

Strategic Review of the Fishery Situation in Thailand

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Abstract

Fisheries are an important source of animal protein for most of Thailand's population, particularly in provinces on or near the coast. Between 1978 and 1997 the per capita consumption of fish averaged 24 kg-capita⁻¹ annually. In 1995, about 535 210 people were involved in the fisheries sector and 44% of these were engaged in small scale marine capture fisheries. Since 1982, Thailand has faced problems with the development of marine capture fisheries and their over-exploitation which has increased fishery conflicts and disputes with neighboring countries.

The Gulf of Thailand is the major fishing area of Thailand and in 1996, it contributed approximately 70% of the total marine catch in the country. The catch in the Gulf consisted of pelagic fish (33%), trash fish (32%), demersal fish (12%), squid and cuttlefish (6%), shrimps (5%), crabs (2%) and other fish (10%). However, demersal fish and some pelagic fish in the Gulf of Thailand have been over-exploited. This is due to a combination of factors including; increasing human population, increased pressure from Thai trawlers which have lost access to foreign fishing grounds after neighboring countries declared EEZs, development in fish processing techniques and increasing demand from animal feed producers that utilize trash fish.

This paper provides a broad view of the fisheries situation in Thailand, focused mainly on the Gulf of Thailand. It covers aspects of the environment, the status of resources available, the socioeconomic situation, the existing framework for management and development, and also makes recommendations for government action to develop sustainable fisheries management. The main objectives proposed for improving fishery management are: (1) promote fishers' and fisher organizations' participation in fishery development; (2) optimize fishery resources and their environment so as to be sustainable and equitable; (3) increase fishery products and stabilize fishers' and processors' incomes; (4) progressively develop deep sea fisheries; (5) improve export competitiveness.

Introduction

Thailand is a peninsular country located in South-east Asia, with (Fig. 1) a total land area of approximately 514 000 km² divided into 76 provinces. The sea-coasts of Thailand are the Gulf of Thailand, the main fishing ground, and the Andaman Sea. The Exclusive Economic Zone (EEZ) of Thailand covers 420 280 km², 304 000 km² in the Gulf of Thailand and 116 280 km² in the Andaman Sea. Thailand's EEZ within the Gulf of Thailand includes overlapping areas between Thailand and Cambodia (34 000 km²), Thailand, Cambodia and Vietnam (14 000 km²), and Thailand and Malaysia (~ 4 000 km²) (adapted from Nakthon 1992).

Fish is the primary source of animal protein for most of Thailand's population, particularly in the coastal and near coastal provinces. In 1995, the average per capita consumption of fish was 46.6 g·day⁻¹ (~ 20.8 kg·year⁻¹) or 6.3% of the daily food intake. In urban and rural areas, the per capita consumption of fish was 47.3 and 46.5 g·day⁻¹, respectively. Over the period 1978 to 1997 the per capita

consumption of fish averaged 24 kg annually, and fluctuated between highs of about 33 kg in 1994 - 95, and lows of about 18 kg in 1987 - 88.

During the years 1985 to 1995, the export-to-import ratio of fish and fishery products increased, with a balancing value (total exports minus total imports) of Baht 94 653. 1 million (US\$3.8 to 26.2 million)¹ in 1995. The major exports were fresh and frozen shrimp, squid, cuttlefish, short-necked clam, boil-dried anchovy and canned tuna.

Thailand has faced problems with the development of marine capture fisheries since 1982. Marine fisheries are over-exploited. Fishery conflicts are increasing, and disputes with neighbouring countries have arisen. This paper provides a broad review of Thailand fisheries in terms of the environment, the status of resources available, the socioeconomic situation and the existing framework for management and development. The issues and opportunities facing fisheries in Thailand, focused primarily on the Gulf of Thailand, are discussed and interventions suggested for sustainable development.

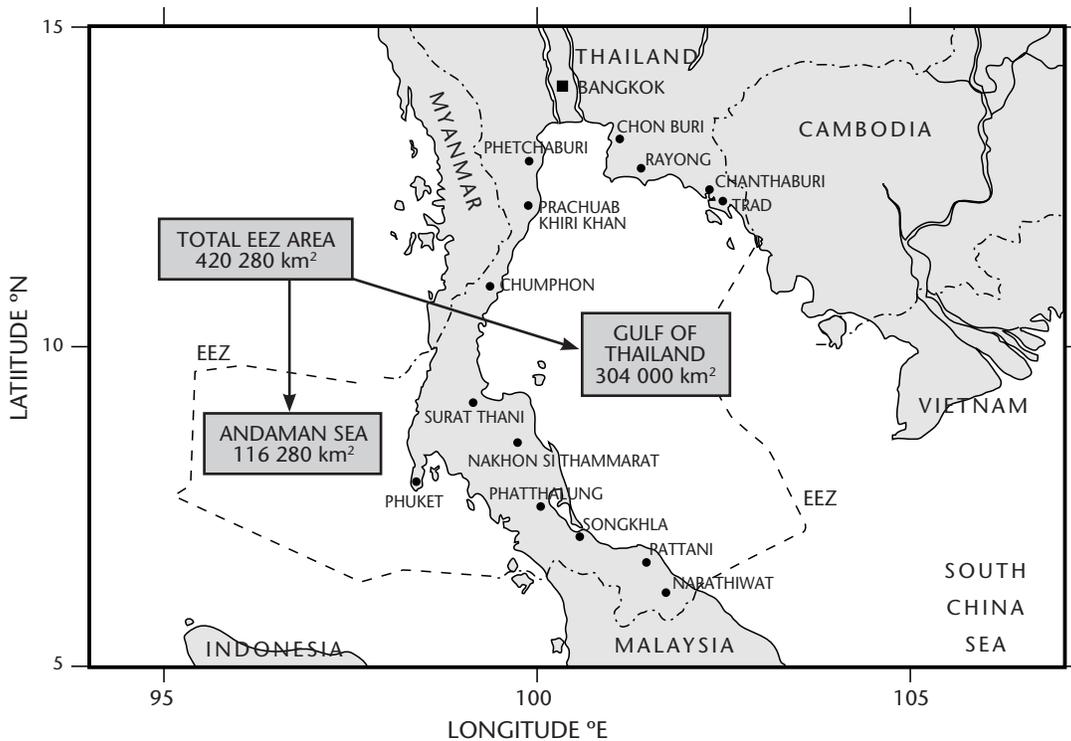


Fig. 1. The exclusive economic zone of Thailand covers 420 280 km², 304 000 km² in the Gulf of Thailand and 116 280 km² in the Andaman Sea.

¹ 1US\$ = Bath 24.92 (1995 Annual average)

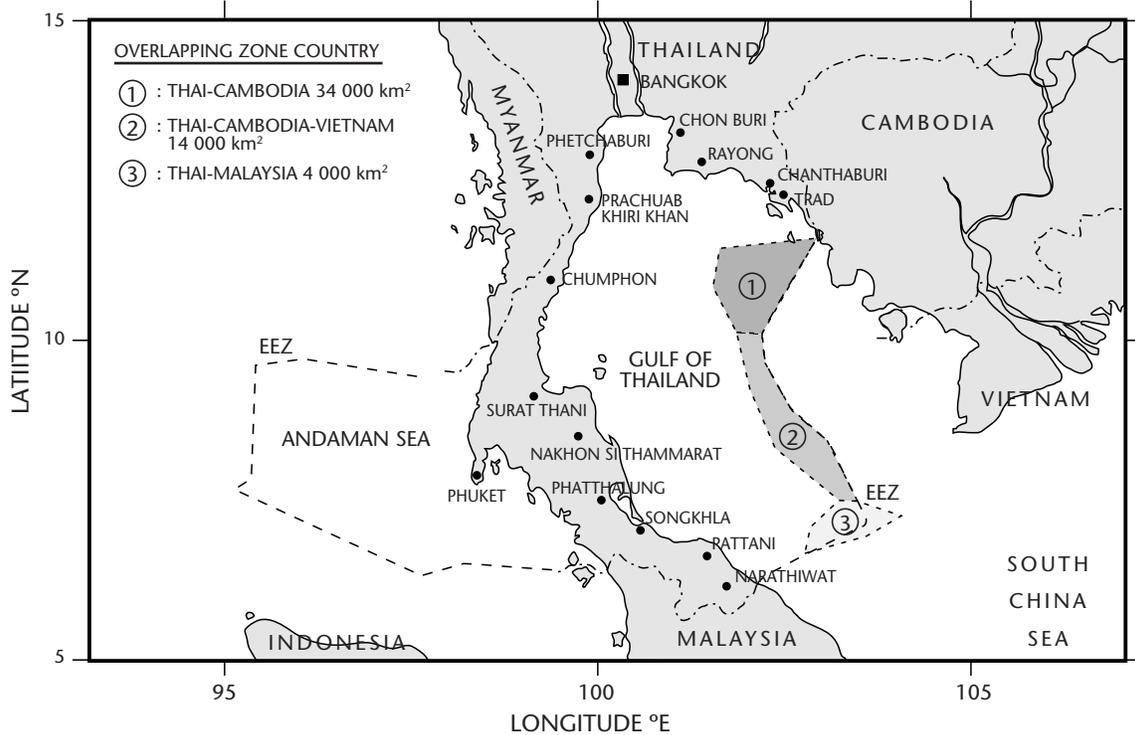


Fig. 2. Overlapping of Thailand's EEZs with those of neighbouring countries.

Biophysical Environment

The Gulf of Thailand

The coastline bordering the Gulf of Thailand is 1 875 km long, and the water is shallow, with an average depth of about 45 m. The deepest part of the Gulf, in the central basin, is about 70 - 85 m deep. The Gulf is partially separated from the South China Sea by underwater ridges, which inhibit the exchange of water. Thus the Gulf can be regarded as an ecologically distinct subset of the South China Sea (Piyakamchana 1989; Pauly and Christensen 1993).

Four major rivers (the Chao Phraya, the Tha Chin, the Mae Klong and the Bang Pakong) drain into the northern, inner gulf, with an average annual discharge of approximately $1.5 \times 10^{10} \text{ m}^3$ (Bunpapong 1987). In the south, high-salinity water from the South China Sea enters (Pongsapipat and Sapsomwong 1973; Robinson 1974). The Gulf of Thailand thus functions as a two-layered, shallow estuary with lower-salinity surface water flowing out, while high-salinity, colder water enters from the South China Sea. In the outer part of the gulf, water tem-

perature ranges from 27.8 to 30° C with an average of 29° C, while surface salinity ranges from 31.4 to 32.7 ppt (Hydrographic Department 1995).

The bottom substrates are predominantly soft mud in the inner Gulf, soft mud in the central basin, and soft or sandy mud in the outer basin (Shepard et al. 1949; Hydrographic Department 1995). The bottom topography of the central basin consists of rolling hills of soft mud 2 - 10 m high. Hence, these areas are not suitable for trawling (Menasveta 1997).

Monsoon winds, tidal currents and the river discharge create complex circulation patterns, including localized upwellings and downwellings. The Gulf's surface water is subjected to two monsoon wind patterns: the northeast monsoon (November to February) and the southwest monsoon (May to September). The mean residual flow in the inner Gulf runs clockwise during the northeast monsoon and counterclockwise during the southwest monsoon. October and April are inter-monsoon months. Neither monsoon wind is constant in direction or speed (Robinson 1974).

Tides in the Gulf of Thailand are composed mainly

of mixed and diurnal tidal constituents. The whole inner Gulf area and the lower part of the west coast are dominated by mixed tides. The east coast and the upper portion of the west coast are dominated by diurnal tides. According to Pukasab and Pochanasomburana (1957), the nodal point exists at latitude 8° 15' N and longitude 102° 30' E.

Primary productivity in the Gulf is high in coastal areas near river mouths, and decreases with depth. Average primary productivity is 2.49 gC·m⁻²·day⁻¹ in the inner Gulf and 2.96 gC·m⁻²·day⁻¹ off the western coast. In the central area it is estimated at 1.37 gC·m⁻²·day⁻¹. High concentrations of phytoplankton are observed in the inner Gulf with cell numbers of up to 4 x 10⁶ - 19 x 10⁶ cell·m⁻³. Zooplankton biomass has increased over a period of 16 years since 1976 and also during 1987 - 89 (Suvapepun 1995).

In general, water quality in the Gulf is considered fair, except for some slight pollution in some specific areas near river mouths. The most common land-based sources of nutrient inputs are domestic wastes and coastal aquaculture effluent. Coastal areas have high levels of nutrients and correspondingly high primary production. This has been associated with extensive blooms of *Noctiluca* along the coast, which have caused anoxic conditions that sometimes result in mass mortalities of fish and benthic invertebrates (Suvapepun 1995). Phosphate concentrations in the inner Gulf ranged from 1.02 to 1.59 mg P·l⁻¹ from 1984 to 1989. Nitrate concentration ranged from 9.15 mgt N·l⁻¹ to 24.86 mg N·l⁻¹ over the same time period (Suvapepun 1991). Secchi disc transparency varied from 14 to 17 m.

Andaman Coast

Tidal currents and along-shore flows dominate the water circulation along the Andaman coast. Similarly to the Gulf of Thailand, the water movements vary with the monsoon period: nearshore surface waters generally move northward during the northeast monsoon and southward during the southwest monsoon. The current speeds are higher during the southwest monsoon (Eiamsa-ard and Amornchairojkul 1997).

The waters of the northern region (Ranong to Phuket) have a high salinity (32.9 - 33.4 ppt) due

to deep sea upwelling, while the southern region (Phuket to Satun) has a lower salinity range (32.6 - 32.8 ppt) due to the influence of surface run-off. The temperature range along the Andaman coast is 27.6 - 29.3° C, slightly lower than the Gulf (Eiamsa-ard and Amornchairojkul 1997).

Critical Habitats

Over 300 major coral reefs, covering approximately 12 000 km², have been identified, in both the Gulf and Andaman Sea. Over 60% of major reefs are in either poor or fair condition; less than 36% are good or very good². The Trad, Phang-Nga and Trang provinces still have significant coral reefs in good and very good condition. The Chon Buri, Rayong, Surat Thani, Phuket and Satun provinces have the most severe coral reef deterioration, due to human activities (Sudara 1999).

Widespread destruction and degradation of coral reefs has occurred over the last four decades (Sudara 1999). It is due to the use of explosives for fishing, the introduction of bottom-trawlers and dragnets in the early 1960s, and the gross mismanagement and uncontrolled expansion of tourism in the late 1970s. The causes of coral reef degradation differ between locations. Blasting of coral reefs is reported to be declining in many places but damage from coastal trawlers is on the increase. More recent contributing factors include sedimentation and pollution from wastewater discharge associated with rapid and uncontrolled coastal area development (Sudara 1999).

In 1961, there were nearly 367 800 ha of mangroves, 37.1% in the Gulf of Thailand. By 1996, the mangroves of the Gulf were estimated to have been reduced to 34 678 ha, only 25.4% of the 1961 level (adapted from Charupatt and Charupatt 1997). From 1961 to 1996 (35 years), the mangrove loss was approximately 2 900 ha·year⁻¹.

The remaining mangroves are particularly extensive in Nakhon Si Thammarat, Trad, Chanthaburi, Chumphon and Surat Thani Provinces. The losses were due to legal and illegal logging, mining, human settlements, industrial development, ports and harbours, dredging, road construction and conversion to shrimp ponds.

Widespread conversion of mangroves occurred in

² The condition rating is categorized by proportion between live and dead coral as ≥3 : 1 very good, 2 : 1 good, 1 : 1 fair, 1 : 2 poor and 1 : ≥3 very poor.

the 1960s to early 1970s for infrastructure development, in the late 1970s until the mid-1980s for extensive shrimp farming, and since 1986 for intensive shrimp farming. The inner Gulf coast, for example, lost most of its mangrove cover during the first expansive phase of brackish water shrimp farming in the 1980s. Despite recent measures to control encroachment on mangroves, and efforts to replant in degraded areas, deforestation has continued, though at a slower rate (Kaosa-ard and Pednekar 1998).

Nine species of seagrass are found in 13 provinces along the Gulf, with extensive seagrass beds at Kung Krabaen Bay in Chantaburi province, Kradad Island and Mak Island in Trad, Samui Island and Pha Ngan Island in Surat Thani, and Pattani Bay in Pattani. The dominant species are *Halophila ovalis*, *Halodule uninervis* and *Enhalus acoroides*. There is clear degradation of seagrass beds due to wastewater discharges from coastal industries, urban development, shrimp farms and other forms of coastal land development, and mining. Trawling and the use of push nets and dragnets can cause severe impacts on seagrasses (Sudara 1999).

Fishery Resources and Potential

In 1996, the Gulf of Thailand contributed approximately 70% of the total marine catch in the country, while the Andaman Sea coast accounted for the remainder. In the Gulf of Thailand, 168 000 t came from small scale fisheries, and 1 735 000 t from large scale or commercial fisheries. These landings were dominated by pelagic fish (33%) and trash fish (32%). The remainder was demersal fish (12%), squid and cuttlefish (6%), shrimp (5%), crabs (2%) and miscellaneous fishes (10%) (Department of Fisheries 1999).

Demersal Fish

Demersal fish are caught mainly by otter-board trawls, pair trawls, beam trawls and push nets. In the Gulf, the number of registered trawls increased from 3 206 units in 1970 to 15 037 in 1989. The annual catch of demersal fish increased from 51 000 t in 1978 to 235 700 t in 1996. In 1996, 64% of the demersal catch originated from the Gulf.

The demersal fish resources in coastal waters have been severely depleted, as shown by estimates of potential yields of various fish stocks, the change in

catch composition towards smaller-sized fish and low value species. Trash fish currently constitute about 60% of the total trawl catch from the Gulf of Thailand. Between 18% and 32% of trash fish are juveniles of commercially important fish species (Supongpan 1996 cited in Menasveta 1997).

The demersal resources (demersal fish and trash fish) in the Gulf of Thailand have been over-fished since 1973 with an estimated MSY of 750 000 t and optimal fishing effort at 8.6 million hours of trawling (Panayotou and Jetanavanich 1987). Another analysis based on Thompson and Bell's method (Gayanilo and Pauly 1997) for estimating MSY and MEY of five dominant species in the trawl catch (i.e. *Priacanthus tayenus*, *Nemipterus hexodon*, *Saurida undosquamis*, *Saurida elongata* and *Metapenaeus affinis*) indicated that those species were over-exploited at the current fishing effort (Supongpan 1996a). Several factors may have contributed to over-fishing, notably: increasing human population; increased pressure from Thai trawlers who lost access to foreign fishing grounds after neighbouring countries declared EEZs; development of processing techniques for turning low-priced demersal fish into human food; and increasing number of animal feed plants that utilize trash fish (Eiamsa-ard and Amornchairojkul 1997).

Pelagic Fish

In the Gulf of Thailand, pelagic fish are caught by stake traps, purse seiners (Chinese, Thai, luring and anchovy), encircling gillnets and drift nets. Important pelagic fish are mackerels (*Rastrelliger* spp.), scads (*Decapterus* spp.), sardines (*Sardinella* spp.), anchovies (*Encrasicholina* spp. and *Stolephorus* spp.), king mackerel (*Scomberomorus* spp.), and tuna (*Thunnus* spp. and *Euthynnus* spp.) (Eiamsa-ard and Amornchairojkul 1997).

In the past, Indo-Pacific mackerel (*Rastrelliger brachysoma*) or platu was the most popular fish for Thai consumers. Hence, this species was extensively studied (Kurogane et al. 1971; Hongskul 1974). In 1971, catches of Indo-Pacific mackerel were about 40 000 t, 47% of pelagic fish catches. However, following the development of improved pelagic fishing gear and techniques, the major contributors to the small pelagic catches in 1977 were sardines and round scads, with 205 000 t and 131 000 t, or 41% and 26% of the total pelagic catches, respectively. These high percentages have since declined, due to the development of an off-

shore fishery for large pelagic fishes, especially tuna.

Supongpan (1996a) stated that the Indo-Pacific mackerel (*Rastrelliger brachysoma*) stocks in the Gulf of Thailand had been fully exploited since 1984 (estimated MSY of 105 000 t and an optimal fishing effort of 145 000 fishing days). The catch of this species decreased during 1990 - 91. The sardines (*Sardinella* spp.) have been over-exploited since 1988 (MSY of 104 000 t and an optimal fishing effort of 190 000 fishing days). The anchovy (*Stolephorus* spp.) resources have likewise been fully exploited since 1990 (MSY at 104 000 t and an optimal fishing effort of 53 000 fishing days). The small tuna and round scad stocks have also been fully exploited since 1988 and 1977 with the estimated MSY at 86 000 t and 100 000 t, respectively. Other pelagic fish stocks including the Spanish mackerel (*Scomberomorus commersoni*), carangids and hardtail scads (*Megalaspis* spp.) have not yet been fully exploited.

Shrimps

The penaeid prawn (*Penaeus* spp.) resources have been over-exploited since 1982 (MSY of 22 000 t and an optimal fishing effort of 25 million hours). The small sized shrimps (*Trachypenaeus* spp. and *Metapenaeopsis* spp.) have also been over-exploited with estimated MSY of 110 000 t and an optimal fishing effort of 44 million hours (Supongpan 1996a).

Other Resources

The cephalopods in Thai waters consist of 10 families, 17 genera and over 30 species. The more important species of the squid fishery are *Loligo chinensis*, *L. duvauceli*, *L. singhalensis*, *L. edulis*, *Loliolus sumatrensis* and *Sepioteuthis lessoniana*; the cuttlefishes; *Sepia pharaonis*, *S. aculeata*, *S. recurvirostra*, *S. lycides*, *S. brevimana* and *Sepiella inermis* and the octopus; *Octopus membranaceus*, *O. dollfusi* and *Cistopus indicus* (Chottiyaputta 1993). The squids, *L. chinensis*, *L. duvauceli*, *Sepioteuthis lessoniana* and *Loliolus sumatrensis* are abundant both in the Gulf and the Andaman Sea. *L. edulis* and *L. singhalensis* are rare in the Gulf but more abundant in the deeper parts of the Andaman Sea coast (Supongpan 1996b). Cuttlefish, *S. pharaonis*, *S. aculeata*, *S. recurvirostra*, *S. brevimana* and *Sepiella inermis* occur both in the Gulf and the Andaman Sea. *S. lycidas* is common along the Andaman Sea coast, but in the Gulf occurs only in the southern part. *Octopus*, *O. membranaceus*, *O. dollfusi* and *Cistopus indicus* are

widely distributed in the Gulf and the Andaman Sea.

From 1985 to 1988, cephalopod catches consisted of squid 56%, cuttlefish 37% and octopus 7%. The cephalopod stocks had by then been fully exploited (MSY of squids, 67 000 t by 1991; cuttlefish 35 000 t and octopus 85 000 t, based on data from 1972 - 1991). The crab resources had been fully exploited as well (Supongpan 1996a).

Socioeconomic Background Demography

Under the third National Economic and Social Development Plan (1972 - 76), the Thai government set a policy of population control. Successful implementation reduced the population growth rate to 1.2 percent during the years 1992 to 1995. In 1999, the total population was 61 626 480, with 51% being women

In 1998, the labor force was 35.6 million, of which 15.4 million (43 %) were employed in the agricultural sector, including fisheries. The 1995 figures show that an estimated 535 210 people (about 0.9% of the population) belonging to 53 112 households were involved in the fisheries sector, of which 51% were males (National Statistical Office 1997). Of these, 44.2% were engaged in small scale marine capture fishers, and 5.7% in commercial marine fisheries. The total number of fishers increased during the peak season; 47.5% were family members and 52.5% employees. Among employees, 58.1% were non-local and 41.9% were local employees. Among non-local employees, 55.8% came from the northeast of the country, 18.4% from other parts of Thailand and 25.8% from foreign countries (National Statistical Office 1997).

Estimates of fishing income are available from 1990. The income of fishing households, especially small scale fishing households, comes from various sources, however the main source is fisheries. Average annual income of small scale fishing households in 1990 was Baht 58 776 (US\$2 358), of which 78.8% was cash income and 21.2% was non-cash income. Average annual incomes of small scale fishing households were higher in the Gulf of Thailand (Baht 63 351) than in the Andaman Sea (Baht 54 098). For the whole country the annual income per capita was Baht 16 463 (National Statistical Office 1992 b).

Education and Literacy

About half of Thai fishers have attained lower elementary education, while about a quarter have reached the upper elementary level (National Statistical Office 1997). Thai fishers are similar to farmers in having less opportunity to get a formal education due to low incomes (Pimoljinda 1997). To break the vicious circle of low income and lack of education, the government must provide information for small scale fishers and formal education for their children (Wongsanga et al. 1997).

Environmental Awareness

The need for participation by stakeholders in natural resource and environmental management has received increased recognition within Thailand, particularly in the Eighth National Economic and Social Development Plan (1997 - 2001). Creating opportunities and an enabling environment to support the participation of all sectors in the development process is one of the main strategies of the national plan. In pursuit of this strategy, the guidelines at the national policy level include:

- Providing opportunities for people and communities to participate in decision-making and to monitor and evaluate public development projects likely to have an impact on natural resources and the environment. The government should facilitate continual public discussion at every step of those projects.
- Providing legal guarantees of the rights of local communities and small fishers to participate in coastal resource management, including the conservation, rehabilitation and maintenance of mangrove forest, sea grasses and coral reefs, to ensure their sustainable use (Tokrisna et al. 1997).

Consequently, upgrading the capacities of rural communities for economic and social development and for conservation of natural resources are priorities.

Infrastructure

To improve the living standard of fishing communities, essential infrastructure such as roads, electricity, small fishing piers and water supply facilities should be built. Some fishing villages in remote areas are in need of basic structures, such as community landings, fishing-gear repair shops, fish processing shops and freshwater tanks. At present,

some fishing villages still have no roads for vehicles, or electricity. There is a continual shortage of fresh water and drinking water, especially during the dry season. The fishing communities must buy fresh water, which is expensive. The Department of Fisheries has implemented the Marine Fishery Development Project since the Fifth National Economic and Social Development Plan (1982 - 86). This project aimed to raise the living standard of fishers, especially small scale fishers. The provision of basic fishing infrastructure was one project activity. However many facilities have not been utilized, or have been improperly managed and maintained, largely because of a lack of clarity in objectives (Pimoljinda 1998; Supongpan 1996a).

Level of Urbanization

Human settlements along the coast in Thailand can be classified into five categories (Adulavidhaya et al. 1982):

- i. Fishing villages.
These are the most common type of settlement along the Thai coasts, generally settled in clusters, along estuaries and shores, they vary in size from 20 - 30 households to very large villages composed of several hundred households. Panayotou et al. (1985) estimated a total number of 90 200 fishing households in the 1 563 villages of the 23 coastal provinces, bringing the fishing-dependent population to 800 000 - 1 000 000. People in fishing villages are usually engaged in small scale fisheries with simple technology and these villages are generally self-sufficient (Thailand Development Research Institute 1986).
- ii. Fishing and farming villages.
These are mainly scattered along the eastern coast and the southern provinces. These communities engage in rice farming as a supplementary occupation to fishing and their standard of living is relatively better than those who only fish (Rientrairut 1985). However, rice production is rarely sufficient for household consumption. Increasing salinity of the soil, population growth, additional pressure on land use, and lack of interest in rice cultivation have all resulted in insufficient rice production. Coconut plantations also provide supplementary income to fishers (Suraswadi 1998).
- iii. Coastal farming communities.
These are located in the inner part of the Gulf of Thailand, including areas along the estuaries and deltas of four major rivers of the region (the

Chao Phraya, Mae Klong, Nakornchaisri, and Bang Prakong). The major occupations are salt farming, shrimp and fish farming, mariculture, and coconut farming. This type of settlement is generally in a scattered pattern with a homestead on each farmland.

iv. Coastal urban and industrial communities.

There are mainly located in the vicinity of the inner Gulf of Thailand. Recently these have been industrialized, e.g. Chon Buri and neighbouring Rayong and Chachoengsao have become the focus of the Eastern Seaboard Development Plan, which has brought in development activities including a major new port, a heavy industry zone, oil refineries, a petrochemical industry, a marine product industry and numerous housing estates. The rate of urbanization and industrialization in Chon Buri and neighbouring provinces is increasing rapidly (Office of the National Environment Board 1986). In addition, many coastal provinces have rapidly developed due to the tourism boom.

v. Migratory communities.

These are mainly in some of the southern provinces on the Bay of Bengal coast. The “Chao Le” (*sea dyak* or *sea gypsy*) are the major ethnic group in these communities. Having no permanent settlement, these people wander from island to island in search of fishing areas. It is estimated that the population of sea dyaks in Thailand is about 2 300 people or 400 households. They live in small groups with a unique culture (Adulavidhaya et al. 1982).

Agriculture and Fisheries Sectors

The development of the Thai agricultural sector during the last 25 to 30 years has been achieved largely at the expense of the country’s rich resource base. The country’s vast supply of water, forest, coastal, marine, and other natural resources have been used extensively, while management and conservation processes have remained under-developed. As a result, Thailand’s once abundant natural resources have diminished significantly, with serious implications for the Thai people.

Table 1 presents principal economic indicators for comparing the productivity of the agricultural and the non-agricultural labor force. In 1995, in terms of agricultural GDP per worker, there was an order of magnitude difference between the two sectors.

The Gross Domestic Product (GDP) increased annually from 1991 to 1995. The income per capita also increased, as did the GDP from fisheries, which accounts for 13% to 15% of the total agricultural GDP (Table 2). The annual growth rate of the fisheries GDP decreased dramatically from 24.2% in 1991 to - 0.8% in 1995. During the same period the overall GDP fluctuated over a small range of 8.2% to 8.9% (Table 3).

As Thailand has progressed from being a producer of primary agricultural products to being the fifth largest exporter of food and processed food products in the world, it has come face to face with the

Table 1. Comparison of the productivity of the agricultural and the non-agricultural labor forces in 1991 - 95.

Items	Unit	1991	1992	1993	1994	1995
Gross domestic product	Million Baht	2 506 635	2 834 677	3 179 451	3 634 848	4 202 835
Gross national product	Million Baht	2 469 744	2 771 716	3 116 484	3 559 816	4 107 377
Economic growth rate	Percent	8.6	8.2	8.5	8.9	8.8
Per capita income	Baht	44 307	49 476	54 809	61 909	70 754
Per capita GDP originating from agriculture	Baht·head ⁻¹	16 272	17 877	16 963	19 493	22 927
Per capita GDP originating from non-agriculture	Baht·head ⁻¹	166 379	186 284	209 879	235 832	267 680

Source: Office of Agricultural Economics 1998.
1US\$ = Baht 24.92 (1995 Annual average).

reality of the terms and conditions of being a major trading nation. As its products have penetrated new, more developed, more sophisticated and specialized niche markets, the quality of Thai goods has been of increasing importance. As global awareness of the environmental impacts of unsustainable agricultural development has increased, consumers have become more conscious of the source

of their food products. As existing resource bases are depleted or destroyed, producers expand onto increasingly marginal lands and violate the ethics and principles of resource protection. This has resulted in increased linkages between trade and the environment and more intensive scrutiny of Thai agricultural production.

Table 2. Gross Domestic Product originating from agriculture (at 1988 prices). Unit: Million Baht.

Items	1991	1992	1993	1994	1995
GDP originating from agriculture	282 739 (100)	299 570 (100)	299 513 (100)	315 065 (100)	321 957 (100)
- Crops	170 277 (60.22)	180 272 (60.18)	174 466 (58.25)	184 006 (58.40)	191 932 (59.61)
- Livestock	29 370 (10.39)	30 314 (10.12)	31 628 (10.56)	31 334 (9.95)	32 053 (9.96)
- Fisheries	37 305 (13.20)	40 263 (13.44)	45 613 (15.23)	49 247 (15.63)	48 867 (15.18)
- Forestry	5 892 (2.08)	5 671 (1.89)	4 990 (1.66)	4 110 (1.30)	3 817 (1.18)
- Agricultural services	9 509 (3.36)	9 429 (3.15)	8 800 (2.94)	9 041 (2.87)	8 341 (2.59)
- Simple agricultural processing products	30 386 (10.75)	33 621 (11.22)	34 016 (11.36)	37 327 (11.85)	36 947 (11.48)

Source: Office of Agricultural Economics 1998. Numbers in brackets represent percentages.
1US\$ = Baht 24.92 (Annual average 1995).

Table 3. Growth rates of the economy and its agricultural sector (at 1988 prices). Unit: percent.

Items	1991	1992	1993	1994	1995
Gross domestic product	8.6	8.2	8.5	8.9	8.8
Gross national product	8.4	7.4	8.8	8.9	8.7
GDP originating from agriculture	7.2	6.0	0.0	5.2	2.2
- Crops	5.7	5.9	-3.2	5.5	4.3
- Livestock	1.0	3.2	4.3	-0.9	2.3
- Fisheries	24.2	7.9	13.3	8.0	-0.8
- Forestry	-0.6	-3.8	-12.0	-17.6	-7.1
- Agricultural services	-0.9	-0.8	-6.7	2.7	-7.7
- Simple agricultural processing products	9.6	10.6	1.2	9.7	-1.0

Source: Office of Agricultural Economics 1998.

Through the 8th Agricultural Development Plan, the Ministry of Agriculture and Cooperatives is committed to addressing issues related to trade and the environment by implementing policies, programs, projects, and activities that will lead to improved competitiveness of Thai agricultural products through the use of advanced technologies. More sustainable agricultural development will be achieved through improved management of natural resources. Human resource development will be emphasized to increase the capacities of farmers and community-level institutions and organizations to adapt to the globalization of the agricultural sector (Office of Agricultural Economics 1998).

The level of integration of global economic development and increased intensity of international trade has required the global community to devise terms, conditions, and structures that will ensure fairness, transparency, and equality in international transactions. In the light of negotiated General Agreement on Tariff and Trade (GATT) agreements and their strict enforcement by the World Trade Organization, the Thai Government has taken actions to ensure that its agricultural and industrial sectors are responsive to the dynamic and changing nature of the framework for international trade.

The Ministry of Agriculture and Cooperatives, led by the Office of Agricultural Economy (OAE), has initiated several programs that if implemented would lead to more appropriate and sustainable agricultural development, fitted to the demands of the framework for international trade and development. With assistance from the World Bank, the Government of Japan, the Danish Cooperation for Environment and Development (DANCED), United Nations Development Program (UNDP), Food and Agriculture Organization (FAO), and other donors, various on-going or planned activities will ensure improvements in natural resources management and strengthening of policy formulation and implementation among key planning and policy making agencies of the Ministry of Agriculture and Cooperatives. Natural resource areas that have been considered include watersheds, coastal zones, and conservation forests with their adjacent buffer zones. Human resource development initiatives are underway that will lead to strengthening capacities in policy formulation and implementation; planning; provision of training and transfer of technology; natural resources and environmental database management, including bio-diversity; natural resources evaluation; and econometric modeling.

In addition to coordinating activities that are being implemented through various technical assistance projects, the Office of Agricultural Economy (OAE) took the lead in preparing the 8th Agricultural Development Plan, incorporated as part of the 8th National Social and Economic Development Plan for Thailand (1997 - 2001). The 8th Agricultural Development Plan was formulated over a period of more than one year, and involved extensive consultation with representatives from key Thai Government planning agencies, all departments and state enterprises under the Ministry of Agriculture and Cooperatives, farmers, non-government organizations, academics, researchers from independent research institutes, and concerned private sector firms. Three principal strategies for Thailand's agricultural development were identified, namely:

1. Competitiveness (in international markets)
2. Natural Resources Conservation and Sustainable Agriculture Development (in line with international conventions and in light of the increasingly close linkages between trade and the environment)
3. Human Resources and Agricultural Institutional Development

Fishers and Fishing Households (Spatial, Temporal)

A structural change in Thai fisheries has taken place during the last 10 years. From 1985 to 1990, the overall number of fishing households and fishing boats decreased by 6.7% and 2.3% respectively (Table 4). Small scale fishing households and small scale fishing boats decreased by 5.9% and 0.6% respectively, whereas commercial-scale fishing households and commercial fishing boats decreased by 9.8% and 7.5%. The decreasing numbers of small scale fishing households and boats were largely due to the decrease in coastal fishing resources and the conflicts between small scale and the commercial-scale fishers.

During 1990 - 95, the number of fishing households and fishing boats in Thailand increased by 11.0% and 5.4% respectively. The increase in fishing households has largely been in small scale fisheries. Commercial fishing households decreased by 5.3%. Likewise, the increase in fishing boats has been in the small scale sector. Small scale fishing boats accounted for 8.1% of the total increase,

while commercial boats have actually decreased in number by 3.7% (Table 4). The creation of a boat-tenure system within the commercial fishing sector is responsible for the decrease in trawling boats. The change to squid light-luring fishing boats has resulted in a decrease in the number of boats per household. To maintain the demersal fishery resources for sustainable development, the Minister of Agriculture and Cooperatives issued a notification to limit entry of new trawl and push net boats. The boat-tenure system has been implemented since 1 November 1996. Owners of trawlers or push netters have to register every fishing year (1 April to 31 March of the following year). Only one type of gear on a motorized boat may be registered, (pair trawl can have two boats with one trawling gear). Immediate notification of a registered boat sinking or being out of order is required, or the registration will be terminated. If a registered boat is arrested in a foreign country, the owner should inform the office within 60 days and the registration will continue after release within that fishing year.

A registered boat can be sold legally, but can be transferred to a son only. The location for registration can be changed anywhere in the Gulf of Thailand and on the Andaman Sea coast.

Three major factors have led to the increase in small scale fishing households and boats during the last five years. Firstly, the population in coastal fishing communities has increased. Secondly, fishery resources have partly recovered because of artificial reef installation. Thirdly, some coastal communities have succeeded in obstructing coastal trawling and have become enthusiastic about looking after fishing areas themselves.

In spatial terms, fisheries are concentrated in the six provinces located in the southern parts of the country both in the Gulf of Thailand and Andaman Sea. These provinces are Songkhla, Nakhorn Sri Thammarat, Phangnga, Satun, Surat Thani and Krabi (Table 5). Small scale fisheries dominate these areas, with shrimp gillnet, shrimp trap, crab gillnet and trawl net as the main fishing gear.

Table 4. Changes in fishery households and fishing boats between 1985 and 1995.

Types	1986 ^{1/}	1990 ^{2/}	1995 ^{3/}	1990/1986 (%)	1995/1990 (%)
Number of fishery households	51 245	47 836	53 112	-6.7	11.0
- Small scale fishery	41 592	39 127	44 867	-5.9	14.7
- Commercial fishery	9 653	8 709	8 245	-9.8	-5.3
Number of fishing boats	52 950	51 757	54 538	-2.3	5.4
-Small scale fishery	40 095	39 870	43 092	-0.6	8.1
-Commercial fishery	12 855	11 887	11 446	-7.5	-3.7

Sources: ^{1/} National Statistical Office 1987.

^{2/} National Statistical Office 1992a.

^{3/} National Statistical Office 1997.

Table 5. Distribution and type of the main marine capture fishery establishments.

Province	Number of capture fishery establishments	Main fishing gear
Songkhla	5 885	Shrimp gillnet, shrimp trap, trawl net
Nakhon Sri Thammarat	4 791	Shrimp gillnet, trawl net
Phangnga	3 970	Shrimp gillnet
Satun	3 795	Shrimp gillnet
Surat Thani	3 285	Crab gillnet
Krabi	3 105	Shrimp gillnet

Source: National Statistical Office 1997.

Professional and Business/industry Groups

The post harvest or processing factories in Thailand are rather simple, often at the household level. There are 9 331 households involved and they are distributed over both the Gulf and Andaman Sea coasts. Some households have more than one processing activity. The top three activities are: fermented production 3 216 units (31.4%), dried and boiled products 3 166 (30.9%) and steam products 3106 (30.3%), with a total of 10 255 units. The industrial factories produce chilled and frozen, canned, minced, fish sauce product and salted fish. Related businesses include boat yards, ice factories and machinery import agencies. These provide millions of job opportunities (adapted from Siriekawat 1996).

Institutional Background

Fisheries-related Policies

The Constitution

The present Constitution of the Kingdom of Thailand was enacted on the 11th of October B.E. 2540 (1997). There are 336 sections related to natural resources and environment. The following describes the more important sections:

Section 56. The right of a person to an environment that is not hazardous to his or her health, welfare or quality of life shall be protected. The right of a person and communities to participate in the exploitation, preservation and protection of natural resources and bio-diversity, and in the promotion and preservation of the quality of the environment shall also be protected.

Any project or activity that may seriously affect the quality of the environment shall not be permitted, unless its impacts on the quality of the environment have been studied and evaluated. Prior to the operation of such project or activity, the opinions of an independent organization, consisting of representatives from private environmental organizations and from higher educational institutions that conduct studies in the environmental field, will be obtained, as provided by law.

The law shall protect the right of a person to sue a state agency, state enterprise, local government organization or other state authorities for failure to perform the duties under paragraph one and paragraph two.

Section 69. Every person shall have a duty to conserve natural resources and the environment, as provided by law.

Section 79. The State shall promote and encourage public participation in the preservation, maintenance and balanced exploitation of natural resources and bio-diversity and in the promotion, maintenance and protection of the quality of the environment in accordance with the persistent development principle as well as the control and elimination of pollution affecting public health, sanitary conditions, welfare and quality of life.

Section 290. For the purpose of promoting and maintaining the quality of the environment, a local government organization has powers and duties as provided by law.

The law contains the following matters as its substance:

- i. The management, preservation and exploitation of the natural resources and environment in the area of the locality;
- ii. The participation in the preservation of natural resources and environment outside the area of the locality only in the case where the living conditions of the inhabitants in the area may be affected;
- iii. The participation in considering the initiation of any project or activity outside the area of the locality which may affect the quality of the environment, health or sanitary conditions of the inhabitants in the area.

Legislation

Legislation related to the fisheries of Thailand includes:

- The Thai Vessels Act, B.E. 2481 (1938)
- The Act Governing the Right to Fish in Thai Fisheries Waters, B.E. 2482 (1939)
- The Fisheries Act, B.E. 2490 (1947)
- The Fish Marketing Act, B.E. 2496 (1953)
- The Wildlife Reservation and Protection Act, B.E. 2535 (1992)

The main legislation is the Fisheries Act, B.E. 2490 (1947), covering fisheries management and conservation, aquaculture, registration and application for permits, collection and fixation of fisheries tax, fisheries statistics as well as the provision of

penalties. This Act was drawn up in 1947 before the development of marine fisheries and was drafted primarily with inland fisheries in mind. It has been amended twice, in 1953 and 1984, and empowers the Ministry of Agriculture and Cooperatives and the Provincial Governor to enforce the law means of administrative power (Karnjanakesorn and Yen-Eng 1998).

There are several important sections in this Act. For example:

Section 7 empowers a Provincial Governor, with the approval of the Minister, to make notification about the types of fisheries within his/her province.

Section 12 defines a reserved area for a person or an entity permitted to fish or to cultivate aquatic animals.

Section 13 prohibits unlicensed persons from fishing in the reserved area.

Section 32 authorizes the Minister or the Provincial Governor to enact measures for: (1) controlling types, number and components of fishing gear; (2) prohibiting certain types of fishing tools and methods used for fishing during breeding seasons; and (3) setting a maximum allowable catch of aquatic species including a total ban on catching particular aquatic species.

Administrative Regulations

The Minister of Agriculture and Cooperatives is empowered by the provisions of the Fisheries Act to impose fishery regulations.

a. Prohibition of the use of certain types of fishing gear during the spawning and breeding seasons of some commercially important species, for example:

- Ministerial regulation of 28 November 1984
A conservation area of approximately 26 400 km² was declared in the Gulf of Thailand to protect several commercially exploited species of demersal and pelagic fish during their spawning and breeding seasons from February to 15 May of each year. This regulation prohibits fishing by all types and sizes of trawlers (with the exception of beam trawlers), all types of purse seiners (except for anchovy purse seiners operating in the daytime during February 15 to March 31 only)

and gillnets with less than 4.7 cm mesh size, along the coastline of Prachuap Khiri Khan, Chumphon and Surat Thani Provinces.

- Ministerial regulation of 11 April 1985
Conservation measures for protecting breeding species in their spawning and nursery grounds were extended to the Andaman Sea. A 1 800 km² area at Phang-gna and Krabi province was declared as a zone of conservation through selectively controlled fishing by closed seasons and/or prohibition of selected fishing gear during April 15 to June 15 of each year.

b. Prohibition of certain types of fishing gear in some areas, for example:

- Ministerial Regulation of 20 July 1972
This regulation prohibits fishing by trawlers and push nets within a distance of 3 000 m from the shoreline and within a perimeter of 400 m of any stationary fishing gear in the Gulf of Thailand. This regulation was designed to maintain the productivity of these near shore waters, as the catches from these areas had dropped below their potential yield. Furthermore, 80% of the total catch consisted of small fish, at least half of which were the juveniles of economically important species.
- Ministerial Regulation of 18 February 1974
The use of any kind of shellfish rack within 3 000 m from the shoreline was prohibited along the entire coastline of Thailand, both in the Gulf and the Andaman Sea. This type of fishing destroys nursery grounds of young shellfish.
- Ministerial Regulation of 14 August 1979
This regulation prohibits fishing operations using all types of trawlers and push nets within 3 000 m from the shoreline and within a radius of 400 m from stationary fishing gear in the Andaman Sea.

c. Declaration of protected areas, for example:

- Ministerial Regulations of 27 February and 15 May 1989
These regulations declared the areas around Khai, Charakhay, Thalao, Khalok and Hin Phae Islands off the coast of Chumphon Province in the Gulf of Thailand and coral reefs at Patong Bay of Phuket Province along the Andaman Sea coastline as protected areas for the conservation of coral reefs.

- Ministerial Regulation of 9 May 1991
A marine turtle nesting area of approximately 1.6 km² at Kra Island of Trat Province in the Gulf of Thailand was declared a protected area to shelter the turtles during the breeding season.
- d. Protection of endangered and threatened species, for example:
 - Ministerial Regulation of 14 April 1949, 19 November 1980, 11 August 1981 and 15 May 1989. These regulations prohibit the catching of sea turtles, collection of their eggs and export of sea turtle shells in a processed or unprocessed form, and became essential to protect dwindling sea turtle populations.
 - Ministerial Regulation of 9 August 1961. This regulation prohibits catching of dugongs in the Gulf of Thailand and Andaman Sea, as this species was fast becoming endangered in these waters.
 - Ministerial Notification Regarding Prohibition of Fishing Any Dolphin of 18 June 1990. This notification states that “no person shall fish any dolphin from the sea of all coastal provinces except after receiving the written permission from the Director-General or except any fishing activities done by the authority assigned by the Director-General”.

National Development Plans

National fisheries development plans have been aligned with the National Economic and Social Development Plan (NESDP) since the latter came into existence in 1961. Under the **First Plan (1961 - 66)**, trawl fisheries, particularly otter-board trawling of demersal resources, were supported by the Board of Investment and the Government of Thailand in cooperation with the Federal Republic of Germany. The marine production in 1966 increased 88% from the year 1962. Under the **Second Plan (1967 - 71)**, policies and objectives continued to emphasize marine fisheries, with the production target set at 860 000 t in 1971. At the end of the plan implementation period, the production reached 730 000 t, with marine production accounting for 93% of total fisheries production. The fisheries development policy in the **Third Plan (1972 - 76)** was to put more effort into aquaculture development. In this period, there was a decrease in marine production, due mainly to the oil crisis. At the end of 1976, marine production was 1.7 million t.

The **Fourth Plan (1977 - 81)** still called for an expansion of coastal aquaculture, but the conservation of natural resources and the environment were the major concerns. Several regulations were promulgated to preserve and conserve marine fisheries resources, including the provision of more patrol boats to implement conservation regulations. By this time, the pelagic fisheries were also developed. There was a slight increase of total marine production to 2.0 million t. Under the **Fifth Plan (1982 - 86)**, one objective was to increase fish production by about 5.5%•year⁻¹. To reach the target, fisheries joint ventures were negotiated with neighbouring countries. In this period, the highest actual production was 2.1 million t, used to meet domestic consumption and to export. The preservation and sustainable management of the fisheries and environment were addressed by regulating and prohibiting fishing in spawning and nursery grounds for specific periods.

Besides the fisheries development policies, one factor that also had a significant influence on the trends in marine production was the increasing number of trawlers. The light-luring fishing gear introduced to pelagic fisheries, which can attract various species including squid, white shrimp and even marine animals, also increased in number. Moreover, there was an increase in medium and large size purse seiners equipped with radar, fish-finders, wireless equipment and refrigeration and freezing technology. Searching and detecting fish schools improved with the increasing use of echo sounders and sonar. Fish processing was developed and improved to produce high quality products for export. The establishment of the Exclusive Economic Zones (EEZs) by neighbouring countries has deprived the Thai marine fisheries of about 300 000 miles² of fishing grounds. In response, the government has promoted joint fisheries ventures with several countries including Oman, Saudi Arabia, Somalia, Indonesia, India, Bangladesh and Australia.

The rapid increase of marine fisheries production over the last three decades has been due to the development of fishing technology, resulting in several demersal and pelagic fishes as well as invertebrates being heavily exploited, with catches almost higher than the estimated maximum sustainable yields (MSYs). Conflicts between commercial fisheries and small scale fisheries often occur. The heavy exploitation of marine resources has now resulted in declining production.

In the **Sixth Plan (1987 - 91)**, the fisheries policy aimed to maintain marine fisheries production at 1.9 million t and to continue increasing aquaculture production by increasing cultured species other than shrimp (e.g. grouper, white snapper and red snapper). Fish handling was also developed and improved. Trash fish processing was introduced. The **Seventh Plan (1992 - 96)** objectives and policy were to put more effort into developing small scale fisheries, since the small scale fisheries contributed only 13% of total marine production but accounted for about 90% of households engaged in fishing. Increasing the income and improving the quality of life of fishers were the main objectives. The management interventions were to provide aid for the villages such as fishing piers, artificial reef installations to provide fish shelters, spawning areas and feeding areas, and to introduce non-destructive fishing gear to catch a sustainable yield. For large scale or commercial fisheries, the objective was to maintain the marine fisheries production in the EEZ at the level of 1.7 million t. Controlling access to fishery resources needed to be addressed urgently in view of the over-exploitation of many fish stocks and the over-capacity of the large scale distant water fishing fleet.

Eighth National Economic and Social Development Plan (1997 - 2001) sets the following objectives:

- To foster and develop the potentials of all Thais, in terms of health, physical well-being, intellect, vocational skills and ability to adapt to changing social and economic conditions.
- To develop a stable society, strengthen family and community, support human development, improve quality of life and promote increasing community participation in national development.
- To promote stable and sustainable economic growth and to empower the people to play a greater role in the development process and receive a fair share of the benefits of growth.
- To utilize, preserve and rehabilitate the environment and natural resources in such a way that they can play a major role in economic and social development and contribute to a better quality of life for the Thai people.
- To reform the system of public administration so as to allow greater participation of non-government organizations, the private sector, communities and the general public in the process of national development.

With regard to agriculture and natural resources, the main targets of the Eighth Plan were to preserve and rehabilitate forest areas to cover no less than 25% of the country, including no less than 1 600 km² of mangrove forest by the last year of the Plan, increase awareness of sustainable alternative agricultural methods, increase opportunities for their application, and promote investment in the rehabilitation and protection of urban and rural environments.

The plan called for natural resources and environmental management, including directions for conserving and rehabilitating natural resources that would promote balance in the ecosystem; maintaining and upgrading environmental conditions to enhance quality of life and to provide an enduring resource base to support development; improving management systems for natural resources and the environment in order to ensure proper supervision, efficient utilization, and fair distribution of benefits to the community and society; and management guidelines for the prevention and relief of natural disasters.

In addition, the plan supported the promotion of popular participation in natural resource and environmental management by providing legal guarantees of the right of local communities and small fishers to participate in coastal resource management, as well as the conservation, rehabilitation and maintenance of mangrove forests, sea grass and coral reefs, to ensure sustainable use of coastal resources, especially those related to the fishing industry. The plan advocated legislation to prohibit methods destructive to coastal ecosystems, particularly the use of push nets and trawls, and fishers encouraged to switch to more sustainable methods.

The Fisheries Development Plan (1997 - 2001) had four main themes as follows:

- i. Fishery policy in Thai waters
Deals with the problems of over-exploitation of fishery resources, conflicts among resources users, and over-capitalization. The objectives of this policy are to manage fisheries resources effectively, to obtain a maximum sustainable production of 1.73 million t a year from Thai waters, and to improve the fishers' quality of life. It also aims to reduce the uneconomic use of fisheries resources by at least 100 000 t-year⁻¹

- ii. Overseas fishery policy
Deals with the promotion and development of sound and stable overseas fisheries, both on the high sea and in joint venture fisheries with other coastal states. It aims to expand fishing grounds for the Thai distant water fishing fleet and to increase fish production for domestic fish processing industries. It is expected that the production from overseas fisheries will reach a minimum level of 1.8 million t annually. Main strategies of this policy include promoting and encouraging cooperation among fishers, especially the large scale commercial fishers, increasing their negotiating power, providing deep sea fishing technological transfer, and increasing fishers' knowledge of law and regulations practiced internationally and in the joint-venture states.
- iii. Aquaculture policy
Includes that of freshwater, brackish water and mariculture. It tries to overcome environmental and technical problems in aquaculture. It aims to increase production from aquaculture and to increase fish farmer household income through cost-effective farm management techniques. Improvement of processing to meet international standards is implemented. The environment in farm areas is monitored.
- iv. Fishery industry policy
Aims to alleviate the marketing problems and to overcome technical and environmental barriers in international trade. Accordingly, post-harvest quality must be standardized and controlled to meet market requirements that vary from market to market. The policy aim was to develop the domestic market for fishery commodities and increase annual fish consumption for the Thai people from 28 kg·capita⁻¹ to 30 kg·capita⁻¹ by the end of the 8th Plan.

The National Fisheries Development Plan (2002 - 2006) under the ninth National Economic and Social Development Plan (2002 - 2006) has five main policies as follows:

- i. The agricultural farmer and related organization development policy
This deals with the promotion of fishers at all levels, promotion of learning processes, and strengthening the capability in business at all fishery levels.
- ii. The fisheries and environment management policy
Aims to bring the Fisheries Act 1947 up to date

- and to enforce it effectively, to control excessive fishing effort, to strengthen public awareness of natural resource conservation, to promote participation in fishery management at all levels, to rehabilitate fishing grounds with regard to provincial zones, to strengthen conservation of bio-diversity with regard to international agreements and to strengthen institutional resources.
- iii. The aquaculture development policy
Aims to develop aquaculture in terms of quality for local consumption and export, promote research and develop bio-technology, improve shrimp culture sustainability, develop aquarium fish and aquarium plants for export.
- iv. The deep sea fishery development policy
Deals with the collaboration between Thai fishery agencies and foreign countries, the development of facilities for deep sea fish landing and transportation, and deep sea fisheries management and administration.
- v. The development of industrial fishing and fishery related policy aims to provide good quality raw products to meet demand, to promote and develop processing of fishery products to a high standard, to increase market share and expand into new foreign markets, to develop medium- and small scale fishery industries, and to reform fishery organization.

Coastal Zone - Resources, Policies and Laws **Mangroves**

In the past, mangroves were used for many purposes, but to a limited extent. However, with recent rapid economic development, mangroves have been destroyed by forest concessions, shrimp farming, mining, urbanization and other developments (Platong and Sitthirach 1997). Before 1961, the Royal Forestry Department permitted logging in mangroves through a concession system. In 1968, the system was changed to a long term concession of 15 years, and the Royal Forestry Department stipulated that the concessionaires should restore the remaining areas at their own expense. Clear felling in alternate stripes was introduced under the 15-year concessions. The concessionaires have not operated according to the rules. In most cases, the entire concession area has been logged. Widespread destruction occurred first in the 1960s and early 1970s for infrastructure development, in the late 1970s till mid 1980s for extensive shrimp farming, and since 1986 for intensive shrimp farming. Mangrove concessions throughout the country are presently cancelled.

Coral Reefs

Coral reefs in Thailand covering 12 000 km², are the third largest in Southeast Asia and with over 300 species, rank among the world's top ten reef sites in terms of beauty and diversity. They are most abundant on the Andaman coast, where two sites near Similan and Surin islands occur at about 30 m depth. In a number of areas, particularly in the Gulf of Thailand, coral reefs have been damaged by pollution, destructive fishing (e.g. using dynamite), navigation (anchor dropping, oil spillage) and tourism (Kaosa-ard and Pednekar 1998).

The Office of Environmental Policy and Planning in cooperation with concerned agencies drafted a National Coral Reef Strategy. The strategy aims to reduce conflicting uses of reefs and to promote development in harmony with conservation. The strategy was approved by a cabinet resolution on 3 March 1992. The implementation included the Phuket Coastal Resource Management Project, which was a pilot effort (Pintukanok 1997).

The Corals Management Project of the Department of Fisheries covers surveying, studying and mapping coral areas along the coastal zone, both in the Gulf and Andaman coasts.

Endangered Wildlife

Thailand has issued several Ministerial Notifications since 1974 and passed the Wildlife Reservation and Protection Act in 1992 to ensure protection of endangered species such as marine mammals (dolphin, dugong) and sea turtles.

Fishery Investment Policies

In Thailand, the Board of Investment (BOI) has been established to provide support for investment through the granting of privileges, following agreements with the World Trade Organization. At present the emphasis is on diversification of investment to the provinces. The majority of privileges are tax measures, viz., the exemption of corporate income tax.

External Policies Affecting Fisheries General Land Use

A number of changes have occurred in coastal land use during the past three to four decades. These include human settlements and urban expansion, infrastructure development, particularly access roads

and other modes of communication, tourism and industry development, agriculture, and tree plantations, and not least, coastal aquaculture. The severity of land use change is clearly evident in the change in mangrove forest cover which has been reduced to less than half of what existed before the early 1960s, and in land dereliction following shrimp pond failures in a number of coastal provinces. Land rights are one of the most complicated and political sensitive issues in Thailand. Like their inland counterparts, coastal communities in many places often do not have adequate land rights (Kaosa-ard and Pednekar 1998).

Pollution and Environmental Protection

Land use changes in the coastal areas, as well as increased agricultural and industrial activities and urbanization, have created hydrological changes and pollution from waste and sediments entering the sea. These loads are significant in the Gulf of Thailand, which receives freshwater flow from some of Thailand's major rivers, the Chao Phraya and the Mae Klong, which bring agricultural, urban and industrial waste from Thailand's central, northern and western regions. Owing to the lack of proper sanitary systems for cities and towns, urban waste and drainage water cause serious problems for river water quality (Kaosa-ard and Pednekar 1998). Generally, the seawater quality is within the pollution limits set by the Pollution Control Department (PCD), barring a few exceptions such as areas with high population or intense economic activity. This is true of a number of tourism sites such as Pattaya, Hua Hin, and the island of Ko Samet, and industrial areas such as Samut Prakarn, Rayong and Chonburi Provinces. Some improvements have occurred in coastal water quality in these areas following public outcry and pollution control campaigns (Hua Hin and Cha-am in Prachuap Khiri Khan and Petchaburi Provinces respectively, for example, were declared pollution control zones in 1997 by the Pollution Control Department). Further improvements are expected as drainage water treatment plants are planned in some high pollution risk areas.

In 1975, the Enhancement and Conservation of National Environment Quality Act was promulgated by the Government, under which the Office of the National Environmental Board was established within the Office of the Prime Minister. This Act was strengthened in 1992, and the National Environmental Board was transferred to the Ministry of

Science, Technology and Energy and upgraded. This Office develops environmental policies, which are implemented by various operating agencies (Menasveta 1997).

There are a number of laws concerning environmental matters in Thailand including water management, the control of animal and plant introductions, wildlife conservation, forest protection, and the creation of national parks and reserves. Thailand also has legislation on environmental impact assessment of development projects and the control of pollution and toxic chemicals.

International and Regional Conventions

Foreign Trade Law - Restrictions and Demands

Regional cooperation is needed to solve the issues for sustainable fisheries development. Some of the policy areas are as follows:

- Joint research to find fishing areas within ASEAN waters and biological and ecological studies on species, gear, fleet areas, units of exploitation, stock assessment and management.
- Investigation of management schemes for shared stocks of ASEAN countries (quotas or other methods).
- Establishment of joint ventures among the ASEAN countries, including fishing facilities and infrastructure.

To achieve these policies the Department of Fisheries has worked closely with international and regional organizations and with neighbouring countries through bilateral cooperation.

Group 1. International cooperation

a. The Southeast Asian Fisheries Development Center (SEAFDEC)

The Southeast Asian Development Center was established on 28 December 1967. There are presently eight member countries: Japan, Singapore, Thailand, Malaysia, Philippines, Vietnam, Brunei Darussalam and Myanmar. The purpose of SEAFDEC is to contribute to the promotion of fisheries development in Southeast Asia by mutual-cooperation among the member governments and through collaboration with international organizations and governments external to SEAFDEC. Four departments have been set up in member countries as follows:

- Training Department (TD) hosted by Thailand
- Marine Fisheries Research Department (MFRD) hosted by Singapore
- Aquaculture Department (AQD) hosted by the Philippines
- Marine Fisheries Research Development and Management Department (MFRDMD) hosted by Malaysia

It is planned that more Departments will be set up in Vietnam or elsewhere. As Thailand is the Depository Government of this Agreement, it has functioned as the host country for the Secretariat office of the Center since 1968. Members agree to provide SEAFDEC money, movable and immovable property, and services necessary for the establishment and operation of the Center. Thailand allocated the budget for the construction of the Training Department at Samut Prakan Province and Secretarial Office in the Department of Fisheries.

The government of Japan has allocated the budget annually for technical assistance to all Departments of SEAFDEC. This includes the provision of scientific equipment, material, short and long-term experts, fellowships for the Center's staff to be trained in Japan, procurement of research vessels, cars, etc.

During 30 years of its operation, about 2 800 personnel have completed the study and training courses organized by TD, MFRD and AQD annually. About 500 - 600 Thai trainees have completed SEAFDEC study and training courses annually. ASEAN has appointed SEAFDEC as the technical organization to work closely with member countries in the ASEAN Sea Turtle Conservation and Protection Program.

b. The Network of Aquaculture Centers in Asia and the Pacific (NACA)

NACA is an intergovernmental organization established in 1990 with headquarters in Thailand, the host country. NACA has Regional Lead Centers located in Thailand, China and India. NACA originated as a program supported by UNDP during 1980 - 89. At present, there are 14 member countries. Its main objective is to assist members to expand aquaculture development mainly for the purpose of:

- Increasing production
- Improving rural income and employment
- Diversifying farm production
- Increasing foreign exchange earnings and savings

c. The Bay of Bengal Program (BOBP)

BOBP was a multi-agency regional fisheries program covering seven countries around the Bay of Bengal: Bangladesh, India, Indonesia, Malaysia, Maldives, Sri Lanka and Thailand. The Program played a catalytic and consultative role in developing coastal fisheries management in the Bay of Bengal to help improve the conditions of small scale fishing communities in member countries. It was sponsored by the governments of Denmark, Japan, and the United Kingdom, and the International Maritime Organization of the UN. The executing agency was FAO. Member countries contributed financially to support the activities of the program.

d. The Indian Ocean Tuna Commission (IOTC)

This regional body was established in 1996 to undertake conservation of tuna-like species and to promote sustainable and rational utilization of tuna resources in the Indian Ocean. Members of the Commission include coastal states in the Indian Ocean and other states that harvest tuna and tuna-like species in the region. Each member country agreed to contribute annually its share of the budget in accordance with a scale of contributions. Seychelles is the host of the secretariat office of the Commission. Thailand submitted an Instrument of Acceptance to the Director-General of FAO in 1997 and became a member of this Commission.

Thailand is a leading country in canned tuna exports, but nearly 80% of the raw material is imported from tuna fishing nations. Since Phuket province is the landing base of tuna from foreign fishing vessels, Thai fishers there have become keenly interested in tuna fishing. However, they lack technology as well as the capital needed. The Department of Fisheries approved the participation of M.V. Mahidol in a pilot project for tuna fishing. This is a collaborative project between public and private sectors operating in the Indian Ocean. About 111 fishers were invited to participate in on-the-job training. The fishers gained experience in preparing floating logs, detecting tuna schools, gear operation and other aspects of tuna fishing. This led to the

establishment of Thai Tuna Cooperatives in Phuket Province.

e. The Asia-Pacific Fishery Commission (APFIC)

The Agreement establishing the Indo-Pacific Fisheries Council (IPFC) came into force on 9 November 1948. Its title was changed to the Asia-Pacific Fishery Commission (APFIC) in 1994 to reflect new functions that enable it to take action directly related to fisheries management and development in its area of responsibility. The Terms of Reference of APFIC are to promote the full and proper utilization of living aquatic resources by development and management of fishing operations and culture techniques and by the development of related processing and marketing activities. Members of the Commission are Australia, Bangladesh, Cambodia, China, France, India, Indonesia, Japan, Republic of Korea, Malaysia, Union of Myanmar, Nepal, New Zealand, Pakistan, Philippines, Sri Lanka, Thailand, United Kingdom, USA and Vietnam.

f. The Marketing Information and Advisory Service for Fish Products in Asia Pacific Region (INFOFISH)

The INFOFISH is an inter-governmental organization servicing the fishing industry of the Asia-Pacific region and beyond. Originally a regional project of FAO, it is hosted by Malaysia and based in Kuala Lumpur. INFOFISH's services include bringing buyers and sellers together. In addition, it organizes exhibitions, conferences, workshops, seminars and training programs and provides consulting services in all aspects of capture fisheries, aquaculture, processing and marketing. Member countries are Maldives, Malaysia, Papua New Guinea, Solomon Islands, Sri Lanka and Thailand.

g. Others

The Department of Fisheries has close collaboration with other regional organizations such as:

- The International Center for Aquatic Resources and Management (ICLARM), now WorldFish Center
- The International Network on Genetics in Aquaculture (INGA)
- International Development Research Center (IDRC)
- Asia-Pacific Economic Cooperation (APEC)
- FAO of the United Nations

The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, the Code of Conduct For Responsible Fisheries of the FAO, the AFTA 2000 (ASEAN Free Trade Area), TRIMs (Trade Related Investment Measures agreed by the WTO member countries) and the UNCTAD, 2000 (the United Nations Conference on Trade and Development) are all considered in formulating Thailand's fisheries policies.

Group 2. Bilateral cooperation

The following projects are some of the cooperation programs that the Department of Fisheries has initiated with other countries/institutions:

- a. Memorandum of Understanding between Thailand and the Republic of the Philippines, signed 30 January 1997. Both sides have agreed to strengthen cooperation in the following fields:-
 - Technical exchange on prawn disease prevention and control
 - Technical exchange on fish processing technology
 - Joint fishing ventures
- b. Agreement on bilateral cooperation in fisheries between Thailand and Mexico signed on 22 October 1992. The objectives are to strengthen economic relations, and promote scientific and technical cooperation and to support investment and co-investment in fisheries matters, especially in aquaculture, tuna fishing, and tuna canning.
- c. Memorandum of Understanding on cooperation in agriculture between Thailand and the People's Republic of China signed on 2 April 1997, to promote scientific and technical cooperation in the field of agriculture on the basis of quality and mutual benefit.
- d. Agreement in fisheries cooperation between Peru and Thailand, to further develop economic relations and promote scientific and technological cooperation as well as to support investment in fisheries matters, especially in the field of aquaculture and deep-sea fishing.

National and Sub-national Fisheries Institutions

The Department of Fisheries, Ministry of Agriculture and Co-operatives, is responsible for regulating fishing in the Kingdom of Thailand, whether inland or offshore. The Department is organized into central and provincial administrations.

The central administration has 28 divisions, which have responsibilities as follows:

- a. To conduct studies, research and experiments in every field of fisheries as well as to propose measures for responsible fishery development and management. These research activities are undertaken by many divisions e.g. Marine Fisheries Division, Freshwater Fisheries Division, Coastal Aquaculture Division, Fishery Environment Division, Aquatic Animal Health Research Institute and National Aquaculture Genetic Research Institute.
- b. To explore, analyze and research fishing grounds beyond Thai waters. The responsible organizations are Ocean Fisheries Division, Foreign Fisheries Affairs Division and Marine Fisheries Division.
- c. To promote and develop all occupations relating to fisheries. The organizations concerned are the Fisheries Economic Division, Fisheries Engineering Division, Fishery Extension Division and Training Division.
- d. To implement the various fisheries Acts and measures. This is the task of the Fisheries Resource Conservation Division, Foreign Fisheries Affairs Division and Provincial Fisheries Offices.

The provincial administration has 76 provincial fisheries offices. They are located in every province of the country, and are responsible for conservation, control of fisheries resources, collecting of taxes and fishing fees, providing information on fisheries conservation, professional promotion and extension, and providing guidance and services to fishery employees.

Other Institutions Involved in Fisheries and Coastal Zone Management (Structure & Mandate)

Other government institutions involved in fisheries and coastal zone management include:

- The Royal Forestry Department (RFD), Ministry of Agriculture and Cooperatives. This agency is responsible for managing mangrove forests and marine parks. The RFD implements the National Park Act, the Forest Reserve Act, and the Wild Animals Conservation and Protection Act. These legislative acts enable the RFD to declare specific coastal areas as protected areas. Several coastal areas and beaches have been designated as National Parks under the National Park Act.
- The Department of Cooperatives Promotion, Ministry of Agriculture and Cooperatives, which handles the registration of fishery cooperatives.
- The Harbour Department, Ministry of Transportation and Communications, which handles the registration of fishing boats. The primary function of the Department is to maintain the navigability of the waterways, which include rivers, canals, lakes and ponds that are open to the public, as well as the maritime areas under national jurisdiction.
- The Fish Marketing Organization provides landing piers, auction halls, soft loans, transportation, statistical records and other facilities.
- The Office of Environmental Policy and Planning, Ministry of Science, Technology and Environment, whose main function is the preparation of policies on natural resources, environmental management and conservation.
- Private sector groups that work towards the protection and conservation of natural resources and the environment include foundations, association non-government organizations (NGOs) and people's organizations (POs). These organizations have the following objectives:
 - i. Create awareness in the local community of the sustainable management of coastal resources.
 - ii. Build up and strengthen local capacity in the conservation and rehabilitation of coastal resources.
 - iii. Encourage coordination among local communities, local government agencies, and NGOs.

Financing Institutions Relevant to Fisheries Activities

The Marine Fishery Census in 1995 revealed that about 45.4% of the fishing households are in debt. Loans come from various sources such as the government, the bank for agriculture and agricultural cooperatives, commercial banks and middlemen in villages (Table 6). Over two-fifths of fishing households in debt owed the middlemen in villages. The fishers usually get money or equipment from the middlemen and usually sell their catches to them.

Table 6. Household loans in marine capture fisheries.

Source of fishery loan	Marine capture fishery	
	No. of households	%
Total	53 112	100.0
Without debt	29 024	54.6
With debt	24 088	45.4
- Government agency	886	
- Bank for Agriculture and Cooperatives	4 984	
- Commercial bank	2 442	
- Middleman	10 500	
- Money lender	4 041	
- Relatives or friends	5 417	
- Others	724	

Source: National Statistical Office and Department of Fisheries 1995.

Research and Training Facilities and Opportunities

Since Thailand has been regarded as a developed country in the last decade, training or research facilities from several donors have been withdrawn. There are still some training opportunities from SEAFDEC and other donor agencies. The collaborative programs between the Thai government and the Japanese government (Japan Society for the Promotion of Science and Mabusho) are still running.

Coastal Fisheries in Focus

Structural Aspects

The marine capture sector can be divided into commercial and small-scale fisheries. The small scale fisheries are defined as those with small boats of less than 12 m LOA (overall length), with or without engine and mostly operated in shallow water. The commercial sector is defined as that with boats of LOA more than 12 m, or more than 10 gross tons (GT), modern fishing gear and operating offshore for several days. They typically land at large ports; some have refrigerators to preserve their catches.

During the period 1985 to 1995, the structure of the marine capture sector changed, the total number of fishing boats decreased by 2%. The number of small scale fishing boats decreased by 3.4% while the number of commercial fishing boats increased by 7.0%. The creation of a boat-tenure system within the commercial sector and the strengthening of the small scale sector according to the 8th National Economic and Social Development Plan (1997 - 2001) resulted in the total number of fishing boats increasing by 4.5%; the small scale fishing boats increasing by 6.5% and the commercial boats decreasing by 7.5% (National Statistical Office 1998; Department of Fisheries 1999; Boonchuwong and Dechboon 2000). Registered fishing boats then numbered 18 182, comprising 49% trawlers, 26% gillnetters, 8% purse seiners, 5% push netters and 12% small scale boats. About 75% of registered boats operated within the EEZ and 25% operated outside Thai waters (Department of Fisheries 1997).

Total marine production for 1996 was 3.112 million t, comprising marine capture (90.3%) and coastal aquaculture (9.7%) production. About 69.7% of the marine catch was caught in the Gulf of Thailand and 30.4% in the Andaman Sea. The catch composition was food fish 47.0%, trash fish 27.8%, shrimp 12.0%, cephalopods 5.6%, and the remaining 7.6% were crab, jellyfish and shellfish (Department of Fisheries 1997).

Capture Methods/techniques (by sector)

The small scale sector conduct fishing about 5 km from the shoreline in one-night operations. The fish are landed at the village and sold directly by the owner's wife. The gear employed are gillnets (fish, shrimp, crab, etc), lift nets, traps, falling nets,

entangling nets, set nets, set bag nets, hook-and-line etc. Some use lights to lure the fish, e.g. falling-net and lift net to catch anchovy.

The commercial sector boats include trawlers, purse seiners, push netters and short-necked clam dredgers. The catch is landed at fishing piers and sold by fish agents. Trash fish catch is landed at fish-meal plants separately. The boats are usually well equipped, with echo-sounder or sonar for purse-seine, several crew members and voyages last several days. Lures such as lights or coconut leaves may be used to lure the fish. Trawlers almost all use otter-boards to stretch the net. Pair trawls are also used. Some trawlers use both otter-board and boom to catch shrimp; they catch fish in daytime and catch shrimp at night by changing their nets. The mesh size used is 2.5 cm for cod-end mesh and for shrimp nets the mesh size is 1.5 cm. The fishing grounds of purse seiners are usually in deeper zones, near the middle and southern parts of the gulf.

Catch and Catch Rates

The total production of the Gulf during 1971 to 1995 showed an increasing trend. The production of trash fish and demersal fish combined was between 500 000 and 1 000 000 t. Recently the production of trash fish has decreased slightly, whereas demersal fish have shown the opposite trend (Fig. 3). The overall increase in production came from pelagic fish production. From 1982 onwards, the pelagic fish catch increased substantially due to improved methods using light lures to catch schooling fish, especially anchovy which accounted for 120 000 t in 1995 (Supongpan et al. 2000).

Decreasing Catch Rates

From 1966 to 1996, a monthly survey by research vessel to measure catch rates of demersal resources was conducted by the Marine Fisheries Division. More than 700 fixed grid stations in the Gulf of Thailand were monitored. In 1966, the catch rate was 172.9 kg·hr⁻¹. A catch rate of over 300 kg·hr⁻¹ had been reported in 1961. The cod-end mesh size used to be 4 cm but in 1971, an additional net with 2.5 cm mesh was applied to the cod-end so that the cod-end mesh size used for surveying was the same as that used by fishermen. This modified method has been carried out up to now, although the number of stations has been reduced due to budget limits. The results showed the catch rate in the period

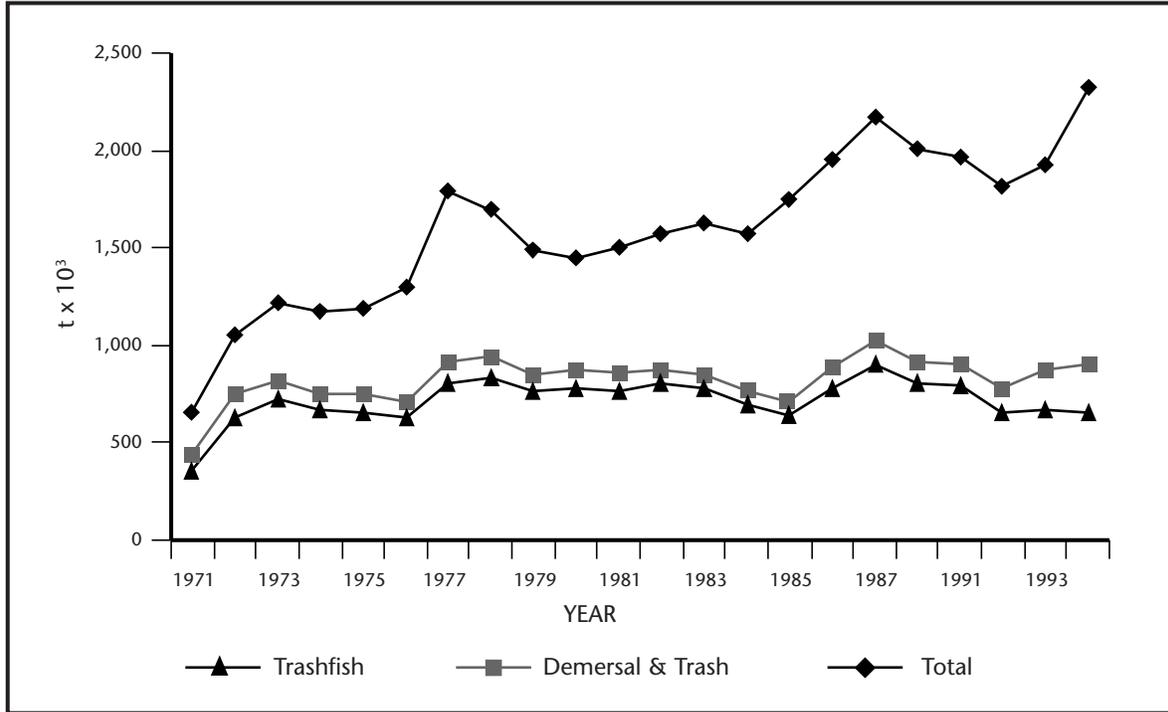


Fig. 3. Total production, demersal fish and trash fish combined and trash fish production in the Gulf of Thailand between 1971 and 1995.

1966 to 1976 declined from 172.9 kg·hr⁻¹ to 75.14 kg·hr⁻¹. During this period there was a petrol crisis, in 1973 and 1975, resulting in a temporary suspension of fishing by some trawlers. The catch rates at this time fluctuated between 60 and 80 kg·hr⁻¹, indicating that when fishing stopped for a while, the resources may have recovered slightly (Fig. 4).

The catch rate has continuously decreased since

the trawl was introduced into Thailand, from 172.94 kg·hr⁻¹ in 1966 to 17.9 kg·hr⁻¹ in 1998 (National Seminar 1999). It is likely that the catch rate may drop to near zero if there is no proper management. The Department of Fisheries has issued many management measures to control the fish resources, but it is difficult to enforce the regulations because there are socioeconomic impacts and political interventions.

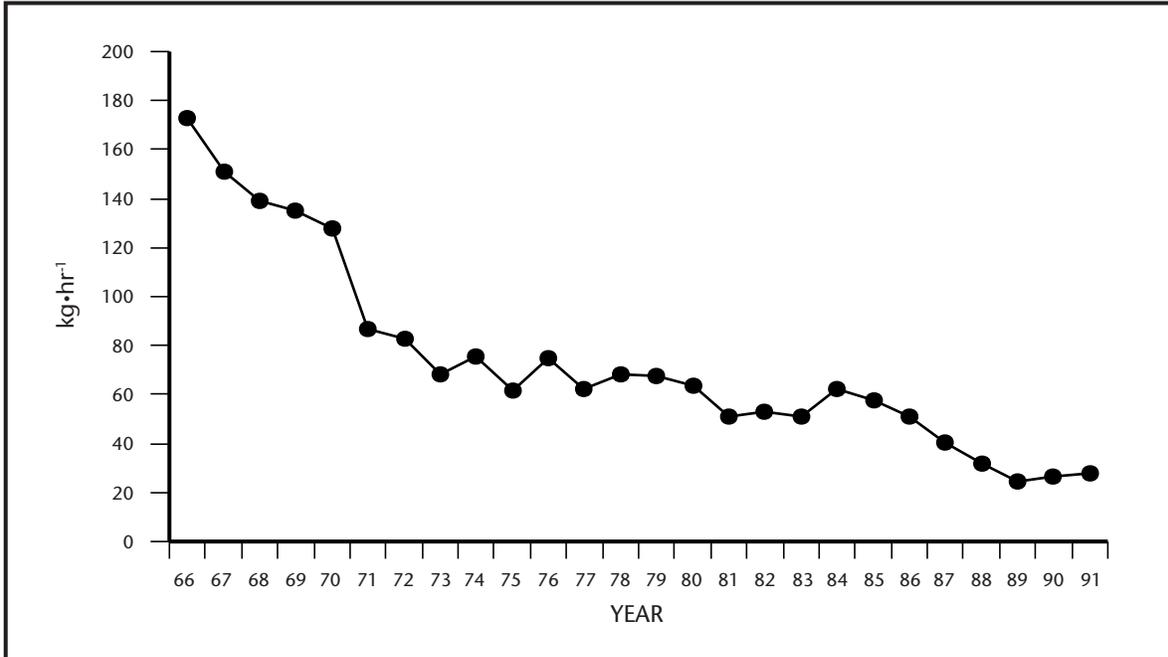


Fig. 4. The catch rates (CPUEs) of total catches and trash fish in the Gulf of Thailand during 1966 to 1991 of Research Vessels Pramong 2 and 9 (National Seminar 1999).

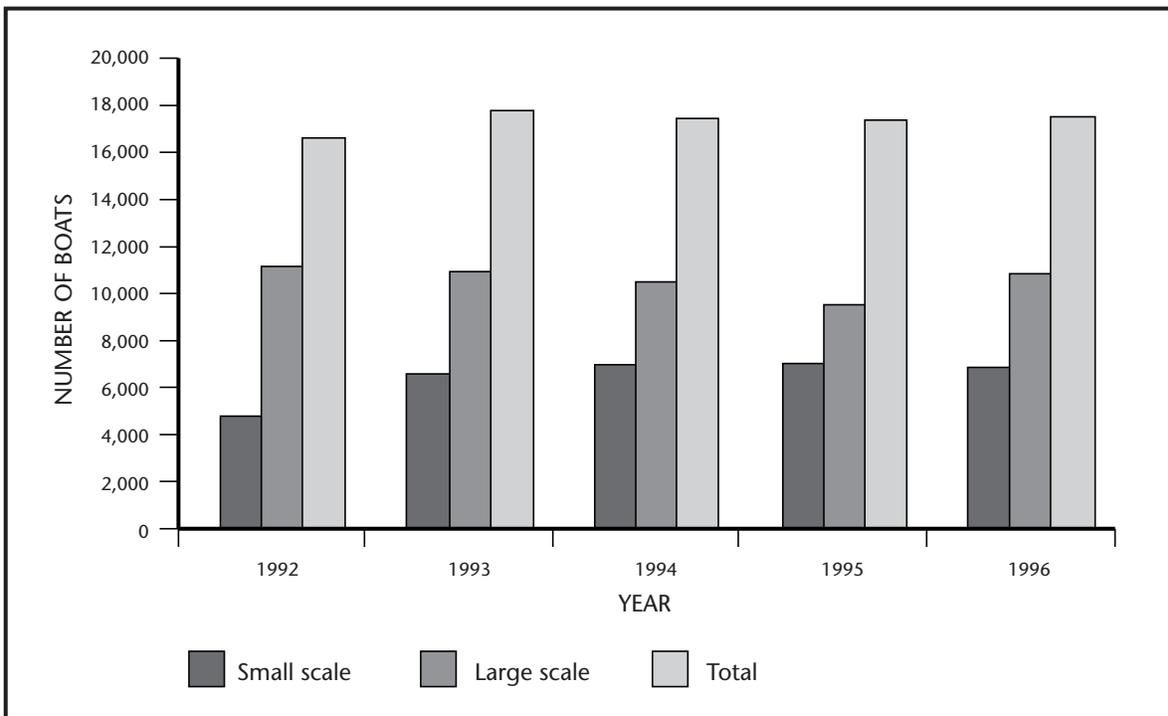


Fig. 5. Registered fishing boats categorized into small scale fishing boats and large scale or commercial fishing boats in Thailand, 1992 - 96.

Number of Fishing Boats

Otter-board trawlers dominated (6 000 to 7 500) from 1992 to 1996 pair trawlers were fewer, and the others gear numbered less than 1 000 (Fig. 6). Squid cast-net, shrimp gillnet and crab gillnet numbered more than other gear in the small scale fisheries sector (Fig. 7).

Catch Composition of Commercial Fisheries

Species composition and volume of catches are different according to type of fishing gear, and the proportion of fish harvested with similar gear further differs according to boat size. The monthly catch of otter trawls is 8 027 - 39 593 t. Most are trash fish, about 45.4 - 62.5% of the total catch. Edible fish comprise between 14.4 - 29.1% of the total. Small otter trawls (< 14 m) harvest shrimp, making up 31.8 % of the total catch. Average catch per month of pair-trawls for all boat sizes varies between 25 316 - 57 921 t. The catch proportion is

completely different among size categories (< 14 m, 14 - 18 m, 18 - 25 m). Medium and large pair-trawlers have similar catch ratios of edible fish, trash fish and cephalopods, 18.1 - 24.3%, 51.5 - 59.0% and 10.9 - 18.2% respectively. Average catch per month of beam-trawls of both sizes varies between 817 - 4 157 t. Although shrimp was caught in higher ratios by beam-trawls, they are mostly small shrimp and hence get lower prices. Medium beam trawls can also catch large quantities of cephalopods, 27% of the total catch. Finally, all sizes of push nets have similar ratios of catch, i.e. edible fish, trash fish, shrimp and cephalopods of 6.5 - 8.4%, 54.5 - 60.7%, 16.5 - 21.3% and 3.1 - 5.2%, respectively

Catches from purse-seines and gillnet consist mainly of edible fish, between 31.0 - 80.0% of the total catch. Catch by purse seine is between 36 760 - 55 351 t·month⁻¹. Most of the catch is economic pelagic species, i.e. Indo-Pacific mackerel and sardines. King mackerel gillnet can catch high quality fish of similar size to that of other gear with

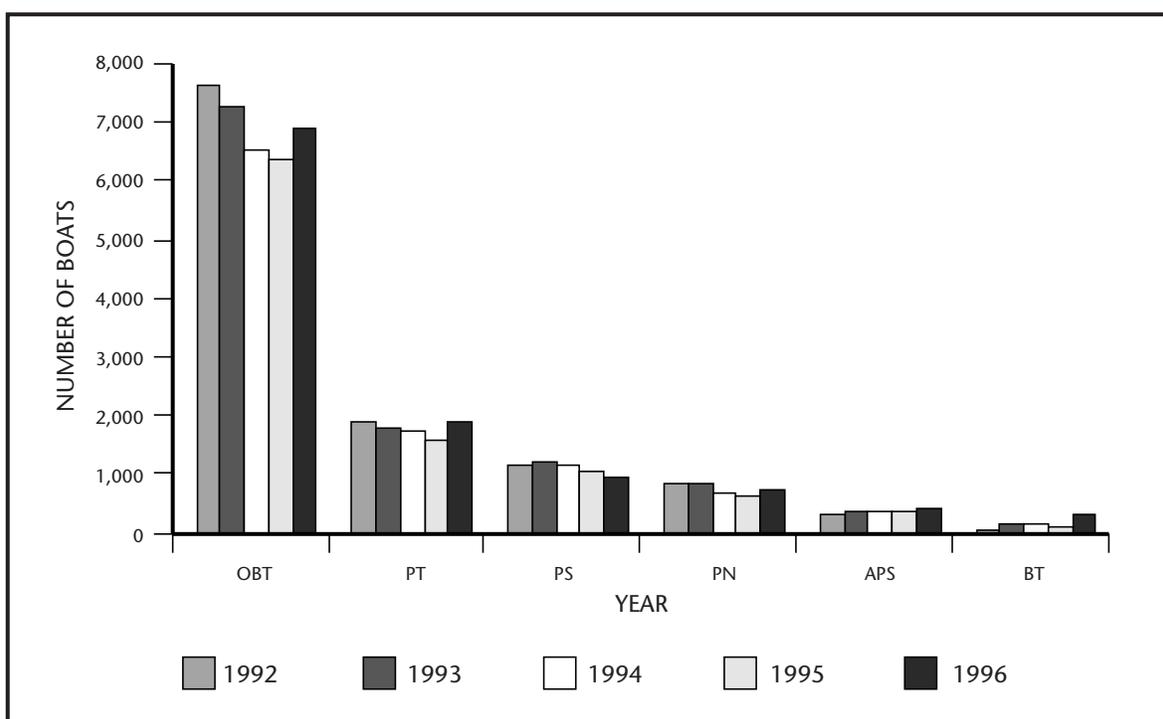


Fig. 6. Registered commercial fishing boats in of Thailand, 1992 - 96.

Note: OBT = Otter-board trawlers, PT = Pair-trawlers, PS = Purse seiners, PN = Push netters, APS = Anchovy Purse seiners, BT = Beam trawlers.

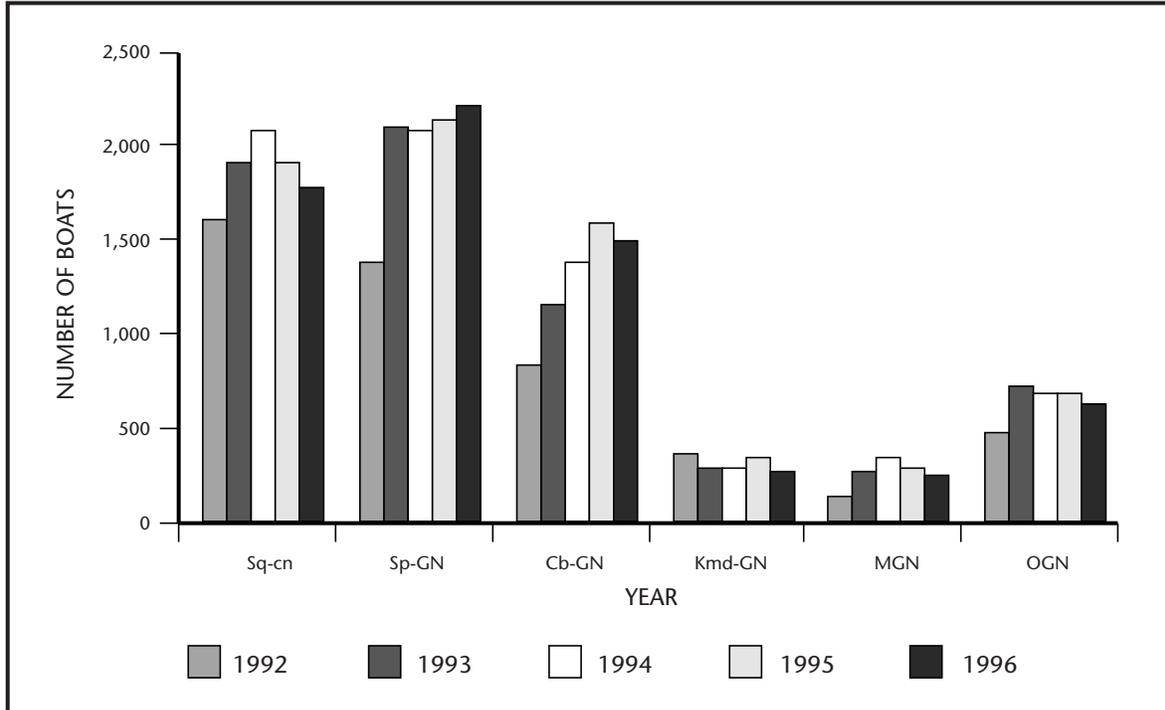


Fig. 7. Registered small scale fishing boats of Thailand, 1992 - 96.

Note: Sq-cn = Squid cast-netters, Cb-GN = crab gillnetters, MGN = Mackerel gillnetters, Sp-GN = Shrimps gillnetters, kmd-GN = King mackerel drift gillnetters, OGN = Other gillnetters.

an average price of Baht 38 - 41 per kg, while the average price of other fish caught by purse-seines is 7 - 10 Baht·kg⁻¹. Major pelagic fish caught are king mackerel and little tunas.

Catch Composition Trends of Research Vessels

The catch composition trend from research vessels showed somewhat different results. At an initial stage of the fishery development, the demersal fish formed more than 60% of the total catch, while from 1973 to 1992, the ratio was almost stagnant at 30 - 40%. At the end of the period, demersal fish showed a slight downward trend (Fig. 8). These were in contrast to trash fish trends. Trash fish formed 20 - 30% of the catch during 1966 to 1973. From 1974 to 1983, the ratio was 30 - 40% of the total, whereas during 1985 - 86 and 1991 - 96 the ratio was more than 40%.

Economics of Coastal Capture Fisheries

The study by Boonchuwong and Dechboon (this volume) examined the small scale and commercial fishing fleets, costs-earnings and profitability, discards and by-catch. They found that there was considerable room for maintaining the small scale fishing fleets due to their contributions to employment and fish production. The profit was greater from larger boats. The larger boats have the ability to adjust to both economic and fishing ground changes. Among trawlers, medium and large boats could best adjust and maintain continuous profits, while push netters of all sizes were declining in net profit. In the case of pelagic fisheries, purse seiners make higher profits and yield higher returns than trawlers and gillnetters. Pelagic fisheries give higher returns to crew-labor and daily wages higher than the national minimum wage.

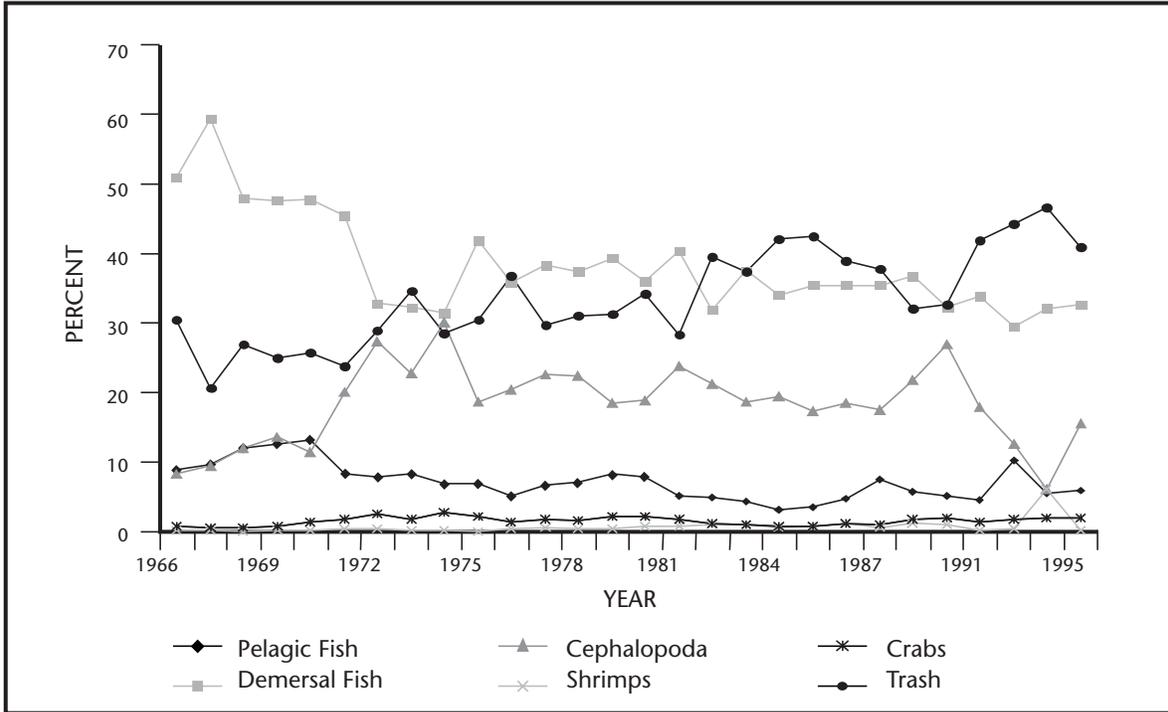


Fig. 8. The percentage species composition of demersal fish and trash fish, caught by research vessels RV Pramong 2 & 9.

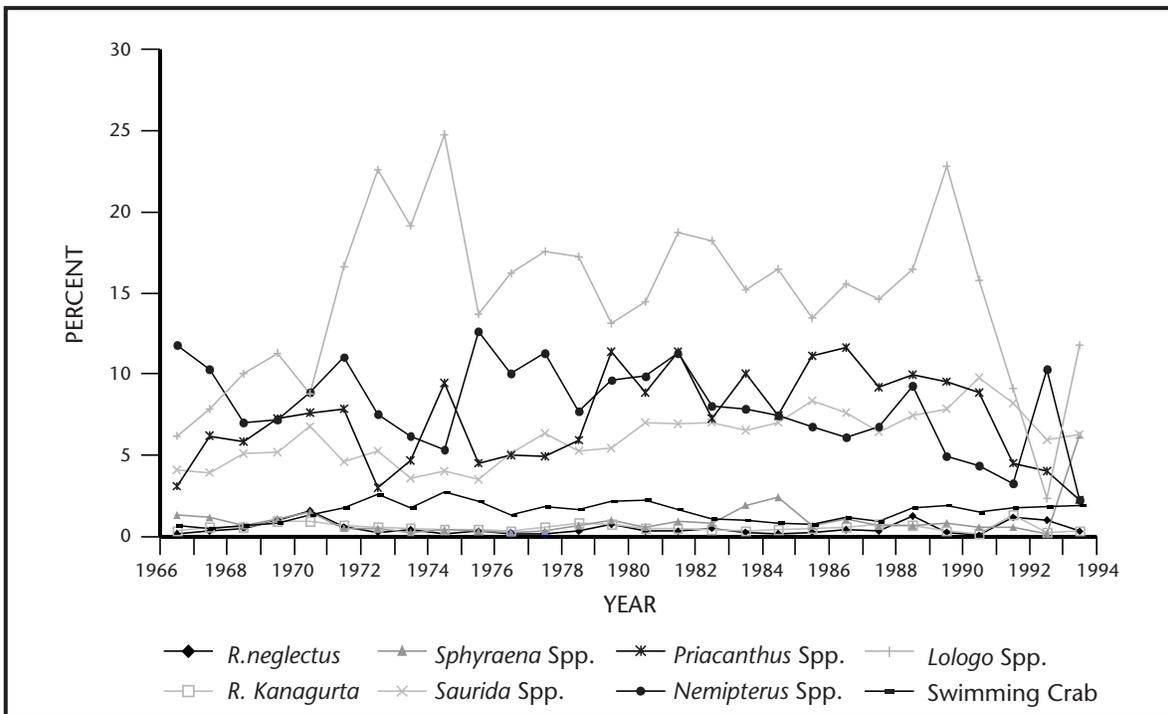


Fig. 9. The percentage species composition of demersal groups, caught by research vessels RV Pramong 2 & 9.

Disposition and Value of Catch

Marine capture fishing operations are managed by various entities as shown in Table 7. More than 90% are operated by fishing households.

Value of Catch

Figure 10 shows the quantity and value of catches from 1987 to 1999. From 1994 to 1999, marine catches in Thai waters showed a decreasing trend. In contrast the value of outside Thai waters increased.

Cost and Return

Costs, Earnings and Profitability of Small Scale Fishing Operations

Boonchuwong and Dechboon (this volume) studied small scale fishing households in Songkla Province, Southern Thailand in 1999. The major fisheries in 6 villages were selected (shrimp gillnet, cuttlefish trammel net, Indo-Pacific mackerel gillnet, other gillnet, and *Acetes* spp. trawl net fisheries). The fishing boats were long tail engine boats with LOA less than 10 m and less than 10 HP. Fishing labor was usually 1 or 2 family persons. Often only one type of gear was used; two, three or four types of gears in combination could be used when the target species were abundant. Single gear groups averaged a total cost of Baht 36 000 - 99 000·year⁻¹ whereas two-gear combinations ranged from Baht 121 000 - 241 000·year⁻¹. Three-gear combinations averaged Baht 197 000·year⁻¹ whereas four-gear combined operations averaged Baht 232 162·year⁻¹.

The investment range was Baht 63 000 to 201 000·year⁻¹ with variable costs of 65 - 71% of the total cost of a single gear type. The fixed costs were 28.9% for shrimp gillnets, 35.0% for cuttlefish trammel-nets, and 31.9% for Indo-pacific mackerel gillnets. The revenue ranged from Baht 257 000 to 330 000·year⁻¹ for catching cuttlefish and Indo-Pacific mackerel in combination and shrimp gillnet respectively. Single gear operations gained lower profits. Cuttlefish and Indo-Pacific mackerel fishing gear gained Baht 90 000·year⁻¹. Shrimp and Indo-Pacific mackerel gained Baht 41 000 to 49 000·year⁻¹. The lowest profit gear were 'other gear' and the shrimp-cuttlefish-Indo-Pacific-other gear combination, that amounted to Baht 20 000 to 25 000·year⁻¹. The return to labor ranged from Baht 266 to 272·man-day⁻¹ although shrimp operations gave the lowest return to labor - Baht 146·man-day⁻¹.

Costs, Earnings and Profitability of Commercial Fishing Operations

Boonchuwong and Dechbon (this volume) examined the six major commercial fishing gear operations in Thai waters the production of which accounted for approximately 75% of total marine catches. The sampled boats were categorized into LOA < 14 m (small), 14 - 18 m (medium), 18 - 25 m (large).

The study of cost structure showed that variable costs ranged from 74 to 89% and fixed costs ranged from 7 to 27%. Trawls and push nets had high fuel and oil expenses, about 32 - 51% of the total costs. Variable costs of purse seines and gillnets were mainly labor, 27 - 51% of total cost, whilst 16 - 21% was fuel expense.

Sharing System

The sharing systems between crew and boat owner differ according to types and sizes of boats, and can be classified into two systems, namely the fixed wage or salary payment, and the sharing-on-value of products sold systems. Both systems have different risks (including expected profit). The wage or salary payment system gives the crew a definite wage, but they lose the opportunity of sharing a good catch. The sharing-on-value of product sold system means that both crew and boat owner jointly share the risk in catch and fish prices. Fixed wage systems induce less enthusiasm from crew although the benefit sharing system is risky. There is thus a mixed system of part regular wage and part sharing-on-value of catches.

The sharing systems differ according to types and sizes of fishing gear. Most of the small otter-trawls (< 14 m) employed a fixed wage system. The medium and large sizes (14 - 18 m and 18 - 25 m) employed mixed systems. As for pair-trawls, about 50 - 75% employed fixed wages. Most beam-trawls and push nets used sharing systems based on the value of catch. The value for sharing is the net value after deduction of operating expenses (fuel cost, ice, food, fixed wages or salaries and fishing gear repair cost). This net value is divided in a ratio of 70 : 30 between boat owner and crews. Crew share is divided according to rank and responsibility assigned in the boat, the master fisherman receiving the biggest share. If the catches are higher than target, the crew will receive a bonus. Considering

Table 7. Number of marine capture fishery establishments by type of management 1985, 1990 and 1995.

Type of Management	1985	%	1990	%	1995	%
Operators' household	51 087	98.8	47 311	97.7	51 668	97.3
Joint management	590	1.1	1 048	2.2	1 420	2.7
Company and juristic partnership	25	0.1	44	0.1	24	0.05
All types of management	51 702	100	48 403	100	53 112	100

Source: National Statistical Office 1997.

Table 8. Marine capture fishery purchases in 1985, 1990 and 1995.

Type of Management	1985	%	1990	%	1995	%
Without sale	3 579	6.9	1 774	3.7	1 570	3.0
With sale	48 123	93.1	46 629	96.3	51 542	97.0
Consumer	4 707		4 535		5 172	
Retailer	7 065		8 788		6 620	
Middleman	35 524		31 868		38 207	
Fish processor	780		1 438		1 469	
Other	47				74	

Source: National Statistical Office 1997.

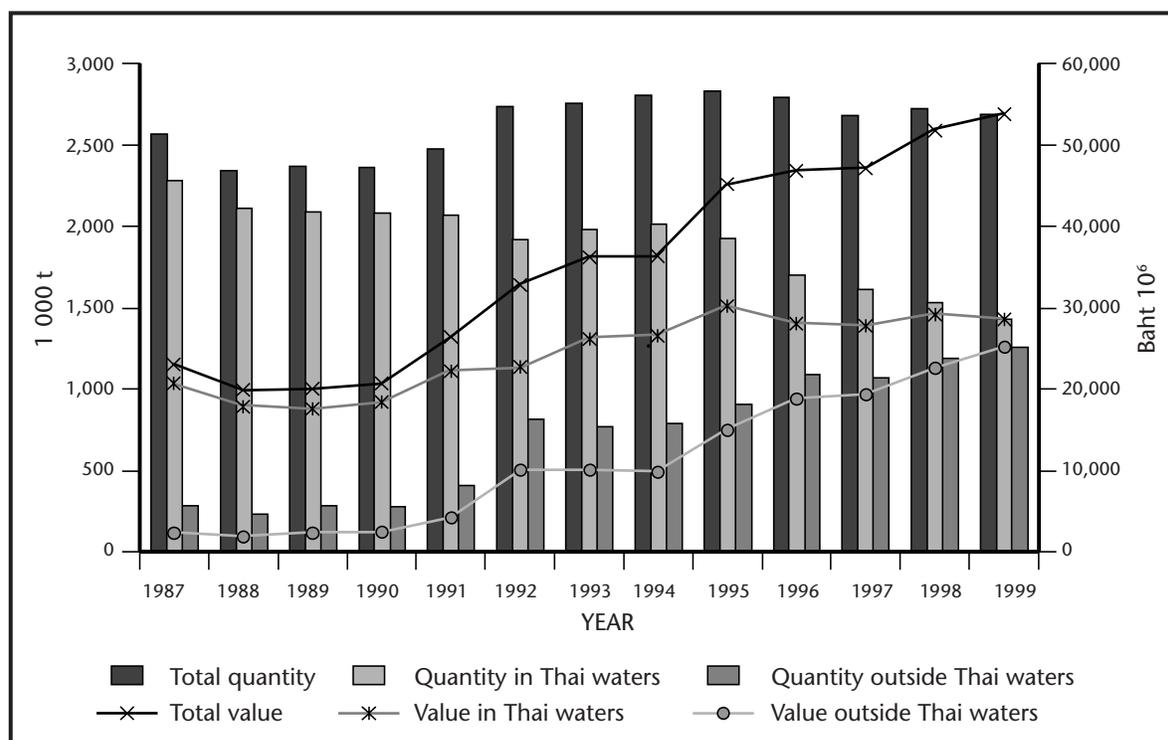


Fig. 10. The quantity and value of marine capture fisheries, 1987 - 99.
 1US\$ = 24.92 Baht (1995 Annual average).

all benefits, the crew of a medium size push netter (14 - 18 m) receives the highest payment, Baht 8 600·month⁻¹·person⁻¹, whereas the crew of a pair-trawler of the same size will receive Baht 4 200·month⁻¹.

Purse seiners and gillnetters have mixed systems. Net pay after expenses of king mackerel drift gillnet crew are divided into shares between boat owners and crews in the ratio of 60 : 40. Crew of small purse seiners receive Baht 7 000·month⁻¹·person⁻¹.

Revenue and Profit

Gross revenue of large pair-trawlers (18 - 25 m) is Baht 521 000·month⁻¹, and that of small beam-trawlers (< 14 m) is Baht 34 000. The gross revenue of trawling differs greatly according to boat size. The small, medium and large otter-trawlers yield revenues of Baht 79 000, 196 000, and 290 000·month⁻¹ respectively. The small, medium and large push netters yield revenues of Baht 68 000, 129 000 and 243 000·month⁻¹ respectively. Gross revenue of large purse seiners (18 - 25 m) is Baht 529 000·month⁻¹ and for medium king mackerel gillnetters (14 - 18 m) Baht 154 000·month⁻¹.

Cash Flow

The cash flow of the large pair trawlers (18 - 25 m) is Baht 138 000·month⁻¹, and small beam trawlers (< 14 m) have a cash flow of Baht 15 000·month⁻¹. The large purse seiners (18 - 25 m) have a cash flow of Baht 144 000·month⁻¹, and medium gillnetters (14 - 18 m) have a cash flow of Baht 40 000·month⁻¹.

Net Income

In demersal fisheries, the study showed that the highest net income was earned by large pair trawlers (18 - 25 m) totaling Baht 108 000·month⁻¹ and the lowest net income by small otter-trawlers (< 14 m), Baht 8 000·month⁻¹. Likewise the large purse seiners (18 - 25 m) yielded the highest net income of Baht 132 000·month⁻¹ and the medium gillnetters yielded the lowest, Baht 35 000·month⁻¹.

Operating Profit

The large pair trawlers (18 - 25 m) yielded the highest profit of Baht 145 000·month⁻¹, while small beam-trawlers (< 14 m) yielded the lowest of Baht 9 000·month⁻¹. Large purse-seine boats (18 - 25 m) yielded the highest operating profit of Baht 156 000·month⁻¹ while the smaller size (< 14 m) yielded

Baht 38 000 of operating profit·month⁻¹, less than the medium gillnet boats.

Net Profit

Results of the study showed that for some fishing gear such as small otter trawls, small pair trawls, small purse seines, and all sizes of push nets and gillnets, income is less than the opportunity cost of capital plus interest on debt. In contrast, the large otter trawlers (18 - 25 m) return the highest net profit of Baht 63 000·month⁻¹. While large purse seiners (18 - 25 m) yield the highest net profit of Baht 88 000·month⁻¹, the mackerel gillnetters yield the lowest, Baht 10 000·month⁻¹. All sizes of purse-seiner and gillnetter yield high net profits.

Factor Return

Return on Capital

Return on capital indicates feasibility of fishery investment. Since fishing is one of the highest natural risk operations, return is high for certain types of fishing gear. Return is defined as percentage of net profit and opportunity cost of capital on the initial investment. Return on capital of trawlers and push netters is higher than that of purse seiners and gillnetters. Small beam-trawlers show the highest return at 104%, owing to their lower investment costs. The best return on capital of purse seiners came from medium and large purse seiners, at 30%. Large gillnetters yielded the highest return on capital at 18%.

Return to Labor

Return to labor is the compensation per working day of fishing. Comparison of this value against the national minimum wage 145 Bath·day⁻¹ in 1995 shows that the fishery sector has the higher return. This value includes food cost that hired crew receive in addition to wages and shares.

Assessment of Exploited Status

Biological Status

Over-exploitation Status

Most demersal resources and some groups of pelagic fish are over-exploited as clearly shown by several reports (Hongskul 1974; Boonyubol and Pramokchutima 1982; Demersal Fish Working Group 1995; Supongpan 1988; 1993 and 1996a; Vibhasiri 1988; Chullasorn 1998; Kongprom et al.

this volume). Furthermore, the catch rates from the research vessels which have been well known for a long time, have shown decreasing trends since 1966 (Kongprom et al. this volume). In 1961, before the introduction of otter-board trawl to Thailand by the Federation of Germany, the monthly catch rates from research vessel surveys were over 300 kg·hr⁻¹. After 1966, the catch rate was 172.9 kg·hr⁻¹ and further declined to 75.1 kg·hr⁻¹ in 1976. The catch rate has continuously decreased and was about 18 kg·hr⁻¹ in 1998.

The weighted mean exploitation rates of 23 marine fish species from 1971 to 1995 was estimated to be 0.55 with several species having higher exploitation rates over the last five years. In general, it can be concluded that marine resources are over-exploited, and about 86% of the resources have been removed (Kongprom et al. this volume).

Excessive Fishing Effort

The estimation of excessive fishing effort using the optimum fishing effort figure for demersal fish as an index, was 20 x 10⁶ trawling hours by research vessels (Kongprom et al. this volume). Based on the efficiency comparison of Boonvanich (1993), the percentage excessive fishing effort was estimated at 44.5% of registered boats in 1996. The excessive fishing boats totaled 2 506, including medium otter-board trawlers 1 024, large otter-board trawlers 1 309, pair trawlers 1 081 and push netters 167.

Utilization of Trash Fish

Trawling gear usually has small mesh size cod-ends and catches fish from a small size. Presently, the size of trash fish caught ranges from 3.5 to 17.5 cm total length. The bigger ones are pelagic fish e.g. sardine and Indo-Pacific mackerel in contrast to the demersal fish which are small, the exception being some long-bodied species e.g. *Saurida elongata*. Indo-Pacific mackerel in the trash fish catch range from 5 to 16 cm total length. The trash fish catch includes juveniles of commercial or economic fish. The amount of trash fish supplied directly to fish mills is high because fish mills purchase all trash fish available. This encourages fishermen to catch more trash fish. Sardines or other big pelagic fish, if not handled well are also sold to fish-can mills when almost rotten. The juvenile economic fish found in the trash fish caught by pair-trawlers includes 13 species of pelagic fish and 15 species of demersal fish. Young economic fish caught by 14 -

18 m trawlers includes 4 species of pelagic fish and 13 species of demersal fish, and those caught by small trawlers includes 15 species of demersal fish, 4 species of pelagic fish, and invertebrates. The ratios between juvenile economic fish and true trash fish differ according to type and size of trawler. Small otter-board trawler catches include 40% of juvenile economic fish, that of 14 - 18 m boats includes 43%, that of pair-trawlers 52%, and push netters 45%. So the pair-trawlers markedly destroy a large number of young economic fish which are sold as trash fish costing Baht 2·kg⁻¹. If those small economic fish grow to marketable size, they are sold for Baht 20 - 50·kg⁻¹. (National Seminar 1999). The biomass of trash fish (kg·km⁻²) is highest near shore, at a depth less than 10 m (Kongprom et al. this volume).

Trends in Catch Composition of Demersal and Trash Fish

The percentage of demersal fish caught decreased from 1966 to 1996 whereas trash fish increased. The mortality index of these two groups from 1971 to 1986 showed parallel increasing trends. Thereafter, the trash fish index increased, reaching a level 5 times higher than that of demersal fish in 1990 (Demersal Fish Working Group 1995).

Decrease in Benthic Species (Change in Bottom Biodiversity)

The species composition of benthos has been markedly changed as a result of fishing by trawlers. During trawling, the nets disturb the benthic environment. In 1976, there were 394 benthic species recorded, which decreased to 88 species in 1995. In 1966, shellfish were abundant followed by sea stars, sea urchins, and polychaetes. By 1989, the shellfish were still highly abundant but polychaetes had disappeared. Sea stars were also less numerous. In 1992, sea stars and sea urchins were dominant.

Smaller Mean Length of Indo-Pacific Mackerel

The mean length of Indo-Pacific mackerel during the past 30 years up to now has showed a decreasing trend, from 18 cm to 15 cm total length (National Seminar 1999). This is further evidence of over-exploitation.

Too Small Mesh Size Cod-end Used

Trawling gear with small mesh size cod-ends, 2.5 cm

stretch mesh size for fish and 1.5 cm for shrimp on otter-board trawlers, and even smaller mesh on push nets, cause a high percentage of trash fish to be caught, which are directly landed at the fish meal factory. In the South China Sea area, the optimum mesh size for fish trawling should be 5.0 cm (Sinoda et al. 1987). The mesh sizes used in other countries around Thailand are larger than Thai trawlers use e.g. Malaysia 3.8 cm, Bangladesh 4.5 cm (Marine Fisheries Division 1997).

Economic Status

A sample of six small scale fishing villages was studied from the southern part of the Gulf of Thailand, Songkhla Province, in 1999. The five fleets studied were shrimp gillnet, cuttlefish trammel net, Indo-Pacific mackerel gillnet, *Acetes* trawl net and other gillnets. The investment, cost, revenue, return to labor and profit are summarized in Table 9.

The variable costs of these gear combinations were about 65 to 71% of the total cost. The most successful gear types were cuttlefish trammel net + Indo-Pacific mackerel gillnet, shrimp gillnet + Indo-Pacific mackerel gillnet, and Indo-Pacific

mackerel gillnet, all of which made more profit than other types.

The Songkhla coastal area fishers are in a bad situation due to the paucity of their funds and the fish resources. For non-fishing alternatives credit and training are necessary, and eventual relocation of the surplus fishermen is inevitable, unless imaginative government projects such as small scale coastal aquaculture development provide viable alternatives to coastal fishing.

For the large scale fisheries, in the long-term they cannot continue their operations. Some fishing gear e.g. small otter trawls, small pair trawls, small purse seines, and all sizes of push nets and gillnets give the owners a better return than other work. In contrast, the large otter trawlers (18 - 25 m), return net profits of Baht 63 000·month⁻¹, while pelagic gear, large purse seiners (18 - 25 m), yield a net profit of Baht 88 000·month⁻¹ and the mackerel gillnetters yield the lowest at Baht 10 000·month⁻¹. All sizes of purse seine and gillnet yield the highest net profit. Table 10 shows the summation of the investment, cost, profit and return to labor of commercial fishing gear in the Gulf of Thailand, 1999.

Table 9. Summation of the investment, cost, revenue and return to labor of small scale fisheries 1999.

Gear	Annual Investment	Fixed Cost (% of total)	Annual Revenue Baht	Return to labor Baht·man·day ⁻¹
SGN	63 316 - 201 000	28.9		
CTN	Ditto	35.0		
IPMGN	Ditto	31.9		
ATN	Ditto			
OGN	Ditto			
		Total cost·yr⁻¹		
Single gear		36 000 - 99 000		
Two gear combination		121 000 - 241 000		
Three gear combination		197 000		
Four gear combination		232 162		
SGN + CTN			257 000 - 330 000	164
CTN + IPMGN			90 000	266
SGN + IPMGN			41 000 - 49 000	264
OGN			20 000 - 25 000	272
SGN + CTN + IPMGN + OGN			20 000 - 25 000	272

Note: SGN = shrimp gillnet, CTN = cuttlefish trammel-net, IPMGN = Indo-Pacific mackerel gillnet, ATN = *Acetes* trawl net, OGN = other gillnets. 1US\$ = 24.92 Baht (1995 annual average).

Table 10a. Investment and cost, profit and return to labor of commercial fishing gear.

Gear	Crew No.	Investment-unit¹ Baht	Cost-month¹ Baht	Operating days-month¹	Fuel-month¹ (Litres)
OBT	4 - 8	423 225 - 2 220 907	78 000 - 228 000	25 - 26	4 537 - 10 693
PT	3 - 14	1 197 825 - 3 895 937	243 000 - 461 000	17 - 27	12 032 - 21 547
BT	3 - 5	71 881 - 313 383	27 000 - 106 000	17 - 24	
PN	3 - 5	132 357 - 1 031 030	66 000 - 126 000	20 - 25	3 559 - 15 915
PS	17 - 25	2 743 886 - 4 339 790	240 000 - 441 000	22 - 23	4 730 - 10 521
KMGN	9 - 10	1 989 489 - 2 666 849	144 000 - 254 000	19 - 20	3 563 - 5 145

Table 10b. Investment, cost, profit and return to labor of commercial fishing gear.

Gear	Boat type	Return to labor Baht-man-day¹	Hull construction (% of total cost)	Equipment (% of total cost)	Net Profit Baht-month¹
OBT	3 sizes	103 - 210	50		63 000 L - OBT
PT	3 sizes	122 - 255	42		
BT	< 14m, > 14m	43 - 120			
PN	3 sizes	46 - 63			
PS	3 sizes	374 - 575	16 - 31	54 - 75	88 000 L - PS
KMGN	> 14m, > 18m	171 - 200	32 - 33	53 - 54	10 000 L - KMGN

Note: OBT = Otter board trawl, PT = Pair trawl, BT = Beam trawl, PN = Push net, PS = Purse seiner, KMGN = King mackerel gillnet.

Management Issues and Opportunities Fishery Management Philosophy

Marine fisheries play an important role for the Thai people in terms of a protein source and the economy of the country. Exported fishery products earn more than 100 000 Baht annually. Fishery related activities, aquaculture and other linkages to industry create jobs and incomes. The GDP of the fishery sector in 1995 was 2% and increased to 2.9% in 1998. The fishery sector hires more than 826 980 workers. There are 77 870 aquaculturists and 183 100 fishery related workers (National Fishery Policy 2000).

The marine fishery is continuously over-exploited. Inappropriate fishing gear use, over-fishing capacity as well as excessive fishing effort, changes in marine biodiversity, habitat degradation, gear conflicts and high costs of operation, lack of fishery

workers, illegal fishing, fishing in foreign waters, international laws and agreements are all major factors making the situation worse.

The Department of Fisheries recognizes the over-fishing situation in the Gulf of Thailand and Andaman Sea. Despite more than 27 issues of Ministerial Notification, the marine resources have still not recovered. Economic outcomes are one factor not under control. Some management regulations are obstructed by the political and social decisions of higher rank. The following examples illustrate the problem:

- The Ministerial Committee has approved selling lower price retail diesel for all kinds of fishing boats since 14 May 1996. This allows 5 400 boats to operate, too many for sustainable harvesting.
- The government has allowed Myanmar aliens to work as crew in the provinces that have large fisheries all over the Gulf and Andaman Sea.

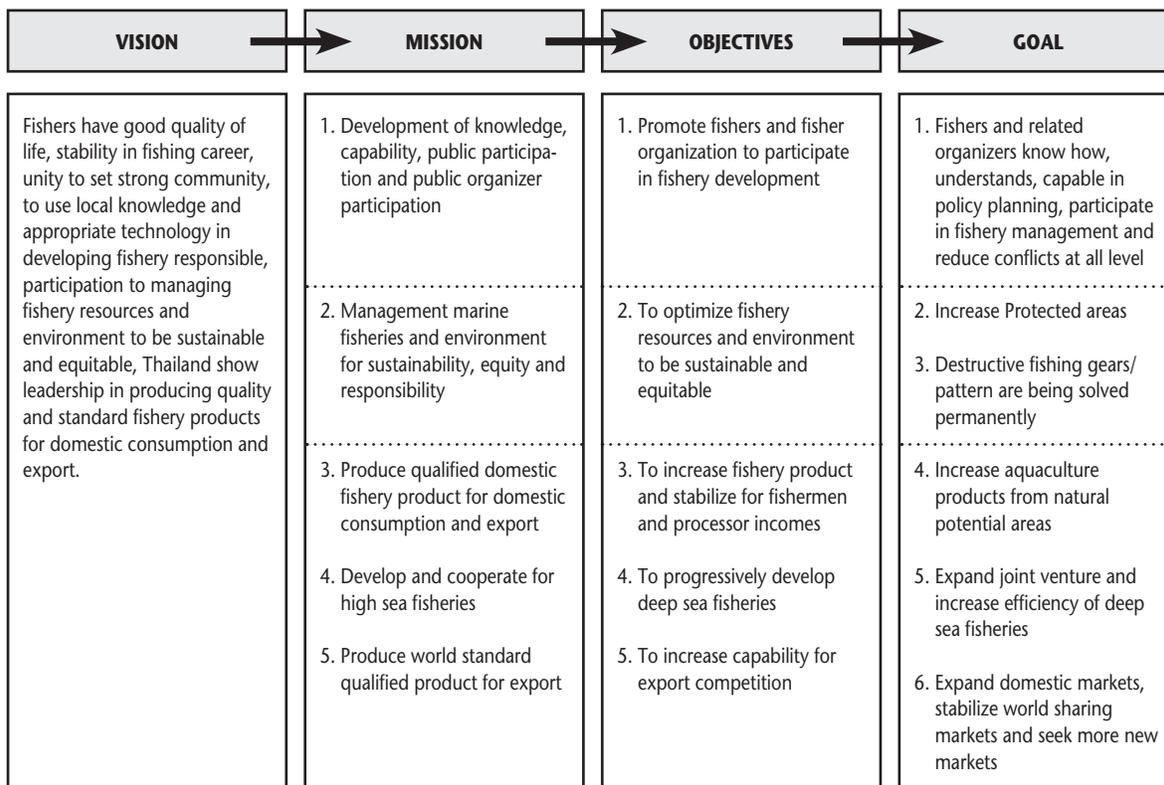


Fig. 11. National fishery development plan 2002 - 2006.

- The government has increased surcharges on imported trash fish resulting in fishermen harvesting more trash fish to support fish-meal factories.
- The Agriculture Health Fund subsidizes fishing of little tuna.

Presently, the new constitution is concentrating on the development of the local community. The 9th National Plan of Economic and Social Development has 7 strategies to develop the country:

- Development of human resources, social conservation, restructuring local administration, sustainability
- Management of marine fisheries and environment
- Establishment of a participatory economic administration system
- Increased capability and strengthening of export markets
- Development and strengthening in science and technology

- Revision of management and administration holistically
- Concentration of agricultural development into 3 directions: to develop the agriculturists and agriculturalist organizations, to develop agricultural products and marketing, to manage the natural resources.

The National Fishery Development Plan (2002 - 2006) Philosophy, under the 9th National Plan of Economic and Social Development, states the following for fishery development (See also Fig.11):

Vision: Fishers should have good quality of life, stability in fishing careers, unity in strong communities, use local knowledge and appropriate technology in developing fisheries, participate in managing fishery resources to be sustainable, equitable and environmentally friendly. Thailand must show leadership in producing quality and standard fishery products for domestic consumption and export.

Fishery Management Goals and Objectives

The Department of Fisheries has set up the fishery management goals and objectives, and these have been approved by several levels of higher rank officials as well as by fishers, stakeholders and processors (Fig. 11).

The goals are:

- Fishers and related organizers must know and understand policy planning, participate in fishery management and reduce conflicts at all levels
- Increase protected areas
- Destructive fishing gear/patterns banned permanently
- Increase aquaculture products from natural potential areas
- Expand joint ventures and increase efficiency of deep sea fisheries
- Expand domestic markets, stabilize sharing markets and seek new markets

The objectives are:

- Encourage fishers and fisher organizations to participate in fishery development
- Optimize fishery resources to be sustainable and equitable
- Increase fishery products and stabilize incomes of fishers and processors
- Progressively develop deep sea fisheries. Increase capability for exports

Fishery Sector Issues/Opportunities

The fishery issues and interventions especially for marine resources and their environment are shown in Fig. 12. Management objectives are as follows:

- a. Productivity and efficiency. The key issues are over-fishing and over-capacity of the fisheries, the use of destructive practices, changes in biodiversity as well as post-harvest losses due to storage techniques. The key interventions are: to control fishing effort, ban destructive fishing gear, reclaim more protective and nursery areas, assign fishing areas in cooperation with the Department of Interior, install artificial reefs to increase areas for growth and spawning, improve marketing/post-harvest facilities as well as to promote value-added product.
- b. The distribution equity. The key issues are the unequal opportunities for the large scale and

small scale fishers. The promotion of fisher organizations, local community administration, stakeholder awareness of natural resources and participation in fishery development management policy, promotion of a management network and the community-based fishery management (CBFM) project are the key interventions.

- c. The integrity of the environment. Inappropriate methods used in fisheries and land-use or other activities impact on the environment directly or indirectly, as well as natural causes. One key intervention recommended is regular monitoring surveys of the plankton causing red tide, water properties and pollutants. The reduction of coastal activities has to be in collaboration with those involved.
- d. Institutional resource person efficiency. The fishery institutions, private agencies and stakeholders are weak as far as politics and social inter-relations are concerned. The key interventions recommended are to enhance research for efficient management, to highlight management information, strengthen institutional collaboration, upgrade the capability of resource persons, train young people, and improve and reform outdated laws and regulations to allow effective enforcement.

Recommendations for Immediate Government Action

The indicative action and investment programs are summarized in Fig. 13.

The recommendations for immediate government actions are:

- a. The DOF should accelerate action to stop severe over-exploitation by reduction of excessive fishing efforts, phase out destructive gear and reduce losses of young economically important fish in the trash fish catch by mesh size enlargement.
- b. Spatial management zones should be urgently established to reduce conflicts among fishers using different types of fishing gear. These fishing zones should be agreed with the Department of Interior.
- c. The DOF should highlight or strengthen more community based fishery co-management (CBFM) pilot projects in various parts of the Gulf of Thailand and Andaman Sea coasts.
- d. The DOF should develop and reform outdated laws and regulations and support full enforcement of the present fishery resource manage-

ment laws, as well as support the local administrative organizations. These laws and regulations should be compatible to global laws and agreements such as the United Nation Convention on the Law of the Sea, the Agreements for the Implementation of the Provisions of the United Nations Conference on the Law of the Sea of 10 December 1982, Highly Migratory and Straddling Fish Stocks, the Code of Conduct for Responsible Fisheries.

- e. The DOF should promote the Local Community Administration and public participation in development of the national fishery.
- f. The DOF should collaborate with other agencies to build public awareness of coastal resources and fishery management regularly at all academic levels as well as among the fishery sectors, stakeholders and media.
- g. Coastal rehabilitation should be highlighted and expanded, more artificial reef installation sites should be provided to protect the fishing grounds by obstructing trawlers.
- h. The training program for fishery management resource persons as well as collaborative research should be strengthened and highlighted.

Recommendations for Government Follow-up Action

The follow-up action for fishery management should be to fully enforce laws and regulations.

Recommendations for Regional or International Collaboration

The regional management of highly migratory fish stocks and straddling stocks or trans-boundary fish stocks is recommended. Already existing organizations should be the core bodies in managing these stocks. Joint ventures in fisheries are also recommended.

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Policy	Strategy	Action			
Fishery Resources and Environment Policy: ★ Improve management of fishery resource and environment, conservation and rehabilitation, and biodiversity; regularly induce public awareness of valuable natural resource promote public participation at all levels manage fishery resource and environment promote technology development and resources in fishery management	Improve management of fishery resource and environment	Improve and reform The Thai Fisheries Act 1947		Improve efficiency within and between agencies	Strengthen control activities impact to natural resources and environment
	Promote public awareness of natural resource preservation and conservation	Strengthen informative and activities to stimulate local community knowledge of valuable natural resources		Promote new generation and local community on management for fishery and environment to be sustainable development	Provide fishery management and conservation courses at all academic levels
	Promote public participation to manage fishery resource and environment	Promote local community establishment to take care natural resource and environment	Promote local management network	Increase training of local leader and target person	Laws and legal measures amended to serve local right
		Motivate fishermen efforts to responsible use natural resources		Promote collaboration among government, private and local agencies	Promote the public participation in community based fishery co-management (CBFM)
	Rehabilitation	Assign fishing areas in cooperation with the national provincial area of the Interior Department		Control fishing effort	Motivate fishers to change destructive fishing gear, responsible fishing or quit to other job
				Ban on destructive fishing gears	Claim more protected and nursery areas
		Seed releasing	Speed up sea rehabilitation project	Installation of artificial reef	
	Promote, preserve and conserve biodiversity	listing and researching of species and habitat		Conserve local species, endanger and rare species/culture	Assign protected area
		Promote fishery under international commitment		Issue law and regulation measures to preserve Biodiversity	Regularly evaluate the status of local and non-local biodiverse species
	Promote technology development and management resource person	Develop research and technology for effective management		Develop capable management people	

Fig. 12. The fishery issues and interventions for marine resources and their environment.

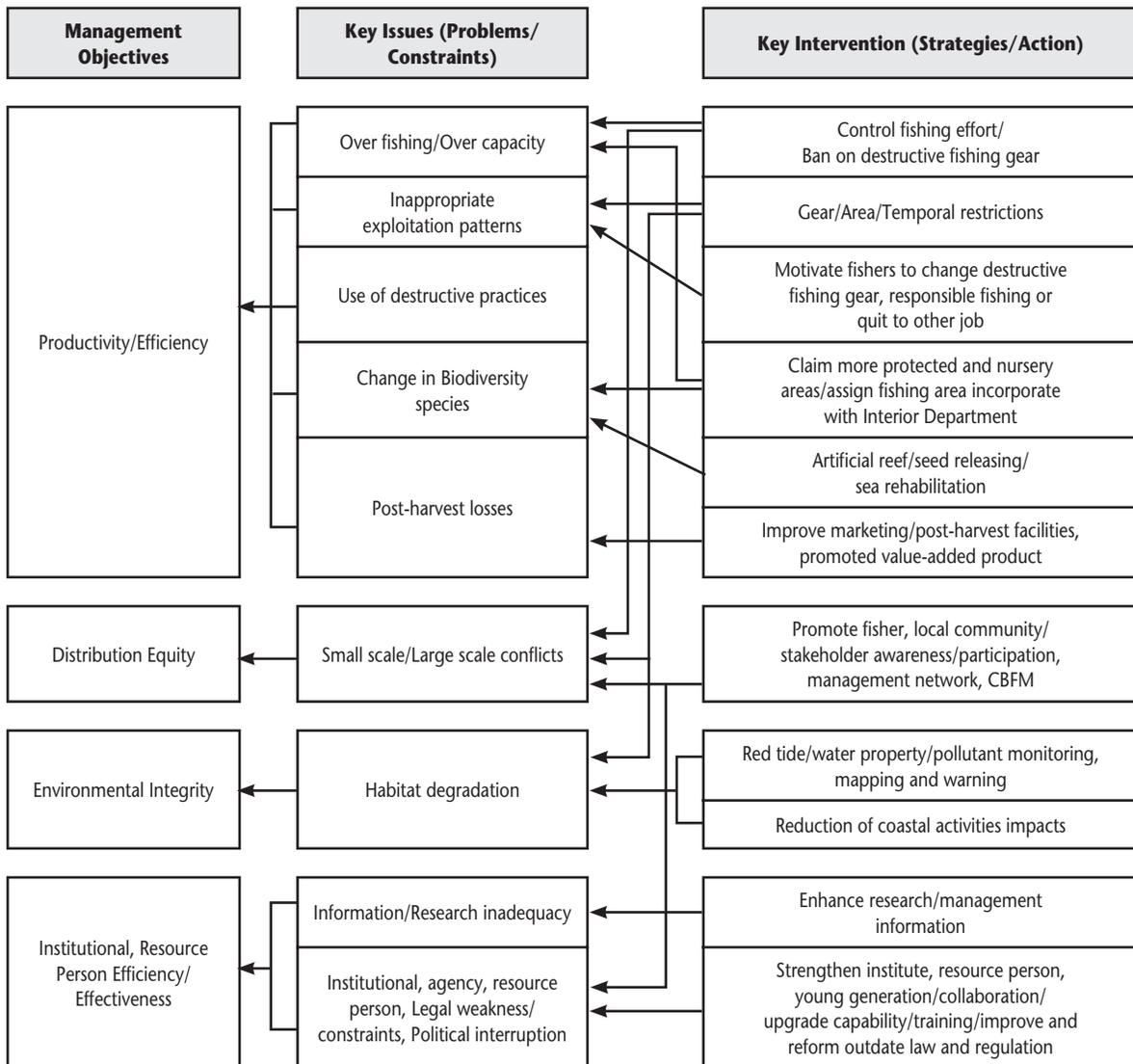


Fig. 13. Indicative action and investment program.

