S.

1974a Consideration of the Economic Benefits and Costs of Joint Ventures versus Indigenous Commercial Fisheries Development. *Expert Committee on Tropical Skipjack, Report.* Noumea, New Caledonia: South Pacific Commission, April.

———.

1974b *Economic Aspects of Pacific Skipjack Tuna Fisheries Development.* Working Paper Prepared for the Meeting of the South Pacific Commission Expert Committee on Tropical Skipjack, Tahiti, 25 February–1 March.

———.

1978a *An Analysis and Appraisal of the Financial Structure and Operations of P. N. Perikani Sulawesi Utara/Tengah—Aertembaga.* UNDP/FAO Fisheries Development Project, Jakarta, Indonesia.

———.

1978b *An Analysis and Appraisal of the Financial Structure and Operation of P. T. Karya Mina.* UNDP/FAO Fisheries Development Project, Jakarta, Indonesia.

———.

1978c *An Analysis and Appraisal of the Financial Structure and Operation of P. T. Usaha Mina.* UNDP/FAO Fisheries Development Project, Jakarta, Indonesia.

———.
1978d *Report on the Mission to Appraise the KIK/KMKP Fisheries Credit Programme in Java.* UNDP/FAO Fisheries Development Project, Jakarta, Indonesia, July.

Copes P.
1972 *Factor Rents, Sole Ownership and the Optimum Level of Fisheries Exploitation.* The Manchester School of Economics, June.

Defense Mapping Agency Hydrographic/Topographic Center.
1980 Western Part of Pacific Ocean (including Philippines and Indonesia). Map No. 524, September, Washington, D.C.

Departmen Perikanan Darat dan Laut.
1965 *Rapat Dinas Perikanan ke I di Tjibogo, 1964.* Jakarta, Indonesia.

Directorate General of Fisheries.
1976a *Fisheries Statistics of Indonesia, 1974.* Jakarta, Indonesia.

———.
1976b Hasil Survey Sosial Ekonomi Perikanan Rakyat Dipantai Utara Jawa, 1975. Jakarta, Indonesia.

———.
1977a *Fisheries Statistics of Indonesia,* 1975. Jakarta, Indonesia.

———.
1977b Progress Report Perusahaan Perikanan Pemerintah Dalam Lingkungan Direktorat Jenderal Perikanan. (an unpublished report prepared by the Directorat of Enterprise Development)

———.
1978a *Fisheries Statistics of Indonesia, 1976.* Jakarta, Indonesia.

———:
1978b *Productivitas Unit Penangkapan Perikanan Laut, 1976.* Jakarta, Indonesia.

———.
1979a *Fisheries Statistics of Indonesia, 1977.* Jakarta, Indonesia.

———.
1979b *Sumber Perikanan, Pengembangan dan Pengolahan.* Jakarta, Indonesia.

———.
1980a *Fisheries Statistics of Indonesia, 1978.* Jakarta, Indonesia.

———.
1980b *International Trade Statistics of Fisheries Commodities, Indonesia, 1979.* Jakarta, Indonesia.

———.
1981 *Fisheries Statistics of Indonesia, 1979.* Jakarta, Indonesia.

———.
1978 *Kumpulan Perundang-undangan/Peraturan Perikanan Laut, Indonesia.* Directorate General of Fisheries, Jakarta, Indonesia.

Djalal, H.
1978 Implementation of Agreements with Foreigners. Discussion Paper Law of The Sea. Workshop on Problems of Conflict and Management of Fisheries in Southeast Asia. (Edited by F. T. Christy). International Center for Living Aquatic Resources Management, Institute of Southeast Asian Studies, Manila.

Doty, Maxwell S., and A. Soegiarto
1970 The Development of Marine Resources in Indonesia. In Howard W. Beers (ed.), *Indonesia: Resources and Their Technological Development.* Lexington: University of Kentucky Press.

Food and Agricultural Organization (FAO).
1980 *Implication of The Extension of National Jurisdiction for Fisheries Management and Development.* (Reported by an FAO Mission to the Government of Indonesia). Jakarta, Indonesia.

Firth, R.
1966 *Malay Fishermen: Their Peasant Economy.* Hamden, Connecticut: Archon Books, The Shoestring Press Inc.

Gulland, J. A.
1974 *The Management of Marine Fisheries.* Seattle: University of Washington Press.

Haryono S.
1975 *Prasaran Mengenai Ekspor Bahan Pangan; Khusus Hasil Laut.* Kumpulan Hasil-hasil Lokakarya dan Kesimpulan Pekan Hasil-hasil Perikanan, 16-19 Desember. Badan Pengembangan Ekspor Nasioanal, Departemen Perdagangan. Jakarta, Indonesia.

Krisnandhi, S.
1969 The Economic Development of Indonesia's Sea Fishing Industry. *Bull. Indonesian Econ. Studies* 5(1). 49-72

Marten, G., S. Comitini, S. Hardjolukito, and Y. Matsuda.
1982 Persetujuan Indonesia-Jepang. Studi Kasus Perikanan Tuna di Laut Banda. *Prisma,* 11 (November): 29-43.

Marten, G., Y. Matsuda, J. Bardach, S. Comitini, and S. Hardjolukito.
1981 *A Strategic Goal Analysis of Options for Tuna Longline Joint Ventures in Southeast Asia: Indonesia-Japan Case Study.* East-West Center, Honolulu, Hawaii.

———.
1982 *A Goal Analysis of Alternative Tuna Fishery Arrangements Between Indonesia and Japan.* Ocean Management, August. OMA 225.

Munro, G. R.
1981 The Economics of Fishing: An Introduction. In John A. Butlin (ed.), *Economics and Resources Policy.* London: Longman.

Oakley, Pinfold, Turvey, and Neil.
1978 *Cold Storage and Transportation of Fish, Sumatra, Indonesia.* (A final report of consultants). A New Zealand Bilateral Aid Project for the Government of Indonesia. Enex of New Zealand, February.

Pownall, P. C.
1975 *Fisheries of Indonesia.* Australian Fisheries Reprint no. 42. (Reprinted from *Australian Fisheries* 34[2] February). Australian Government Publishing Service.

P. T. Perikanan Samodra Besar.
1978 *Laporan Tahunan P. T. Samodra Besar, 1977.* Directorate General Perikanan, Jakarta, Indonesia.

P. T. Perikanan Samodra Besar, P. T. Usaha Mina, Perum Perikanan Maluku, and P. N. Perikani Sulawesi Utara-Tengah.
1981 *Skipjack and Tuna in Indonesia.* Jakarta, Indonesia: Glory Offset Press.

Prescott, J. R. V.
1981 *Maritime Jurisdiction in Southeast Asia: A Commentary and Map.* EAPI Research Report No. 2. East-West Center, Honolulu, Hawaii.

Roedel, P. M.
1975 *Optimum Sustainable Yield as a Concept in Fisheries Management.* Special Publication No. 9, Washington, D.C.: American Fisheries Society.

Roemer, M.
1970 *Fishing For Growth. Export-let Development in Peru, 1950–1967.* Cambridge: Harvard University Press.

Sidarto.
1975 *Beberapa Pengamatan Tentang Pemasaran dan Ekspor Hasil-hasil Perikanan Indonesia.* Kumpulan Hasil-hasil Lokakarya dan Kesimpulan Pekan Hasil-hasil Perikanan, 16–19 Desember. Badan Pengembangan Ekspor Nasional, Departemen Perdagangan, Indonesia.

———.
1977 *Some Notes on Joint Venture in Fisheries Development, Progress and Problems.* Indonesia–Japan Fifth Conference. Jakarta: Centre for Strategic and International Studies.

———.
1979 Recent Development of Fisheries in Indonesia. *Ekonomi dan Keuangan Indonesia,* XXVII (1): 105–123.

Sigit, S.
1968 *Foreign Capital Investment. Business Prospect in Indonesia Today.* Hong Kong: Standard-Sing Tao Printers.

Soeroyo, O.
1975 *Peranan Himpunan Pengusaha Perikanan Indonesia (Indonesian Fishery Club) Dalam Peningkatan Ekspor Hasil-hasil Perikanan.* Kumpulan

Hasil-hasil Lokakarya dan Kesimpulan Pekan Hasil-hasil Perikanan, 16–19 Desember. Badan Pengembangan Ekspor Nasioanal, Departmen Perdagangan Indonesia.

Tomlinson, J. W. C., and I. Vertinsky.

1975 Selecting a Strategy for Joint Ventures in Fisheries: A First Approximation. In S. Zionts (ed.), *Multiple Criteria Decision Making*. Berlin: Springer Verlag.

Unar, M.

1981 *A Review of the East Indonesian Skipjack Pole-and-Line Fishery*. Research Institute for Marine Fisheries. Department of Agriculture, Indonesia.

Valencia, M. J.

1978 The South China Sea: Prospects for Marine Regionalism. *Marine Policy*, April.

Zachman, N.

1973 Fisheries Development and Management in Indonesia. *Journ. Fish. Res. Board Canada*, vol. 30:2335–2440.

East-West Environment and Policy Research Reports contain Institute or cooperative research results that reflect the EAPI concept and approach to natural systems assessment for development, human interactions with tropical ecosystems, marine environment and extended maritime jurisdictions, and environmental dimensions of energy policies.

Manuscripts for this series are reviewed for substance and content by referees outside the Institute before the EAPI Academic Publications Committee makes a recommendation to publish.

Richard A. Carpenter, Chairman
EAPI Academic Publications Committee
Sheryl R. Bryson, Senior Editor

ISBN 0-86638-048-5