Management of Coastal Fisheries in Vietnam

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Abstract

The fisheries sector of Vietnam plays an important role in the social and economic development of the country. The sector contributes about 3% of the GDP and fish contributes about 40% of animal protein consumption in the country. In 1999, total fisheries production amounted to 1.8 million t. Of this, 1.2 million t was derived from marine capture fisheries and 0.6 million t from aquaculture. Fish exports were valued at US$971.12 million in the same year. Vietnam's marine fisheries and coastal aquaculture have further potential for development. However, overfishing in coastal areas, degradation of the marine environment and conflicts between small-scale and large scale fishers must be resolved to realize the sector's potential.

This report presents the status of coastal fisheries resources, reviews government fisheries policies and suggested management measures. Based on the recommendations from a multisectoral consultative workshop conducted among the key experts on fisheries and resource management in Vietnam, the following fisheries management objectives were suggested for sustainable development of coastal fisheries in Vietnam: (1) optimization of productivity and efficiency of the fisheries exploitation regime; (2) ensuring that the benefits of production are distributed equitably; (3) ensuring that the productivity generated results in minimum damage to the resource base and the supporting natural environment; and (4) upgrading and strengthening the related institutions. Indicative action programs for improved management are also presented.

Introduction

Vietnam, a peninsular country in Southeast Asia, has a coastline 3 260 km long and the Exclusive Economic Zone covers more than one million km^2. The fisheries sector plays an important role in the social and economic development of Vietnam. The sector is estimated to contribute 3% to the Vietnamese GDP, and fish provides about 40% of the animal protein consumption. In 1999,total fisheries production was estimated at 1 827 310 t, of which 1 212 800 t came from marine capture fisheries and 614 510 t from aquaculture. In the same year, fish exports amounted to US$971.12 million (MOFI 1999).

In the past decade, the fisheries sector has achieved considerable growth. However, the sector suffers from many problems that need to be resolved to ensure sustainable development. Such problems include overfishing in the coastal area, degradation of the marine environment and coastal resources, underdeveloped infrastructure, and lack of effective resource management. This report summarizes information on Vietnam's coastal fisheries, including

environmental and socioeconomic status, institutional-legal framework, and fisheries management issues and opportunities. The report presents indicative action programs for improving fisheries management and attaining sustainable development of coastal fisheries in Vietnam. The action programs recommended in this paper are based on a national consultative workshop conducted under

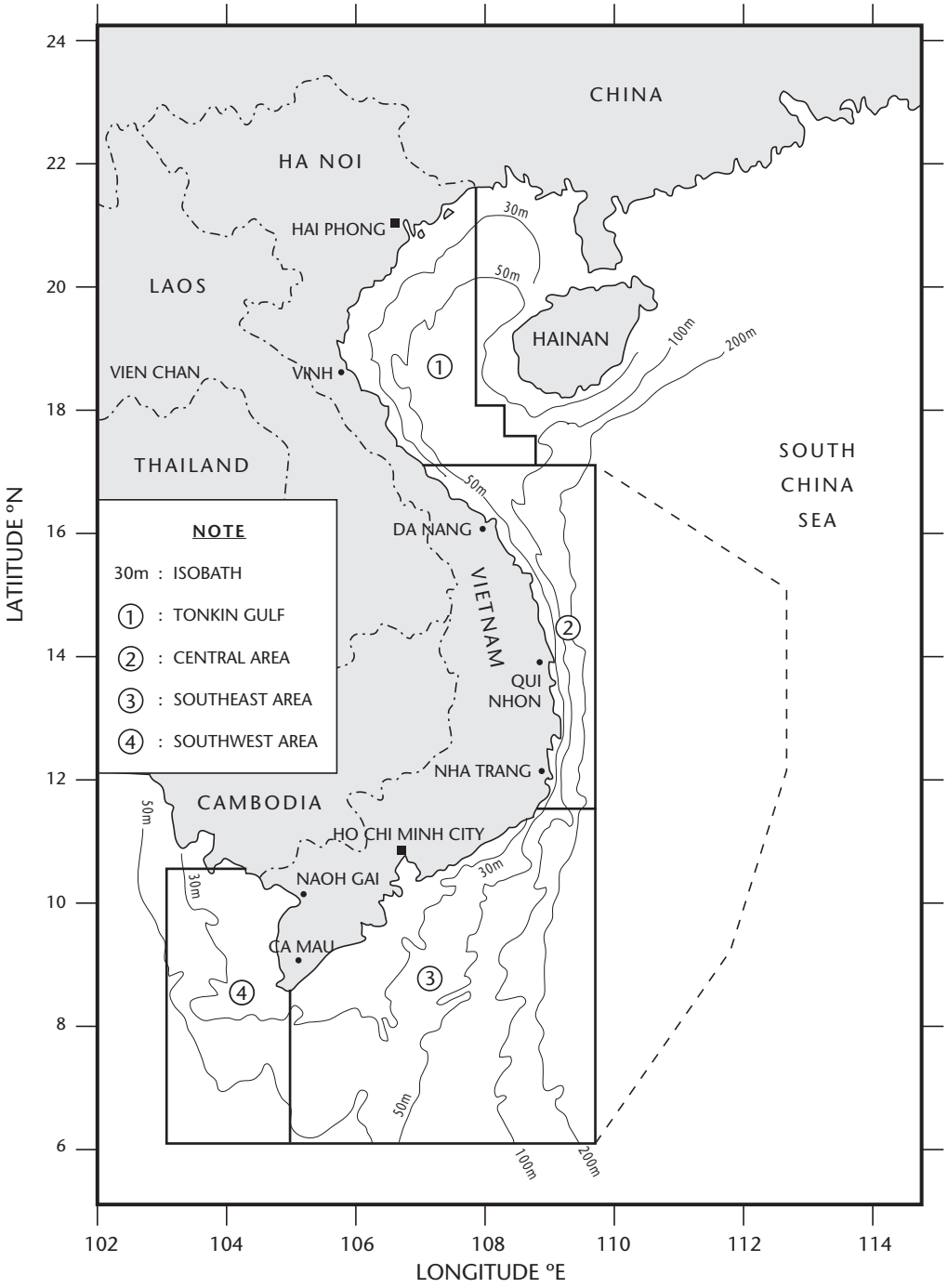

Fig. 1. The Exclusive Economic Zone of Vietnam.

the project "Sustainable Management of Coastal Fish Stocks in Asia" on 28 - 30 August 2001 at the Research Institute of Marine Fisheries (RIMF), Haiphong, Vietnam. The workshop was attended by representatives from various disciplines and from different national institutions and agencies in Vietnam.

Coastal Environment Setting

Physico-chemical Characteristics

Vietnam is under the influence of the tropical monsoon regime. There is considerable difference in climate and environment between the northern and southern parts. In the northern part of Vietnam, the climate can be considered sub-tropical with two seasons. Winter is from November to March and is characterized by mild temperatures of about 16ºC and relatively low rainfall. Summer (from May to September) is usually very hot with temperatures from 27 to 38º C, and humid with frequent typhoons or tropical storms (average rainfall at 1 730 mm•year^{-1}). A more tropical climate is prevalent in southern Vietnam. This region has a dry season between October and March and a wet season from April to September with high precipitation (about 2 000 mm•year^{-1} in Ho Chi Minh City).

The continental shelf, where coastal fisheries operate, is wide and shallow in the north and south, and narrow with a steep slope in the central region. The coastal marine environment is divided into four regions based on their hydrological regimes, namely, the Gulf of Tonkin, central region, southeast and southwest region (see Fig. 1). The Gulf of Tonkin spans an area of 140 000 km^2 and is shared by Vietnam and China. The Gulf is relatively shallow, mostly less than 50 m depth and has a relatively flat bottom with muddy to sandy substrate. In the central region, the depths drop steeply to 200 - 500 m within 30 to 50 km off the coast, with a maximum depth of about 5 000 m. A number of estuaries line the southeast subregion, including the Mekong river system, which discharges large volumes of freshwater and sediments. The southwest subregion (Gulf of Thailand) extends from the border between Vietnam and Cambodia to 6º 00' N latitude and from 105º 00' E to 103º 00' E longitude. This fishing region is shallow (mostly less than 50 m deep), and suitable for bottom trawling.

In general, surface currents in Vietnam, which are induced by the monsoon winds, flow from north to south in winter and reverse direction in summer. Water temperature and salinity vary according to season and location. Average sea surface temperatures usually range from 21 to 26º C. These are generally high in the south and low in the north, especially in January-February, when air temperatures in the north drop to 15 - 16º C. In August, when temperatures are highest, sea surface temperatures range from 28 - 29º C (Thuoc and Long 1997).

Industrial, maritime transportation and oil exploitation activities have not been developed in Vietnam. Thus, pollution is not yet considered a serious matter, and harmful elements in the marine environment are thought to be negligible. However, some coastal areas are starting to be polluted by industrial, agricultural and human wastes coming from the lower rivers. A large proportion of the waste is not treated properly and sometimes contains poisonous chemicals, heavy metals, organic matter and agricultural chemicals. Localized pollution is often from trans-boundary pollution caused by the monsoon and currents bringing polluted products from countries around the Pacific Ocean. In some areas such as Ha Long, Hai Phong and Vung Tau, oil concentrations in the sea have exceeded the threshold for tourism (0.3 mg•l^{-1}). In general, however, the seas of Vietnam are relatively clean compared with other countries in the region.

Critical Coastal Habitats

Wetland ecosystems include large estuarine and delta systems with extensive mangrove swamps and tidal mudflats, seasonally inundated inland marshes and coastal sand dune areas with brackish water saline lagoons. The two largest wetland ecosystems are found in the Mekong Delta in the south and in the Red river in the north. The deltas are heavily populated and are intensively used for agricultural production.

Sedimentation in some coastal aquaculture ponds is a problem in the Red river and Mekong Deltas. Both deltas carry heavy silt loads. Sedimentation is often linked to soil erosion in the watershed, which is influenced by the extent of forest cover. Results from the Mekong water quality monitoring project suggest that suspended solids have increased since 1988; this is possibly related to increased upstream soil erosion caused by deforestation and changing land management practices (Mekong Secretariat 1992). Acid-sulphate soils are particularly common

in the Mekong Delta and some parts of the Red river delta.

Mangrove forests in Vietnam have declined rapidly in recent years. In the 1950s, mangroves covered around 4 000 km^2 along the coastal areas (Hong 1993). The area had decreased to 2 520 km^2 by 1983 and further decreased to 1 570 km^2 by 1994. Of the remaining mangrove forests, 60% are concentrated in the coastal zone of South Vietnam, which is part of the Mekong Delta. In North Vietnam, mangrove forests occupy approximately 10% of the remaining stands of mangroves in the country and are not well developed. In the northeast, an estimated 390 km^2 thrived in the area during the early 1980s, but since then mangrove cover has been significantly reduced due to agriculture, woodcutting and aquaculture development.

The main causes of the decrease in mangrove forests are the cutting of wood and the conversion of mangroves for agriculture and pond aquaculture (Hong 1993). Of the 75 mangrove species in Vietnam, 40% are tree-trunk species that are utilized for timber, fuel wood and charcoal. While a substantial number of mangrove trees have been cut for fuel wood and household uses. The expansion of shrimp aquaculture has contributed to significant loss of mangrove area since the mid-1980s, parti-cularly in the Mekong Delta. Estimates from a survey conducted in 1995 suggest that 49% of semi-intensive and 55% of extensive and traditional shrimp ponds in Vietnam are sited on former mangrove areas, covering a total area of up to 1 310 km^2 (NACA and MOFI 1995). Problems associated with the large-scale cutting of mangroves include dimi-nished coastal fisheries resources, increased erosion and reduced biodiversity.

Seagrass and algal beds are found along the coast and around islands in Central and Southern Vietnam. The biggest seagrass and seaweed beds are concentrated off islands in the southern coast such as Con Dao, Phu Quoc and Spratly islands. There are about 660 species of seaweeds identified in the coastal areas of Vietnam (Dai and Tien 1995). The most common genera are *Sargassum* (about 60 species), *Laurencia* (16 species), *Gracilaria* (15 species), *Caulerpa* (15 species), *Chaetomorpha* (10 species), *Enteromorpha* (8 species). There are 15 species of seagrass reported in Vietnam and their occurrence tends to increase from north (8 species) to south (13 species) (Tien et al 1999).

Coral reefs in Vietnam are common in coastal areas from north to south and islands inshore or offshore. There are approximately 300 coral species belonging to 67 genera (Yet et al. 1994; Tuan and Yet 1995). Of these, 165 species occur in Tonkin Gulf, 171 species in central and southeast waters, 134 species in southwest waters and 180 species in Paracels and Spratly areas. Coral reefs contain resources of economic value such as seaweeds, lobsters, holothurians and coral fishes (Tuan and Yet 1995; Thuoc and Long 1997). A total of 346 species have been identified based on recent faunal studies of coral reef fishes (Thuoc and Long 1997).

The coral reefs in Vietnam exhibit different structural types (Tuan and Yet 1995). Fringing reefs occur along shorelines and around islands in the shelf of the west of Tonkin Gulf, central coast, the eastern and western waters of the South. Bank reefs are dominant on the banks of the shelf of Khanh Hoa, Binh Thuan province and the southeastern areas of Con Dao islands. Bank reefs are found in Spratly and Paracels archipelagos. Atolls are characteristic types for offshore waters outside the shelf. Most near shore corals are heavily exploited (Tuan and Yet 1995; Thuoc and Long 1997). Destructive activities on reefs include coral mining for lime, dynamite fishing and other destructive fishing practices. Siltation has also degraded many reef sites, including the extensive coral reef areas around Cat Ba islands off Hai Phong City on the west coast of Tonkin Gulf.

Fishery Resources and Potential

The marine coastal waters of Vietnam including the EEZ contain large areas with depths of less than 200 m. There are about 2 038 marine fish species belonging to 717 genera and 198 families that have been noted (Huong 1995; Chung et al. 2001). Over a hundred of these species are economically important. The distribution of coastal fishes in the Gulf of Tonkin has a significant seasonal character (Dinh 1995). Under the monsoon regime, fishes in the northern part of Vietnam migrate from nearshore areas to deep areas during winter (October to March). In summer (April to September), the direction of migration reverses. In the southern part where seasonal temperature variations are not pronounced, fishes concentrate in nearshore areas during the dry season and disperse during the rainy season. In general, fish schools are seldom in big shoals but are mostly scattered, and yields are low.

Marine fisheries production consists mainly of pelagic and demersal fish, which contribute 80 to 90% of fisheries yield (Thuoc and Long 1997). The remaining 10 to 20% is contributed by valuable invertebrates such as penaeid and acetes shrimps, crabs, lobsters, cuttlefish, squids and molluscs. Among these, penaeid shrimps and cuttlefish are the most important species for export.

Pelagic Resources

According to the most recent assessments, the standing stock of pelagic fishes in Vietnam waters is about 2.0 million t, while the exploitation potential is 0.8 million t·year^{-1} (Table 1). Of this potential yield, 0.69 million t·year^{-1} was estimated for small pelagic species and 0.12 million t·year^{-1} for oceanic pelagics (Chung et al. 2001). Most of the pelagic stocks are found off the southeast and central region of Vietnam (Vinh and Thu 1997).

Some coastal pelagic fish species concentrate near the bottom during daytime and come to the surface and disperse at night. For example, in a survey using a bottom trawl, the catch for jacks (Carangidae) was 153 kg·hr^{-1} during daytime and only 39 kg·hr^{-1} during the night (Dinh 1995). In addition, most fish species living near the coast have average sizes smaller than 250 mm. Offshore species usually have average sizes of about 500 mm or larger. The growth rate of most fishes is highest during the first 1 - 2 years (Chevey 1933 in Dinh 1995). For example, the round scad (*Decapterus maru-adsi*) reaches 45 - 55% of its maximum size within the first year. The main spawning season time of many pelagic species is from March to July, with peak months in May and June (Dinh 1995).

Demersal Resources

Demersal fishes live near the sea bottom and consist of mixed fish communities. Normally more than 30 species are caught in one haul of bottom trawl and none of them are dominant (Thuoc et al. 2000). Similar to pelagic fish, most demersal species are batch spawners with short life cycles of one to five years (Dinh 1995). Food types are also varied and feeding intensity does not exhibit strong seasonal fluctuation.

The total biomass of demersal fish stocks estimated from bottom catches in Vietnam waters is about 1.4 million t (Table 2). In a more recent study, (Thuoc 2001) estimated that the standing stock for demersal resources in Vietnam is about 3.4 to 3.5 million t with a potential yield of 1.4 to 1.5 million t·year^{-1}. Coastal demersal resources in almost all areas are exploited at or above their sustainable levels (Thuoc et al. 2000; Thuoc 2001). The government therefore emphasizes that any further expansion of the marine capture fishery should be targeted at under-exploited resources and that the fishing pressure on coastal stocks should be reduced (e.g. by establishing alternative employment opportunities for fishers).

Table 1. Estimates of standing stock and potential yield of pelagic resources in Vietnam waters.

Region	Pelagic Resources	Standing stock (t)	Potential yield (t·year^{-1})
Gulf of Tonkin	Small pelagics	390 000	156 000
Central region	Small pelagics	500 000	200 000
Southeast region	Small pelagics	524 000	209 600
Southwest region	Small pelagics	316 000	126 000
Sea Banks	Small pelagics	10 000	2 500
Offshore region	Oceanic pelagics (*)	(300 000)	(120 000)
	TOTAL	2 040 000	814 100

Source: Chung et al. 2001.
Note: * - estimated data.

Table 2. Estimated standing stock biomass of demersal fishes in Vietnam.

Region	Area (km^2)	Estimated biomass (t)	Stock Density ($t \cdot km^2$)
Gulf of Tonkin	77 173	115 972	1.50
Central region	78 974	112 070	1.42
Southeast region	222 258	1 051 117	4.73
Southwest region	49 048	92 721	1.90
TOTAL	427 452	1 371 881	

Source: Thouc et al. 2000.

Shrimps and Lobsters

Shrimps are the most important commercial species in Vietnam due to their high price followed by fish, squid, crab and mollusks. There are over 100 shrimp species belonging to 16 genera and 8 families (Thuoc and Long 1997). Among these, the family Penaeidae represents about 20 economically valuable species which are mainly distributed in depths of less than 50 m. There are also five species of flathead lobsters (Scyllaridae) of which two are economically valuable species. There are eight species of spiny lobster (Palinuridae) including five economically valuable species.

The shrimp species diversity varies among the areas. In the western part of Tonkin Gulf, there are 58 shrimp species, in the central coastal area there are 78 shrimp species, about 50 shrimp species are found in the southeast region and there are more than 50 shrimp species in the southwest region. Table 3 presents standing stock and potential yield of shrimps and lobsters in various regions of Vietnam.

The annual yield of shrimp (mainly Penaeidae) during the 1990s was estimated between 40 000 to 50 000 $t \cdot year^{-1}$. Most shrimp species are distributed along the coastline from the depth of 50 m to the shore. During their spawning seasons in February - March and June - July, shrimp species concentrate at depths from 15 m to 30 m. Nursery areas of shrimp larvae and juveniles typically occur within depths of 15m , especially mangrove forest or estuaries. The main fishing period of the shrimp fishery is from April to August and the secondary period is from November to December. Shrimp fishing grounds are mostly concentrated along the coast of Tonkin Gulf and around Mekong Delta.

Table 3. Estimated standing stock and potential yield of shrimps and lobsters in the Vietnamese waters.

Region	Area	Standing stock (t)	Potential yield ($t \cdot year^{-1}$)	Remark
Tonkin Gulf	Western part	1 390	696	Period from 1975 to 1978
Central region	Area with depth < 50 m Area with depth > 50 m	2 706 15 893 - 17 275	1 353 7 947 - 8 638	–
Southeast region	Area with depth < 30 m Area with depth > 30 m Total	8 237 13 220 - 15 373 21 457 - 23 610	4 119 6 610 - 7 678 10 729 - 11 806	Penaeidae, *Thenus orientalis* Penaeidae, *Thenus* spp. and *Ibacus* 1977 - 1988
Southwest region	–	3 242 3 256	1 621 1 607	1982 - 1985 1993 - 1995

Source: Pham Ngoc Dang and Nguyen Cong Con 1995 and Pham Thuoc 1998.

Other Resources

The estimated standing stocks and exploitation potentials of cuttlefish and squids in the Vietnam are presented in Tables 4 and 5, respectively. There are 53 cephalopod species belonging to 12 genera and six families. Among them, 3 families (i.e. Loliginidae, Sepiidae and Octopodidae) are the most important with the 12 economically valuable species, 7 of which are main export commodities. Squid and cuttlefish are widely distributed in Vietnam waters (Thuoc and Long 1997; Chung et al. 2001). In summer (April - September), squid appear near coastal areas for spawning, with peaks in July and August. In comparison, cuttlefish spawn in winter months with the peak from December to March. Their fishing season coincides with the spawning season. Cuttlefish are becoming increasingly important commercial targets, with the annual yield reaching 25 000 t.

Economically important mollusc populations have declined or disappeared in some areas because of excessive exploitation. For example, in Nha Phu inlet (Khanh Hoa province) the green mussel *Perna viridis*, which yielded 40 - 50 t•year^{-1} prior to 1975, has now been reduced to near extinction. The pearl oyster *Pinctada martensii* in Quang Ninh province, which had a potential yield of 8 000 t in 1969, has been almost exhausted. The annual scallop (*Chlamys nobilis*) yield of 10 000 t in 1986 in Binh Thuan province had been reduced to only 200 - 300 t by 1995.

Table 4. Estimates of standing stock (in t) and potential yield (in t•year^{-1}) of cuttlefish in Vietnam seawaters by depth range.

Region	Parameters	Depth range (m)				Total
		< 50	50 - 100	100 - 200	> 200	
Tonkin Gulf	Standing Stock	1 498	395	-	-	1 893
	Potential Yield	599	158			757
Central region	Standing Stock	3 900	3 836	4 505	1 301	13 542
	Potential Yield	1 560	1 534	1 802	520	5 416
Southern region	Standing Stock	24 933	10 756	7 404	5 613	48 706
	Potential Yield	9 973	4 302	2 962	2 245	19 482
TOTAL	Standing Stock	30 331	14 987	11 909	6 913	64 140
	Potential Yield	12 132	5 994	4 764	2 765	25 655
	Percentage (%)	47.3	23.3	18.6	10.8	100

Source: Chung et al. 2001.

Table 5. Estimates of standing stock (in t) and potential yield (in t•year^{-1}) of squids in Vietnam seawaters by depth range.

Region	Parameters	Depth range (m)				Total
		< 50	50 - 100	100 - 200	> 200	
Tonkin Gulf	Standing Stock	9 244	2 524			11 768
	Potential Yield	3 698	1 010			4 708
Central region	Standing Stock	318	435	2 033	2 982	5 768
	Potential Yield	127	174	813	1 193	2 307
Southern region	Standing Stock	21 319	12 832	2 559	4 867	41 577
	Potential Yield	8 527	5 132	1 024	1 947	16 630
TOTAL	Standing Stock	30 882	15 790	4 593	7 848	59 113
	Potential Yield	12 352	6 316	1 837	3 139	23 644
	Percentage (%)	52.2	26.7	7.8	13.3	100

Source: Chung et al. 2001.

Socioeconomic Background

In 1995, the population of Vietnam was estimated at 74 million, of which 80% resided in rural areas (MOFI 1996). The annual population growth rate decreased from 4.0% in the 1960s to 2.0% in 1995, which translates to a steady increase of 1.5 million people annually. The national population strategy aimed to reduce the annual growth to 1.8% by the year 2000, at which time the population was projected to reach 82 million.

The total median age in 1989 was 19.1 years for men and 21.4 years for women; this is two years higher for both sexes since 1979. The 1989 census data showed that 39% of the population was under 15 years old and only 7% was over 60. This means that a little over half the population consists of adults in their working age. The dependency rate, i.e. the average number of dependent persons (under 15 and over 60) per 100 adults of working age, is 78. The dependency rate is higher in rural areas: 86 dependents per 100 adults of working age, compared to 61 for urban areas. The average number of persons per fishing household is 5.5, which is higher than the average for non-fishing households. On average, 2.4 persons in a fishing household are employed.

The total labour force in 1995 was estimated at 40.3 million people, of which 34.7 million (86%) were employed, 15 million (3.7%) were still in school, 2.1 million (5.2%) were looking after their homes, and the remaining 2 million (5%) were unemployed (MOFI 1996). In 1995, capture fisheries and aquaculture provided full-time employment to about 1 million people. About 447 000 were engaged in capture fisheries and 560 000 were involved in aquaculture (MOFI 1996). Another 59 000 people were employed in the processing industry, giving a total of 1 065 000 people employed full-time in capture fisheries, aquaculture and processing in 1995. This corresponds to 3.1% of the employed labour force. In addition, support industries and sectors related to fisheries generated employment for another 1 962 000 people in 1995, which was equivalent to 5.7 % of the employed labour force. In total, the fisheries sector provided employment for almost 9% of the employed labour force.

MOFI's strategies (MOFI 1992; Danida 1997a & b) for development of the fisheries sector (1990 - 2005) and marine fisheries (1996 - 2010) aim to increase the number of fishermen to 590 000 in 2010. The marine fisheries jobs are predicted to be created by off-shore fisheries. Further, MOFI expects that the number of people employed directly in the aquaculture industry will double by the year of 2010.

Women account for slightly more than half of the total employed labour force. However, there are major differences between state-run and private sectors with regard to participation by gender. While women account for 51.4% of the total employed labour force, they account for only 39% of the employed in the state sector. This is due to the fact that most women are engaged in agriculture, which is predominantly private. Women constitute the majority (53.3%) of employed in the agriculture sector, with female participation in state agriculture being slightly less. Capture fisheries is a male-dominated occupation, with only 27% female participation. However, the fish processing industry differs from the general fishing industry, with female participation at 80 - 85%. Salaries in agriculture and fisheries are generally lower than those in industry and service sectors. Salaries in capture fisheries are related to the actual catch. The salaries in central Vietnam are higher than in the north and south. Employees of private fishing operations are paid as much as double the salary offered by the state owner enterprises. The average monthly salary in the fish processing industry ranges from VND 300 000 to VND800 000 (US$18.83 to 50.20)[1]. Salaries for fish processing are lowest in the north. In contrast to capture fisheries, salaries in the private fish processing plants tend to be lower than in the state-owned enterprises.

Vietnam has 52 fishing ports with a total berth length of 2 905 m. However, these are only small and medium fishing ports or supply ports, that provide ice, fuel, fresh water and repair services, and sheltering places for fishing boats. In general there is a shortage of modern facilities such as discharging vehicles, freezer warehouses or stores. Areas for sorting and classifying fish as well as transportation networks inside ports are still inadequate. Because many coastal locations have no fishing port, most of the catch from fishing boats must be transported by small boats to buyers. In some places, catches are unloaded directly on sandy areas, which is time-consuming and often causes spoilage, especially in hot weather (Long 2000).

[1] 1 US$ = 15,934.27 VND (2002 average)

In recent years, the government has made efforts to improve fisheries infrastructure. Many new fishing ports have been built and many old fishing ports have been enhanced. Since 1996, US$71 million has been invested in new ports and upgrades. In particular, the Cat Lo port in Vung Tau City is planned as a very large fishing port with a total investment of US$24 million. Currently, there are 75 shipyards for fishing boats providing a total building capacity of 4 000 boats and repairing capacity of 800 fishing boats•year^{-1}. Apart from these, there are many small shipyards at the district level, which build small fishing boats in the traditional way. There are 126 freezer stores with a total capacity of about 20 000 t and 120 ice-making enterprises.

According to Long (2000), there are different economic organizations in the fisheries sector, such as:

State-owned fishing enterprises

- These enterprises operate steel fishing boats with engines of more than 135 HP. In recent years, the profitability of such enterprises has declined due to dwindling fishery resources and management inflexibility. Consequently, the number of fishing boats of state-owned enterprises has decreased.

Fishing cooperatives

- After 1985, many fishing cooperatives disappeared. In 1997, many new cooperatives were established mainly in order to obtain loans from banks.
  - Fishing groups. Fishers organize into groups mainly to reduce the costs of boats and gear. From 1985 to 1997, the number of fishing groups increased from 2 205 to 5 542.
  - Private businesses in marine fishing. These include households that own fishing boats and employ less than five workers, skippers who own one or two fishing boats and employ more than five workers, and "private capital", which is an entity that owns more than two fishing boats with > 250 HP.

Institutional Background

Fisheries Related Policies

In general, legislation governing fisheries in Vietnam is complex and not very well prepared. The central government and the Ministry of Fisheries issue legislation regarding the management of aquatic resources and aquaculture in Vietnam, which may have wide scope of action and may be issued at all government levels. Provincial governments are usually tasked with implementing legislation enacted by the central government. Annex I provides a comprehensive list of institutions and agencies that are involved directly or indirectly in the development, management and conservation activities for coastal and fisheries resources in Vietnam.

Since 1986, Vietnam has been transforming its general policy and strategy from a centrally planned economy to a market economy under socialism (MOFI 1992). Toward this end, the Ministry of Fisheries has developed a general policy framework for the fisheries sector (see Danida 1997a and b) with the following main objectives under the current social and economic development plan (2000 - 2010):

- To increase domestic consumption of fish and fishery products
- To increase export earnings
- To create substantial additional employment
- To improve the sector's infrastructure, equipment and technology base
- To increase the sector's contribution to the government budget.

During the last two decades, mangrove forests in Vietnam have been degraded considerably by human activities. To protect these resources, the government has enacted legislation and policies including measures on forest restoration and preservation. A directive on the technical procedure for the establishment and maintenance of mangrove forests was issued on 24 October 1984, with Decision No. 975 QPN 7 - 84. In addition, Resolution No. 246/HDBT of the Council of Ministers was enacted on September 20 1985 to promote the rational use of natural resources and environmental protection.

Article No. 5 of the "Law on Forest Protection", which was promulgated on September 5 1972, contains a provision for the establishment of protected areas. Within forest reserves, it is prohibited to fell trees or to kill birds and other wildlife. However, deforestation has continued, mainly as a result of natural calamities. Hence, the Prime Minister enacted instruction No. 53/CT on 24 February 1990 to establish plantations for the protection of the environment, including coastal and estuarine habitats. Based on this, the Ministry of Forestry promulgated decision No. 413/QD on 18 September 1992 initi-

ating a plantation programme for 6 000 ha of suitable area along Minh Hai's coast. As a contracting party to the Ramsar convention[2] on January 20 1989, the Government of Vietnam designated the mangrove islands of Xuan Thuy District in Nam Ha province for inclusion in the RAMSAR list.

The responsibility for coastal development and environmental protection in Vietnam is delegated to local administrations. For example, the Provincial People's Committee of Minh Hai (MHPPC) province has formulated a number of decisions, regulations and instructions to protect and limit the irrational utilization of mangroves. In order to protect and preserve the species of endangered wildlife, the Vietnamese government issued the "Red Data Book of Vietnam, Volume 1 - Animals" in 1992, and "Red Data Book of Vietnam, Volume 2 Plants" in 1996. These books list 365 animal species and 356 plant species for protection.

Vietnam's economy was in decline during the period 1976 - 80 due to the inefficiencies of the command economy. Since the shift to a market economy, beginning in 1981, Vietnam's fisheries have achieved remarkable development in technical capacity, fisheries product quantity and export value. At present, the government concentrates investment in three major programs, namely: offshore capture fishery, aquaculture and fisheries export development.

Offshore Capture Fisheries

Vietnam has policies to protect and restore inshore resources by limiting fishing in coastal areas, while simultaneously encouraging the exploitation of offshore resources. From 1997 to 1999, the government provided soft loans (1 300 billion VND) for building offshore fishing vessels. In late 1999, the fishing fleet grew to 73 397 units with a total capacity of 2 518 493 HP.

Aquaculture Development

In the last decade, both public and private sectors have invested in aquaculture in Vietnam. The government has provided funds for the construction of dykes, main canals and main water gates in aquaculture areas and has invested in experimental hatcheries and feed production units. Presently, the majority of investments in the aquaculture industry are at the farm level (Table 6). Direct public sector investment has played a relatively minor role in the development of the aquaculture industry.

Fish Processing and Export Development

In 1998, Vietnam had 234 fish processing plants, of which 186 were exporting plants with a total production capacity of 200 000 $t \cdot year^{-1}$. Some enterprises have invested in upgrading infrastructure and facilities, renovating technologies, diversifying products, producing high-quality products and applying the Hazard Analysis Critical Control Point (HACCP) system in food processing quality control. To date, 60 plants apply HACCP to export products to EU and American markets. In the coming years, the government is expected to invest heavily in fisheries processing and export development.

Table 6. Investments in the aquaculture industry (1986 to 1995).

Item	Investment (billion VND)
Public sector investment	147.0
Domestic private sector investment	777.0
Farm level investment	2 437.4
Foreign investment	728.0
Sub-total investment	4 089.4

Source: SCP Fisheries Consultants Australia 1996.

[2] The Convention on Wetlands is an intergovernmental treaty adopted on 2 February 1971 in the Iranian City of Ramsar.

External Policies Affecting Fisheries

The use of land and water area for coastal aquaculture development is governed by the new land law, which came into force in October 1993. Articles 48, 49 and 50 provide specific guidance on the use of coastal land and water for aquaculture (along with forestry and agriculture) and the management and use of new alluvial coastal land. According to Article 48, the use of coastal land for aquaculture shall: (i) be in conformity with land use planning; (ii) protect the land and increase accretion; (iii) protect the ecosystem; and (iv) not cause a hindrance to national security protection and navigation.

There are some restrictions on the use of lakes, rivers, mangroves or coastal areas for aquaculture. However, in most cases developments proceed without restriction, although there are a few exceptions. In inland areas, individuals may establish ponds on private land without the need to obtain permission. To establish ponds on public land, permission may be required from the district, provincial or central government. Procedures differ depending on the district. In coastal areas, permission to establish new impoundments may be required from the local government authorities.

The Ministry of Science, Technology and Environment (MOSTE) prepared the Law on Environmental Protection in January 1994. The enactment of the law and the establishment of MOSTE itself have created a framework for environmental management in Vietnam. Following this enactment, the government issued the Decree 175 on Providing Guidance for the Implementation of the Law on Environmental Protection in October 1994. This provides further details on the roles, mandates and responsibilities of the government institutions involved in environmental protection.

The responsibility for coastal development and environmental protection in Vietnam is delegated to local administrations. For example, in Minh Hai province, the people's committee has formulated a number of decisions, regulations and instructions to control the use of mangrove areas for shrimp culture. However, it appears that the culture of shrimps has proceeded without proper consideration of the environmental impacts. On February 17 1992, the Ho Chi Minh City's Agriculture Service issued guidelines prohibiting mangrove forest clearance for the purpose of shrimp pond construction. These guidelines also required registration of all units and households building shrimp ponds in mangroves and approval from the Agriculture Service for ponds greater than 1 ha.

International/Regional Conventions

i. Vietnam is a signatory of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, which came into force on July 1st 1975. Among other things, the Convention recognized that international cooperation is essential for the protection against overexploitatio of certain species of wild fauna and flora through international trade. According to the Convention, the export/import of any specimen of the endangered species shall require the prior grant and presentation of an export/import permit with very strict conditions.

National Fisheries Institutions

The Ministry of Fisheries is the main agency that manages fisheries at the national level. It is responsible for:

- Capture fisheries;
- Aquaculture;
- Preservation and development of fisheries resources;
- Fishing vessel registration;
- Fisheries processing, wholesale and retail trade for domestic fish products and import/export;
- Logistic services;
- International cooperation;
- Inspection of production facilities and hygiene standards, issuing quality licenses for domestic and export products;
- Training of fisheries scientists, technicians, managers, workers, granting certificates for captains and operators of fishing vessels;
- Conducting scientific and technical research, applying new technology to fisheries production.

In 1991, the Fisheries Resources Preservation Department was founded under the Ministry of Fisheries. Together with this Department, a system of resource protection agencies, responsible for fisheries resources management and registration of fishing vessels, was established. As of December 1999, there are 36 resource protection agencies with a staff of 888 persons at the provincial level.

The National Environment Agency under the Ministry of Science, Technology and Environment is

also involved in fisheries although in a less direct manner. The agency is the main national organization responsible for coastal zone management. Its responsibilities include: (i) provision of environment documentation and development of environmental management strategies, and (ii) cooperation and coordination with other institutes for study, strategies and policy for coastal management.

Coastal Fisheries in Focus

Scale, Structure and Information Aspects

Fisheries in Vietnam are categorized into small scale and large-scale sectors. Small scale fisheries are defined as those that use non-powered boats or motorized boats with an engine of less than 90 HP. The typical small scale fishing operation is labour-intensive and confined to nearshore waters. Common small scale fishing gear include beach seines, gillnets, lift nets, push nets, trawls, cast nets, traps, hooks, lines, set nets and trammel nets. At present, the small scale fishery in Vietnam accounts for more than 95% of total fishing boats, nearly two thirds of production and value, and 92% of the fisheries labour force.

Large scale or industrial fishing enterprises include those run by private companies, joint ventures and state-owned enterprises. The industrial fishing fleets in Vietnam are small and undeveloped in terms of quantity and quality compared with the industrial fishing fleets of other countries in the region. Most operate in coastal areas of < 100 m depth; few can fish in deep seas. These fishing fleets account for approximately 5% of the total fishing boats, but they produce about 37% of marine capture production and value. The large scale fleets mainly fish for high-value and/or export commodities such as tuna, skipjack, mackerels, dolphin fish and shrimp. The gear used are trawls, purse seines, drift gillnets, tuna longline and trammel-nets for shrimp.

The number of boats engaged in the marine capture fishery by category, their production and value are given in Table 7. In 1998, the total number of fishing boat was 100 500 units, of which 71 799 units were motorized vessels with a total engine capacity of 2 427 856 HP and 28 701 units were non-motorized boats. The distribution of motorized fishing boats according to engine horsepower is as follows: 53% with engine < 20 HP; 30% from 20 HP to 45 HP; 10% from 46 HP to 90 HP; and 7% for engine > 90 HP.

Fishing Methods and Technologies

There are more than 20 kinds of fishing gear used in capture fisheries and these are generally classified into six main types (Table 8). Gillnets and trawls are the most common gear types and collectively account for more than 55% of the fishing gear used. Trawlers concentrate mainly in the southern coastal provinces such as Kien Giang, Minh Hai and Ba Ria-Vung Tau (Figure 1). Purse seine and tuna mackerel gillnets are used predominantly in the provinces from Da Nang to the south, and lift nets from Da Nang to Binh Thuan province. Other fishing gear are widely used all over the coastal areas. Table 9 shows that certain gear types are used by both the small scale and large scale sectors. For such "shared" gear types however, the scale of operations, target species and other aspects differ markedly between the two fishing sectors.

Table 7. Total fishing boats, production and value by marine capture fishery sector in 1998.

Sector	Fishing boats		Production		Value	
	Number	%	t	%	(million US$)	%
Small-scale fisheries - Motorized boats - Non-power boats	95 493 66 792 28 701	95.02	708 928	62.70	387.61	62.70
Large scale fisheries	5 007	4.98	421 732	37.30	230.59	37.30
TOTAL	100 500	100	1 130 660	100	618.20	100

Table 8. Percentage number of various fishing gear types in Vietnam.

Fishing gear	%
Trawls (otter board trawl, pair trawl and beam trawl)	26.0
Seinenets (beach seine, purse seine)	4.3
Gillnets (drift gillnet, mackerel gillnet, shrimp gillnet and trammel net)	31.4
Lift nets	5.6
Hooks and lines (long-line and hand-line)	13.4
Set nets	7.1
Other gear	12.2

Table 9. Boat capacity by fishing gear type in Vietnam.

Type of fishing gear	Boat capacity (HP)	
	Small scale fisheries	Large scale fisheries
Bottom fish trawl	60 - 150	150 - 600
Shrimp trawl	20 - 60	–
Purse seine	45 - 150	150
Tuna mackerel gillnet	33 - 100	150 - 200
Other fish gillnet	12 - 60	–
Light lift net	33 - 45	–
Long-line, hand-line	12 - 60	150 - 200
Others	Non-power - 22	–

Catch and Catch Rates

The south region of Vietnam leads the central and north regions in fisheries production (Table 10). Overall, the trawl contributes about 43% of the catch, due to the high contribution of trawls in the catch of the north and south regions. The central region however illustrates that purse seines, gillnets and lift-nets contribute about 65% of the total catch.

Marine capture fisheries production increased steadily from 1981 to 1999 (Fig. 2), posting a nearly three-fold increase from 419 740 t in 1981 to 1 212 800 t in 1999. However, average catch per unit effort (CPUE) declined over the same period because the annual increases in production were obtained through greater than proportional increases in total horsepower. Over the two decades, total horsepower increased more than five-and-a-half fold from 453 871 HP in 1981 to 2 518 493 HP in 1999.

CPUE declines were observed in specific fishing grounds (Vinh et al. 2001). The CPUE declined from 1.34 to 0.34 $t \cdot HP^{-1} \cdot year^{-1}$ in the Gulf of Tonkin (1985 - 97), from 1.06 to 0.66 $t \cdot HP^{-1} \cdot year^{-1}$ in the Central area (1986 - 91) and from 2.05 to 1.20 $t \cdot HP^{-1} \cdot year^{-1}$ in South Vietnam (1985 - 88). In the northern coastal provinces, decreased catch rates were observed for the trawl, purse seine and lift net with lights (Table 11).

The catch composition features typical characteristics of tropical assemblages, such as high species richness but low species abundance. A typical trawl

haul normally includes 30 to 40 species. Table 12 lists the common fish species caught by major fishing gear types. Table 13 shows the species composition changes of catches from trawl surveys undertaken in Vietnamese waters. These trends will be further studied using the compiled information on trawl surveys (see Garces and Silvetre this vol.; Thuoc et al. 2000).

Table 10. Total catch (t) (percentage contribution in parenthesis) by fishing gear type in Vietnam (1997).

Region	Total Catch	Fishing gear						
		Trawl	Purse-seine	Gillnet	Lift net	Hook and line	Fixed net	Other
North region	73 703 (100)	27 182 (36.9)	4 880 (6.6)	18 728 (25.4)	14 110 (19.1)	4 773 (6.5)	1 240 (1.7)	2 391 (3.2)
Central region	173 218 (100)	31 078 (17.9)	41 614 (24.0)	34 674 (20.0)	36 534 (21.7)	23 793 (13.7)	841 (0.5)	4 504 (2.6)
South region	283 415 (100)	169 958 (60.0)	62 593 (22.0)	18 729 (6.6)	– –	16 452 (5.8)	13 731 (4.7)	2 322 (0.8)
TOTAL	530 336 (100)	228 218 (43.0)	109 087 (20.6)	72 131 (13.6)	50 644 (9.5)	45 028 (8.5)	15 452 (2.9)	9 217 (1.7)

Source: Long 2000; Long this vol.

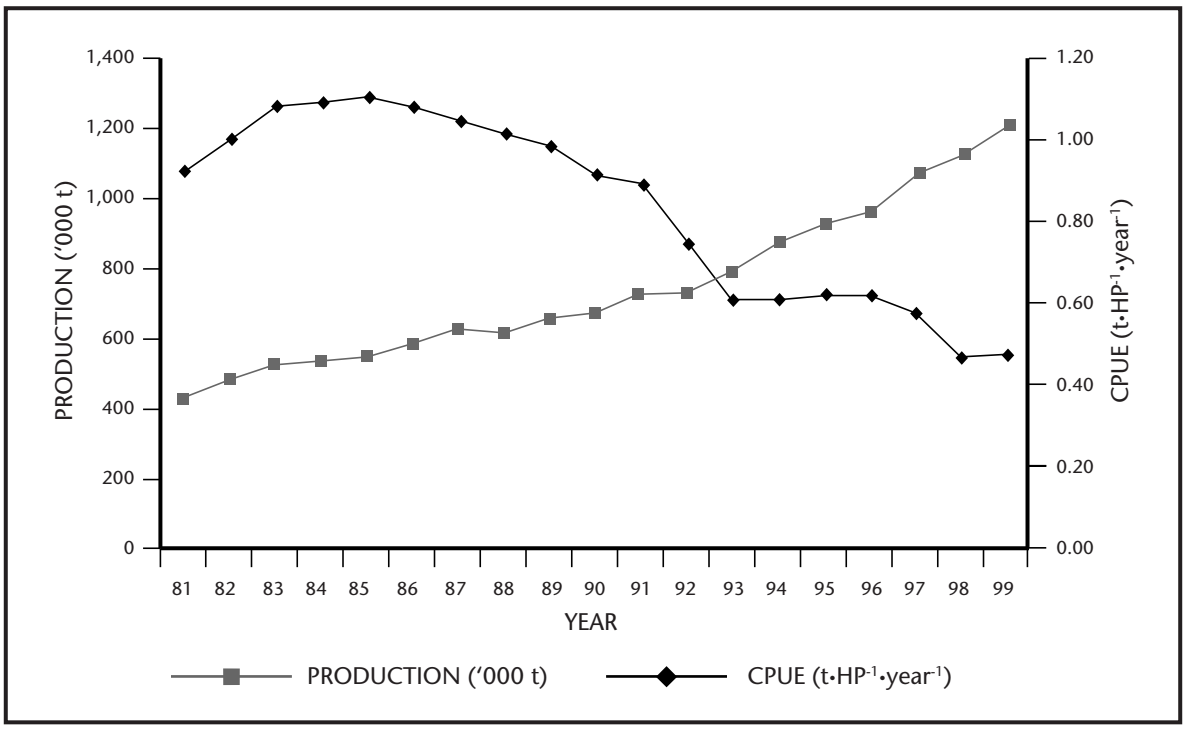

Fig. 2. Marine capture fisheries production and average catch per unit effort from 1981 to 1999. Data source: MOFI 2000.

Table 11. Trends in changes in catch rates of selected fishing gear types in the northern provinces of Vietnam.

Fishing gear type	Catch rates ($t \cdot boat^{-1} \cdot year^{-1}$)	
	1976	1990
Trawling: - 250 HP trawler - 400 HP trawler	 360 480	 200 240
Purse seine	100 - 150	20 - 30
Lift net with light	200	30

Table 12. List of main species caught by major gear types in Vietnam.

Gear type	Dominant species
Purse seine	Yellowtail round scad (*Atule mate*), round scad (*Decapterus maruadsi*), bigeye scad (*Selar crumenophthalmus*), yellow stripe trevally (Carangidae), Indian mackerel (*Rastrelliger kanagurta*), frigate mackerel (*Auxis thazard thaxard*), and eastern little tuna (*Euthynnus affinis*)
Pair trawl	Cuttlefish, swordtip squid, purple-spotted bigeye (*Priacanthus tayenus*), golden threadfin bream (*Nemipterus virgatus*), white croaker (*Pennahia argentata*), barracuda (Sphyranidae), lizardfish (Synodontidae), grouper (Serranidae), and snapper (Lutjanidae)
Lift net	Anchovy (Engraulidae), sardines (Clupeidae), Indian mackerel (*Rastrelliger kanagurta*), yellowtail (*Atule mate*), round scad (*Decapterus maruadsi*), bigeye scad (*Selar crumenophthalmus*), and swordtip squid
Drifting gillnet	Eastern little tuna (*Euthynnus affinis*), bonito (Scombridae), frigate mackerel (Scombridae) king mackerel (*Scomberomorus commerson*), Indo-pacific mackerel (*Scomberomorus guttatus*), barracuda (Sphyranidae) and hairtail (Trichiuridae)

Table 13. Trends in relative abundance of major species in the catch from trawl surveys by region in Vietnamese waters.

Fish species	Catch (% weight) from year to year		
Tonkin Gulf	**1975**	**1987**	**1999**
Decapterus maruadsi	11.7	7.4	4.3
D. lajang	–	1.7	–
Evynnis cardinalis	9.1	–	37.5
Priacanthus tayenus	–	7.4	3.7
P. macracanthus	3.1	5.3	5.5
Scomberomorus guttatus	–	3.3	–
S. commerson	–	8.2	–
Rastrelliger kanagurta	–	1.5	–
Saurida tumbil	2.6	0.5	5.4
Selar crumenophthalmus	–	1.1	–
Selaroides leptolepis	2.3	–	–

Table 13. Trends in relative abundance of major species in the catch from trawl surveys by region in Vietnamese waters. (continued)

Fish species	Catch (% weight) from year to year		
Tonkin Gulf	**1975**	**1987**	**1999**
Formio niger[1]	–	1.3	–
Psenes indicus[2]	–	1.9	–
Upeneus mollucensis	3.5	–	1.0
Others	67.7	60.4	42.6
Central region	**1979 - 1983**	**1987**	**1995**
Pennahia argentata	3.4	–	–
Decapterus kurroides	0.4	6.7	–
D. maruadsi	0.8	2.2	–
Therapon theraps	–	1.5	2.2
Malakichthys wakiyai	29.3	4.6	–
Taius tumifrons	–	2.1	–
Saurida tumbil	7.2	1.5	1.8
Argyrosomus argentatus	–	–	9.3
Psenes indicus	–	1.5	–
Arius spp.	–	1.6	0.2
Priacanthus macracanthus	4.4	0.8	0.1
Upeneus sulphureus	–	0.7	–
Leiognathus rivulatus	–	–	6.3
Trichiurus lepturus	22.2	–	6.1
Others	30.2	76.1	74.0
Southeast region	**1980**	**1988**	**1999**
Decapterus maruadsi	19.4	2.8	3.9
Selaroides leptolepis	5.9	1.1	1.2
Priacanthus macracanthus	4.7	–	12.0
Saurida tumbil	4.4	2.5	1.5
S. undosquamis	3.5	1.8	3.0
Lutjanus spp.	2.6	4.8	1.4
Nemipterus spp.	–	2.3	1.7
Selar crumenophthalmus	1.5	0.7	–
Caranx malabaricus	0.8	0.6	–
Trachynocephalus myops	0.7	1.9	5.1

Table 13. Trends in relative abundance of major species in the catch from trawl surveys by region in Vietnamese waters.

Fish species	Catch (% weight) from year to year		
Southeast region	**1980**	**1988**	**1999**
Pomadasys hasta	0.7	1.6	–
Arius spp.	0.8	0.9	–
Loligo spp.	–	4.0	2.9
Sepia spp.	–	2.3	5.8
Others	55.0	75.0	61.5
Southwest region	**1980**	**1988**	**1995**
Leiognathus equulus	20.7	–	0.1
L. rivulatus	1.1	–	6.3
Argyrosomus argentatus	2.0	31.3	9.3
Selaroides leptolepis	12.5	0.3	0.5
Arius thalassinus	2.2	5.7	0.2
Nemipterus spp.	3.0	2.6	–
Rastrelliger kanagurta	0.8	0.1	0.8
Therapon theraps	2.6	1.1	2.2
Saurida tumbil	0.6	0.7	1.8
Lutianus erythropterus	4.1	0.5	–
Sphyraena jello	1.7	0.3	0.3
Pomadasys hasta	0.4	0.4	0.7
Trichiurus haumela	0.1	–	6.1
Loligo sp.	–	1.8	4.0
Sepia sp.	–	0.5	2.9
Others	48.2	53.7	64.8

Source: Son 1989 and Thuoc et al. 2000.
Note: [1] Valid name in FishBase Parastromateus niger.
[2] Valid name in FishBase Ariomma indicus.

Economics of Coastal Capture Fishery

As mentioned earlier, marine capture fisheries production in Vietnam has been increasing from year to year. In the last two years, it has reached more than 1 million t·year^{-1}. Although, there are more than 2 000 fish species in Vietnamese seawaters, only about 50 species are of major economic importance to commercial fisheries. Most fish species are generally small, short-lived with maximum total body length of 780 mm and an average of 100 - 200 mm.

Currently, the relationship between demand and supply is the basic factor that determines the price of fish. Actual value varies with season, area of production, quantity of landings, strength of demand, size, freshness, etc. It is difficult to clarify the price

of fish at landing sites, because the catches are usually delivered through negotiations between fishers and middlemen, not through auction.

The price of fish at domestic markets is affected by the price at export markets. The former tends to rise at a higher rate than the latter. Normally, frozen fish is not in demand in most domestic markets, while fresh and iced fishes are accepted, together with processed foods. Recently, demand for frozen fish has risen in large cities, typically for consumption at restaurants and hotels by overseas visitors. This new type of consumption is one of the causes for the rise in prices of fish in the domestic markets.

Figure 3 presents the trend in total profits of the marine capture fisheries based on total costs and total returns data from 1981 to 1998. Profits rose steadily from 1981 to 1987, then remained relatively unchanged until 1991, and then dropped sharply over the next two years. The year 1991 seems to have signaled the start of erratically fluctuating total profits, ending the era of progressively increasing profits. In addition, the total profit levels after 1991 were lower than the total profits in previous years, except for the "initial" years of 1981 and 1982. Lower total profits were realized despite continuously increasing fishing capacity as measured by total horsepower. This suggests that total fishing capacity has exceeded the economically optimal level.

In recent years, the number of mechanized fishing boats increased considerably, from 29 117 units in 1983 to 71 799 units in 1998, giving an annual average increase of 6.2%. The average horsepower per boat also increased from 16.3 HP•boat^{-1} in 1983 to 34.3 HP•boat^{-1} in 1999. The number of fishing boats increased rapidly from 1988 to 1994. This was influenced by the changes in fishery management policies of the government. Before 1985, fisheries were managed and operated in the form of fishing cooperatives and enterprises that provided few economic incentives. One of the effects of this policy was low fisheries production. After 1985, Vietnam applied the *Doi Moi* policy, which relied on market mechanisms and encouraged private businesses. This motivated the development of fisheries, resulting in remarkable increases in fishing fleet size and catches. During the period of 1994 -

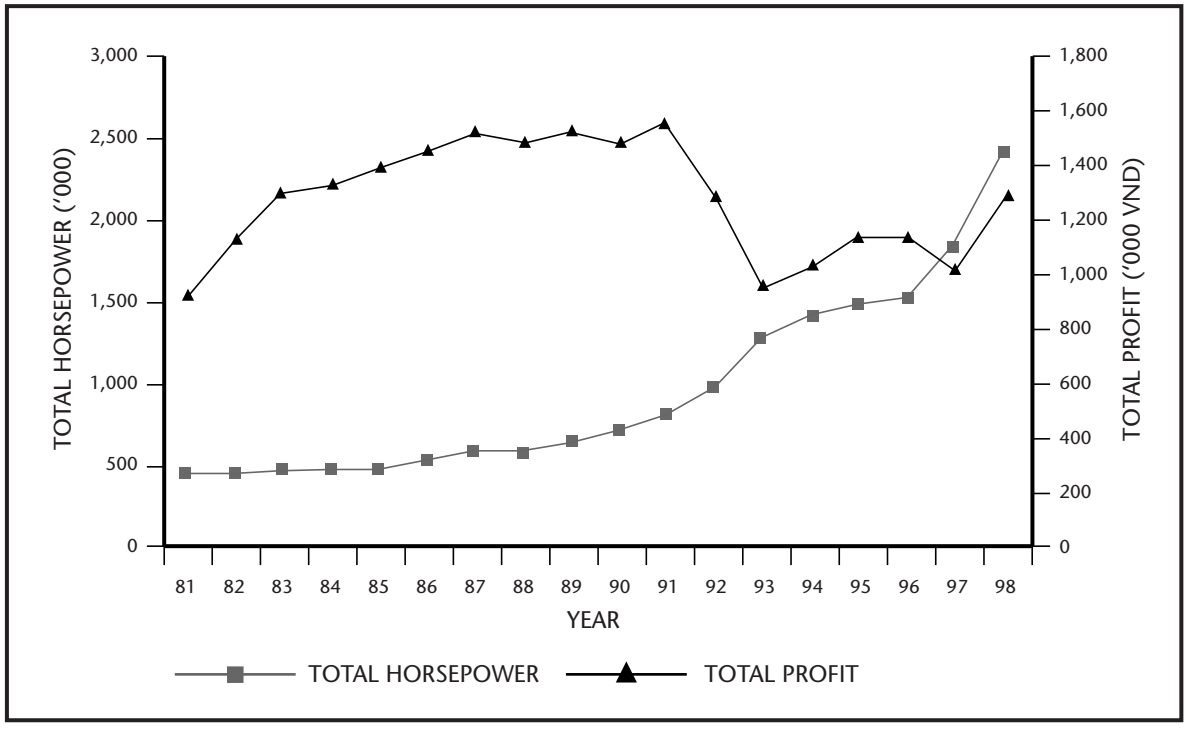

Fig. 3. Total horsepower and total profit from 1981 to 1998. Data source: Long 2000 & this vol..

98, the increase in boat number was slight while the increase in total HP was larger. This indicates that fishing boats built in this period have greater engine capacities, allowing them to operate at greater distances from the coast.

Fishing boats of less than 45 HP account for 85.5% of the total mechanized fishing boats in the country (Table 14). The percentages of boats with less than 45 HP are comparable in the northern and central regions at 93.9% and 92.4%, respectively. In the southern region, such boats comprise 70.9% of the total motorized boats, indicating a higher concentration of larger fishing boats with bigger engine capacities. This is one of the reasons for the higher fisheries production of the southern region.

Based on annual total value of fisheries (Table 15), fisheries in the southern provinces have developed more strongly than those in northern and central provinces. Fisheries export products have been growing in quantity and value. The export quantity increased from 3 441 t in 1980 to 64 366 t in 1990, while the export value increased from US$166.7 million in 1988 to US$971 million in 1999, 5.8 times as much. In 1990 - 99, the national export earning increased 474%, on average 52.6% year^{-1}.

Fisheries in Vietnam, which have been growing rapidly for many years, are becoming one of the key economic sectors of the country. The GDP of fisheries constitutes 3% of the domestic total. The average annual increase of the fisheries GDP is 40% (Nguyen Long this vol.). In 1990, the GDP of fisheries was 1 281 billion VND and in 1995, it reached 6 664 billion VND. The average GDP/fisherman is about US$160 person^{-1}·year^{-1}. When viewed against average living standards throughout the country, fishermen are still mired in poverty.

The marketing channels for fisheries products are varied. Since the introduction of market reform, entry to the marketing industry has been relatively unrestricted. This has resulted in a rapid increase in the number of middlemen servicing the sector. At present, the middlemen play an important role in supplying fish to the domestic market. Middlemen provide financing to fishers. Typically, a middleman lends money to cover the costs of fishing boats, which are normally 20 - 70 million VND·boat^{-1}. In exchange, a fisher grants the middleman exclusive right to purchase the catch. Landed fish

Table 14. Number of fishing boats by horsepower class.

Region	Number of motorized boats	Average capacity HP·boat^{-1}	> 45 HP	46 - 84 HP	85 - 150 HP	151 - 200 HP	250 - 400 HP	> 400 HP
Northern region	20 409	16.4	19 161	198	57	21	19	0
Central region	26 675	16.0	24 651	1 839	185	0	0	0
Southern region	23 971	47.7	16 988	3 922	1 459	410	928	21
TOTAL	71 055	26.8	60 800	5 959	1 701	437	947	21

Source: Long 2000.

Table 15. Total value of fisheries (billion VND) in 1986 - 95.

Year		1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Whole country		987.8	1 074.7	1 325.5	1 449.0	1 500.3	1 561.9	1 662.2	1 780.0	2 224.2	2 475.0
Key Provinces	North	90.8	84.6	82.1	79.5	91.1	114.5	132.2	422.2	154.8	180.6
	Center	198.6	202.7	207.5	213.5	214.5	147.4	161.1	168.9	220.6	284.5
	South	561.7	584.6	624.1	620.1	668.6	947.9	1 008.3	1 131.7	1 520.9	1 574.9

Source: MOFI, Bureau of Statistics.

are normally purchased by fish traders or middlemen. Fish is often sorted by species, size class and quality to satisfy specific markets. High valued products are selected for export while lower valued products are sold in large cities as fresh products or to processing plants that make products for the domestic market. Trash fish is processed into fish sauce.

Vietnam now supplies fish to 49 countries including large markets such as Japan, the European Union, America and China. Shrimp, cephalopods and fish are the major commodities for export. The export products are mainly raw and semi-processed products. High-quality products that are exported directly to supermarkets are rare.

Assessment of Exploitation Status

The standing stocks and potential yield of the marine waters of Vietnam are estimated at about 3.5 million t and 1.5 million t, respectively (Thuoc et al. 2000; Thuoc 2001). The total production of marine capture fisheries in 1999 reached more than 1.2 million t, of which more than 80% were taken from coastal fishing grounds. The annual production of the capture fisheries increased from 928 860 t in 1995 to 1 212 800 t in 1999. Fishing operations are mainly carried out in the coastal area in depths up to 50 m. The intensified fishing in the coastal areas has caused over-exploitation. Declining catch rates in recent years suggests that the inshore and coastal fishery resources may have already been fully exploited or are over-fished (Thuoc 2001). Other evidence of the current state of exploitation includes the increased amount of by-catch in trawl fisheries and the smaller sizes of the fish caught.

Recently, the government in cooperation with Japan International Cooperation Agency (JICA) conducted surveys of pelagic fishery resources in the offshore area of Central Vietnam. The results (JICA 1998) indicate that the potential yield of medium and large sized pelagic fish such as bonitos and tunas is approximately 100 000 t (Chung et al. 2001). Knowing that fish resources in offshore areas are still relatively abundant and can be further exploited, the government plans to maintain the fishery production in coastal (near shore) areas at around 700 000 $t \cdot year^{-1}$ and increase catches by shifting fishing effort to deeper waters and offshore areas.

There is a great need for improved fisheries statistical systems in Vietnam (van Zwieten et al. 2002). The effective use of the present fisheries information is currently constrained by its low categorical resolution and the non-transparent aggregation of data into mere administrative or geo-political regions.

Management Issues and Opportunities

Fisheries Management Philosophy

The Ministry of Fisheries, established in 1976 as the General Department of Fisheries, has been mandated to implement the Master Plan of Fisheries at the country level with the goal of achieving sustainable development in fisheries. In order to rationally utilize the fisheries resources for the benefit of Vietnamese people, the Government has issued many legal documents comprising law and by-law provision serving the management of Vietnam fisheries. At present, one measure for the rational utilization and sustainable development of fisheries resources in Vietnam is to limit the fishing effort in coastal areas to about 700 000 $t \cdot year^{-1}$ and increase the fishing effort in deep seas by shifting fishing boats to the offshore areas.

In 1991, the Fisheries Resources Preservation Department was founded under the Ministry of Fisheries. Together with this Department, the system of the resource protection agencies (mentioned previously) was established.

There is an aim to develop the fisheries economics in coherence with building technical infrastructure and addressing social issues of onshore rural areas. The aim is to create more jobs, increase income, raise the people's knowledge and living standards, train human resources, maintain the order of society and build prosperous fishing villages.

In order to realize the visions and aspirations for Vietnam fisheries, the strategic objectives and action plans were established in the Master Plan for Fisheries Development in the period 1996 - 2010 (see Danida 1997a and b). The six important programs and their main objectives are as follows:

1. Usage of the environment and fisheries resources:
   - All capture fisheries and aquaculture activities will be carried out in a manner that is fully consistent with the principle of sustainable

and sound use of the environment on the basis of laws to be established.
- Development, restoration and conservation capacities for the biological diversity of fisheries resources will be ensured and stimulated.

2. Rational exploitation of offshore fisheries resources:
   - The country's offshore fisheries resources will be exploited in a sustainable manner to maximize the national economic benefits, social and socioeconomic impacts.
   - Reducing gradually, the fishing in inshore areas, increasing the production of the offshore fishery, fulfilling the management measures in order to protect and restore resources.

3. Coastal aquaculture development:
   - Ensuring that the natural resource potential for aquaculture is effectively used to support economic development and growth. Vietnam has considerable potential for aquaculture activities and it is a goal of the Ministry to ensure that these activities are managed in a sustainable manner, for this and future generations.
   - Taking householders as a main force in aquaculture development.
   - Rearranging the system of seed production in the direction of new technologies and disease-free seed production, concentrating on building sea farming in large aquaculture areas.

4. Fisheries export development:
   - Industrialization and modernization of the export fisheries production sector by raising efficiency, playing a key role in changing the structure of the economic sector, boosting fisheries production to become a key sector of the economy, contributing to improved living standards of the people of coastal and rural areas, while contributing to the solving of environmental issues.

5. Coastal and island integrated development, combined with providing basic infrastructure to support fisheries:
   - It is an overriding goal of the Ministry of Fisheries to ensure that fishing communities and the fishing industry are supported by the basic physical infrastructure required to function effectively in a market oriented economic system.
   - Technology development must be an ongoing process. A suitable technological base for fisheries to be established by 2010.

6. Capacity strengthening for fisheries sector management and administration, and human resources development:
   - The Ministry of Fisheries will strengthen its institutional capability and capacity to effectively manage the environment and the living aquatic resources of the nation. This institutional goal is not limited to the Ministry of Fisheries, but includes all its specialized agencies and the fisheries administration as a whole.
   - The integrated process of strengthening the fisheries administration and reforming fisheries will be fully implemented by 2010. However, benefits and impacts will start accruing gradually and show positive impacts starting in 2000.
   - The Ministry of Fisheries will be strengthened to support the fishing industry to develop strong and enduring comparative advantages. To do this, the Ministry is determined to support the combination of using the natural resources with the application of appropriate technologies and the high skill levels of the labour force. The medium to long-term goal of the ministry is to establish a national capability to support technology enhancement and human resources development.

Fisheries Management Goals and Objectives (Strategic)

A National Consultative Workshop on "Sustainable Management of Coastal Fish Stocks in Vietnam" was convened on 28 - 30 August 2000 at the Haiphong Research Institute of Marine Products. The workshop was organized under the ADB/RETA 5766 Project - "Sustainable Management of Coastal Fish Stocks in Asia". A total of 44 participants attended, including scientists, managers and lawmakers in Vietnam. The workshop was also attended by international experts, including three from WorldFish and the adviser of the DANIDA Project "Assessment of the living marine resources in Vietnam". It is important to note that the national consultative workshop conducted in August 2000 was one of the few consultative meetings organized in Vietnam with participation of national experts coming from various disciplines and representing various agencies involved in fisheries and coastal management.

To improve the management and sustainable utilization of coastal fisheries resources and related ecological systems in Vietnam, there is a need to implement a wide range of measures within the confines of the traditional fisheries sector. Interventions also require coordination with other sectoral agencies at various levels of the institutional hierarchy.

Based on the discussion during the national workshop, a consensus was achieved and the suggested goals (see Fig. 4) for improved fisheries management are :

- optimize productivity/efficiency of the fisheries exploitation regime,
- ensure that the benefits of production are distributed equitably,
- ensure that the productivity generated, results in minimum damage to the resource base and the supporting natural environment, and
- upgrade and strengthen the institutions.

Fisheries Sector Issues/Opportunities and Key Interventions

Fig. 5 shows the logical structuring of the management objectives, issues and the suggested interventions relevant to the coastal fisheries management in Vietnam. The structure is very similar to those presented by Silvestre and Pauly (1997). It also provides a summary of the main points introduced in this report and illustrates the need for effective action on a wide front and at various levels of the institutional hierarchy.

As in other countries in Asia, the fisheries resources in the coastal areas of Vietnam in the past decade, have not only been overexploited but also threatened by the use of destructive fishing methods and habitat degradation. In the near future, these problems need to be resolved by a step-wise approach and there is a need for a comprehensive plan for fisheries management, which will address the following issues:

- Overfishing, i.e. excessive fishing effort,
- Inappropriate exploitation patterns,
- Use of destructive fishing methods,
- Post-harvest losses,
- Habitat degradation/destruction,
- Small and large scale fisheries conflicts,
- Coastal soil erosion,
- Mangrove conversion/cutting,
- Domestic/sewage pollution,
- Information and research inadequacies,
- Institutional weaknesses and constraints.

Recommendations for Continued Government Action

Fisheries management is a very complex task and needs to be sustainable in the long term. Currently, significant actions must be continued by the Vietnamese government, including:

- Limiting the number of small fishing boats and building some new offshore fishing vessels to reduce the pressure on overfishing of the coastal fishery;
- Prohibition of the use of destructive fishing methods (dynamite and poison);
- Selectivity of suitable gear and temporal restriction for closed fishing areas and seasons;
- Reduction of coastal environmental impacts through management of habitats and coastal zones;
- Establishment of fishery law.

Recommendations for Government Follow-up Action

There are a number of recommended action plans that need to be implemented in support of the efforts in coastal fisheries management in Vietnam:

- Limited entry and effort reduction, which includes:
  - Monitoring of fish stocks;
  - Development of offshore fisheries;
  - Increasing the sea farming activities;
  - Strengthening fisheries regulation enforcement capacity (control, patrols),
- Continued reduction of coastal environmental impacts, including:
  - Management of the environment, natural resources and ecosystems;
  - Integrated coastal area development;
  - Establishment and consolidation of the marine protected areas system (marine parks, marine sanctuaries);
  - Protection and rehabilitation of coral reef and mangrove systems;

- Upgrading fisheries monitoring, control and surveillance system,

- Improved marketing and post-harvest facilities, including:
  - Upgrading processing plants;
  - Upgrading infrastructure and facilities, renovating technologies.
- Enhancement of stakeholders' awareness and participation, through:
  - Improved education through television or movie documentaries;
  - Greater stakeholder participation in the decision-making process.
- Upgrading and strengthening of institutions,
- Enhancement of fisheries information and research,
- Development of the effective cooperation with other countries in the region for environment and fisheries resources preservation.

Recommendations for regional Collaborative Efforts

In order to attain sustainable development of coastal fisheries resources, it is necessary to establish links and co-operation between Vietnam and neighbouring countries (Son 1998a and b). This collaboration would benefit all countries and organizations, and will be focused on the following:

- Stock assessment methods,
- Shared stock utilization and management,
- Impact study of environmental degradation,
- Reduction of post-harvest losses,
- Sea farming and sea ranching,
- Socioeconomics and policy issues for alleviating poverty,
- Exchange of relevant information and experiences.

'First level' objective	'Second level' objectives	Illustrative 'third level' objectives
Sustainable Coastal Fisheries Development	**Productivity/efficiency**	• High fish production/revenue • High catch/effort (CPUE) • High foreign exchange earning • Supply stability • High returns on investments
	Distribitional equity	• Equal access to production factors • Reasonable artisanal catches • Reasonable fish prices • Reasonable artisanal incomes • High employment level
	Environmental integrity	• Reasonable water quality • Reduced impact on critical habitats • Reduced stress on biodiversity • Use of non-destructive gears • Marine sanctuaries
	Efficient water and land use	• Long-term water and land use rights • Integrated farming system • Watershed and urbanization management • Mangrove reforestation.
	Institutional efficiency and effectiveness	• Effective use of information • Effective and efficient institutions

Fig 4. The proposed goals and objectives of fisheries management in Vietnam, agreed on at the national consultative workshop.

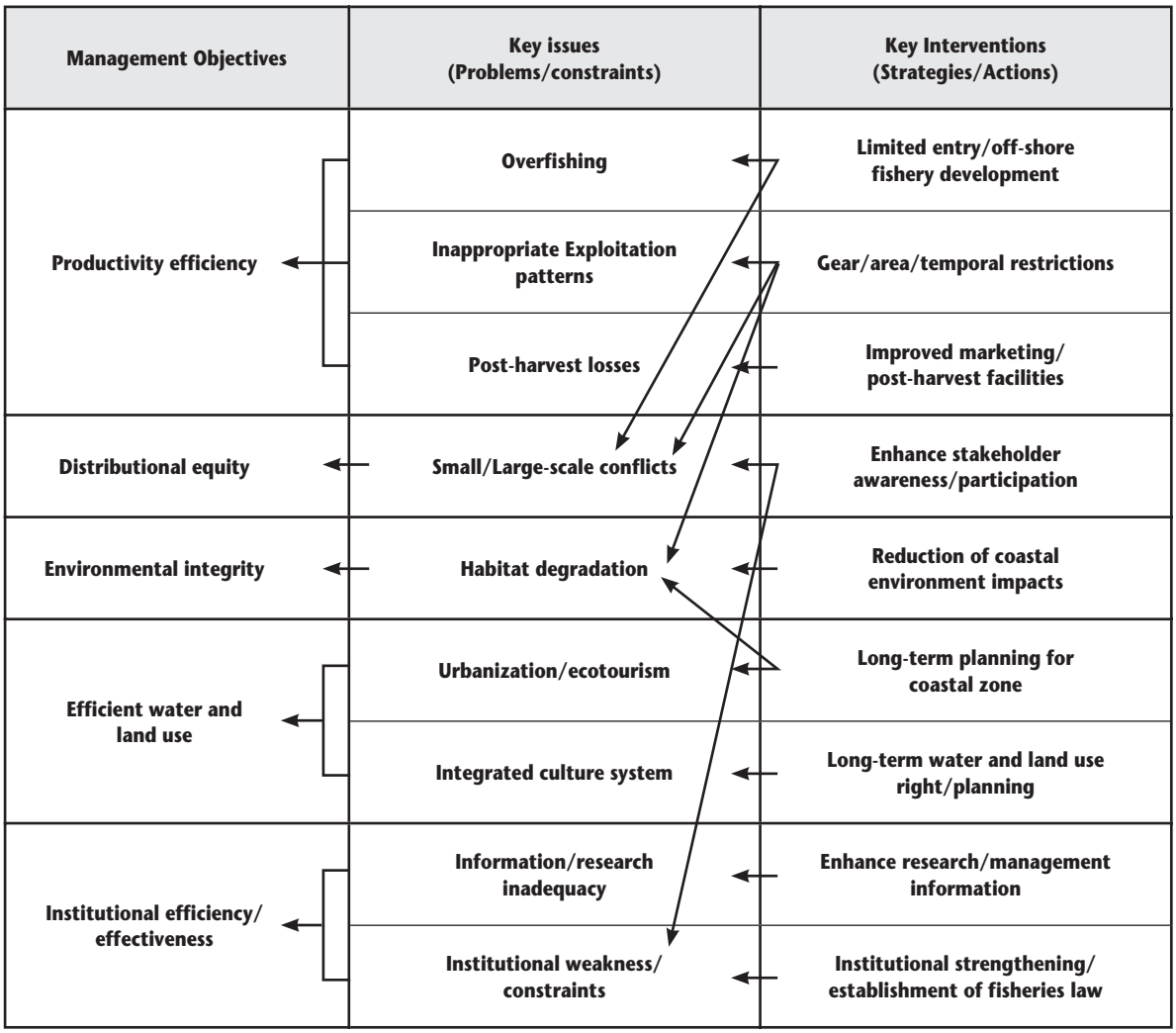

Fig 5. Fisheries management issues and key interventions.

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Annex I.

List of institutions involved in the development, management and conservation of the coastal and fisheries resources in Vietnam.

1. Ministry of Fisheries (Headquarters in Ha Noi)

At present the Ministry is responsible for:

- Capture fisheries;
- Aquaculture;
- Preservation and development of fisheries resources;
- Fishing vessel registration;
- Fisheries processing, wholesale and retail trade for domestic fish products and import/export
- Logistic services;
- International Cooperation;
- Inspection of production facilities and hygiene standards, issuing quality licenses for domestic and export products;
- Training of fisheries scientists, technicians, managers, workers, granting certificates for captains and operators of fishing vessels;
- Conducting scientific and technical research, applying new technology to fisheries production.

The Ministry has nine Departments and Inspectors Section as follows:

Department	Function and duties
Science and Technology	Aids the Minister in the fields of science, technology, and environment, building the strategies and policies for fisheries science, technology and environment development.
Planning and Investment	Aiding the Minister in the field of investment planning, capital construction and statistics.
Financial and Accounting	In charge of financial management of MoF, managing accounting activities of the Ministry's administrative department, manages state assistance to the ministry and its administrative units, financial accounting of development investment projects implemented by the ministry.
International Cooperation	Aids the Minister in international cooperation, serving as coordinator in economic and technical cooperation with foreign organizations and countries.
Personnel and Labour	Aiding the Minister in the fields of labour organisation, salary and training.
Fisheries Management	Formulates policies and sets directions for developing fisheries; renovating, building and developing non-state, cooperatives, small - scale fisheries enterprises.
Fisheries Resource Preservation	Assisting the Minister in the conservation and development of fisheries resources, fish health, fisheries safety insurance, organizing and managing the work of fisheries resources preservation and disease prevention, monitoring technical safety, registering fishing vessels and pressurized machines as regulated by the Ministry and inspecting the preservation of fisheries resources.
Legislation	Aids the Minister in the fields of legislation and law concerning the fisheries sector.
Administration	Aiding the Minister in defining and organizing the implementation of working programs, monitoring their implementation, processing information for ministry leaders, following up implementation of the Minister's decisions, carrying out administrative tasks, ensuring logistical and communications requirements of the ministry.
Inspectors Section	Aiding the Minister in inspecting and considering complaint letters, serving as the office for collecting and settling complaints, carrying out inspection in the institutions of the ministry.

2. Scientific research and training institutions

As stipulated by the Government 50-CP Decree on 21 June 1994, the state budget funded scientific research and training institutions belonging to the Ministry of Fisheries as follows:

Institution Name	Established	Main Duties
Institute of Fisheries Economics and Planning (Ha Noi)	1984	To conduct research on the economics and management of fisheries, planning and production restructuring, strategy development, regional planning for fisheries development and training staff in these functions.
Research Institute of Marine Fisheries (Hai Phong)	1961 and reorganized in 1975	- To survey and research living marine resources and study the marine environment and the relations between environment and fishery development. - To study marine bio-diversity and the establishment of marine protection areas. - To study, experiment, develop and apply new technologies for exploiting fish and other sea products, for seed production and aquaculture in brackish-water and coastal areas, and for post harvest technology. - To transfer technologies in the fields of fishing, aquaculture, fish processing to all economic partners. - To provide post-graduate and other training on fisheries science and technology. - To promote international co-operation in the fields of research, implementing research-development and technology transfer projects from international organizations. - To provide information, consultation, investigation, planning and the setting up of econo-technical studies in fisheries resources, environment, capture fisheries, aquaculture and processing. - To organize the production of new specific products in single or small quantities of high quality.
Research Institute for Aquaculture Number 1 (Ha Bac)	1983	To conduct research on the environment and freshwater fish and on genetics in aquaculture, to conduct experimental production and applied research for the areas from Thua Thien Hue to the North: • Genetic selection • Fish breeding • Applied biology • Environment and fish diseases • Information and training • Experimental fish farming • Technology transfer
Research Institute for Aquaculture Number 2 (Ho Chi Minh City)	1975 and reorganized in 1983	To conduct research on the environment and fish resources, scientific research on seed, aquaculture and to conduct experimental production and applied research for the areas in the South (including both freshwater and brackish-water culture).
Centre for Aquaculture Research Number 3 (Nha Trang)	1984	To conduct research on the environment, seed, aquaculture, to conduct experimental production and applied research for the central provinces and central highlands, including both fresh and brackish-water culture, particularly shrimp, lobster and molluscs.
Centre for Science-Technology and Economics Information (Ha Noi)		Responsible for researching and processing information for fisheries management.
Centre for Fisheries Hygiene and Quality Control		Responsible for appraising and granting quality licenses for fisheries products for domestic use and export; monitoring and certifying quality and hygiene of fisheries production nation-wide

3. Training institutions

The Ministry of Fisheries has three training institutions as follows:

Name of Institution	Duties
Technical College for Fisheries Number 1 (Hai Phong City)	Responsible for training cadres, technicians and workers in the fields of exploitation, processing, freezing engineering, hydraulic engineering, training and granting certificates for captains and vessel operators from Thua Thien Hue northwards.
Technical College for Fisheries Number 2 (Ho Chi Minh City)	Responsible for training cadres, technicians and workers in the fields of exploitation, processing, freezing engineering, hydraulic engineering, training and granting certificates for captains and vessels operators from Da Nang to south.
Technical College for Fisheries Number 4 (Ha Bac Province)	Responsible for training workers in fisheries aquaculture, cadres in finance and accounting and aquaculture. It also provides in-service university training in fisheries aquaculture and economics; Training and retraining of the administrative staff in fisheries sciences and foreign languages. Its scope of operation is from Thua Thien Hue northwards.

4. Other institutions involved in fisheries and coastal zone management

The following institutions are involved in fisheries and coastal zone management:

Name of Organisation	Responsibility and major activities
National Environment Agency, Ministry of Science, Technology & Environment (MOSTE)	Environment management: - provision of environment documentation/development of environmental management strategies, - cooperation and coordination with other institutes for study, strategies and policy for coastal management
Nha Trang, Institute of Oceanography	Marine biodiversity studies in the central and south part of Vietnam
Hai Phong, Sub-institute of Oceanography	Same as the Institute in Nha Trang, but with responsibilities for research/environmental monitoring in the northern part of Vietnam.
Centre for Meteorology and Hydrology, Ha Noi	Studies on coastal tidal regimes, and hydrology
Geography Institute, National Centre for Natural Resources and Technology, Ha Noi	Environmental studies on geography of Vietnam, including river and coastal erosion, geology and coastline topography
Environment Protection Centre (EPC), Ho Chi Minh City	Environmental studies of water quality in the river mouths and along coast
National Programme of Marine Investigation, Ha Noi	Coastal and marine studies. Survey on natural conditions of coastal areas and some islands
Institute of Water Resources Planning & Management, Ha Noi	Planning water resources and irrigation. Research on sea dyke construction and climate change
Centre for Remote Sensing, Ha Noi	Preparation of maps from remote sensing
Sub-Institute for forest Inventory and Planning, Ho Chi Minh City	Forest inventory and planning and forest management. Research on growth and area change of mangroves and melal euca.
Institute of Agricultural Inventory and Planning, Ministry of Agriculture and Rural Development, Ha Noi	Inventory and planning of agricultural land, including land use in coastal areas

Name of Organisation	Responsibility and major activities
Vietnam Marine Science Technology Association, Ha Noi	Marine study and dissemination of knowledge. Research on geology, geography, tidal regime and marine biodiversity.
Aquatic Resources University, Nha Trang	Training and graduate studies on aquatic resources, including aquaculture.
Faculty of Biology & Faculty of (Geography) College of Natural Science-Vietnam National University (VNU)	Training engineers, post graduate students in geography, geology & biology. Research on estuaries and river mouth studies and biodiversity.
Centre for Natural Resources and Environmental study (CRES)-VNU	Study & training in natural resources management, wetland and mangrove studies, coastal area study and strategies for wetland protection.
Faculty of Agriculture, Can Tho University	Aquaculture research and education
Faculty of Geology, Ha Noi Technical University of Mining and Geology	Training and research on mining exploitation and coastal geology

5. Financing institutions relevant to fisheries activities

The financing institutions relevant to fisheries activities in Vietnam are as follows:

- Ministry of Planning and Investment
- Ministry of Science, Technology and Environment
- Ministry of Finance
- Ministry of Fisheries
- National Border and continental Shelf Committee of Vietnam
- Vietnam Bank for Agriculture and Rural Development
- Rural Shareholders Bank
- People's Credit Fund
- The Bank for the Poor
- Provincial People's Committees
- Provincial Fisheries Departments

The above mentioned institutions are permitted to fund the budgets for fisheries activities depending on the program, project or special tasks approved by central or local government.

6. Research and training facilities/opportunities

The research activities of the Ministry of Fisheries are undertaken through the Research Institute and its various sub-centres and research stations located throughout the country, see below:

Name of Institutes	Location	Main Responsibility
Research Institute of Marine Products (RIMP)	Hai Phong City	Activities, both in research and training related to fisheries.
Research Institute for Aquaculture No. 1 (RIA 1)	Bac Ninh Province	- ditto -
Research Institute for Aquaculture No. 2 (RIA 2)	Ho Chi Minh City	- ditto -
Centre for Aquaculture Research No. 3 (CAR 3)	Nha Trang City	- ditto -
Institute of Fisheries Economics and Planning (IFEP)	Ha Noi Capital	- ditto -
Faculty of Biology of the Ha Noi National University	Ha Noi Capital	Actively involved in research and training related to the fisheries sector
University of Fisheries	Nha Trang	- ditto -
University of Agriculture and Fisheries of HCM City	Ho Chi Minh City	- ditto -
University of Can Tho	Can Tho	Actively involved in research and training related to the fisheries sector
Fisheries Technical College No. 1	Hai Phong City	- ditto -
Fisheries Technical and Professional College No.2	Ho Chi Minh City	- ditto -
Vocational Secondary School of Fisheries	Bac Ninh Province	- ditto -
Institute of Oceanography	Nha Trang	- ditto -
Sub-Institute of Oceanography	Hai Phong City	- ditto -
Institute of Ecology of Biological Resources	Ha Noi	- ditto -
Sub-Institute of Ecology of Biological Resources of Ho Chi Minh City	Ho Chi Minh City	- ditto -