A Preliminary Analysis on the Socioeconomic Situation of Coastal Fishing Communities in Vietnam

Nguyen Long
Research Institute of Marine Fisheries
170 Lelai Street, 3500 Haiphong
Vietnam

Long, N. 2003. A preliminary analysis on the socioeconomic situation of coastal fishing communities in Vietnam, p. 657 - 688. *In* G. Silvestre, L. Garces, I. Stobutzki, M. Ahmed, R.A. Valmonte-Santos, C. Luna, L. Lachica-Aliño, P. Munro, V. Christensen and D. Pauly (eds.) Assessment, Management and Future Directions for Coastal Fisheries in Asian Countries. WorldFish Center Conference Proceedings 67, 1 120 p.

Abstract

Fish production in Vietnam increased rapidly from 420 000 t in 1981 to 1 130 680 t in 1998. Likewise, there was an expansion in the number of motorized fishing boats from 29 584 units with an average horsepower (HP) of 19.8 boat^{-1} in 1981 to 71 800 units with an average HP of 26.2 in 1998. In 1995, fish production was valued at VN$2 475 billion (US$0.02 billion at 1 US$ = 11 041 VN$; source: oanda.com). However 93% of the total fishing boats in Vietnam have engine capacity of less than 84 HP, thus fishing operations are still small scale and fishing grounds are limited to the coastal waters. The infrastructure facilities for fishing operations and post-harvest are still minimal.

Fisheries contribute 3% of the gross domestic product (GDP) in Vietnam. In 1990, the GDP of fisheries was VN$1 281 billion and reached VN$6 664 billion (US$0.60 billion) in 1995. Fisheries labor in Vietnam includes labor for aquaculture, processing, fishery services and fishing. Fisheries labor increased from 1 860 000 persons to 3 030 000 giving a relative increase of 63% from 1990 to 1995. The average level of fish consumption in Vietnam is estimated at 13.5 kg•capita^{-1}.

In 1980, there were 28 021 motorized fishing boats that steadily increased to 71 800 in 1998. Likewise, the average engine capacity per boat increased from 19.8 HP in 1980 to 26.2 HP in 1998. The types of fishing gear that provide substantive catch in Vietnam are the trawl, purse seine, gillnet, long line, hand line, lift net and stick-held falling net. The fishing grounds in Vietnam can be classified into: (a) North: trawl, gillnet, lift net, purse seine, hook and line fishery; (b) Central: purse seine, lift net, gillnet, trawl fishery; and (c) South: trawl, purse seine, gillnet and line fishery. In terms of fish catch and net profit contribution the most important are the trawl and purse seine fisheries. Fish production in the Southern provinces is more developed compared to the northern and central provinces.

Most of the commercial scale fishing vessels bring trash fish or by-catch to the shore for fish sauce or fish powder processing. Only trawlers that fish offshore and thus stay at sea for several days discard the trash fish.

An attempt to estimate the maximum sustainable yield (MSY) of the coastal fishery resources in Vietnam was made. Using the Schaefer and Fox Models, it was found that MSY is equal to 976 378 t and 1 006 850 t respectively, as against the annual catch of 1 130 660 t, implying biological over-fishing. Thus, the total fish catch in the traditional fishing areas of Vietnam is beyond the sustainable limit of 582 000 t. The Government of Vietnam has therefore developed policies and plans to reduce the fishing pressure on the coastal waters and pursue development of offshore fisheries.

Socioeconomic Profile

Review of the Status of Fishery Resources

In general, small scale fisheries predominate in Vietnam. Fishing boats less than 84 HP constitute 93.6% of the total fishing boats. Almost all fisheries activities have been conducted in coastal waters. In recent years, the number of fishing boats and the total horsepower used have continuously increased. In 1987 - 97, the total horsepower increased from 597 022 HP to 1 880 000 HP (an increase of 3.15 times) while the total catch increased from 624 445 t to 1 130 660 t (only 1.81 times as much). However, in 1997 the total catch declined to 0.6 t•HP^{-1} compared to 1.04 t•HP^{-1} in 1987.

The over exploitation in coastal areas has become very apparent. The Government of Vietnam has been attempting to reduce the fishing effort in coastal areas and promoting a development program for offshore fisheries.

Together with the development of fisheries, the infrastructure, fishing techniques and catches have increased as shown in Table 1.

Table 1. Comparison of Vietnamese fisheries in 1980 and 1998.

Criteria	1980	1998
Number of mechanized fishing boats	28 021	71 800
Total Horsepower (HP)	553 995	1 880 000
Average HP•boat^{-1}	16.3	26.2
Catch per year (t)	419 740*	1 130 660

Source: MOFI-Vietnam 1995 - 98.
Note: * catch in 1981.

Because 93.6% of fishing boats in the region are less than 84 HP, fishing grounds are mainly in near-shore waters (< 50 m). Thus, the majority of catches (estimated at 80%) come from coastal fishing grounds. Based on results of the Research Institute of Marine Fisheries (RIMF) by Bui Dinh Chung et al. (1999), the total allowable catch in the coastal waters for depths of less than 50 m is 582 200 t. The catches in coastal seawaters have been over this limit since 1992. During that period, the increasing number of fishing boats contributed to a decrease in mean catch•HP^{-1} from 1.14 t•HP^{-1}•year^{-1} in 1984 to 0.6 t•HP^{-1}•year^{-1} in 1998. As the mean catch per boat unit decreased, fishers tried to raise the fishing effort by:

- increasing the number of hauls per fishing day or number of fishing days per year
- reducing the mesh size, thereby contributing to an increase in the ratio of juvenile caught
- applying various fishing techniques, such as using high-powered light, different kinds of fishing gear or other means with negative impacts on the environment.

Given the above fishing practices, the Ministry of Fisheries is seeking ways to reduce the fishing pressure in near shore waters.

Status of Fisheries in Vietnam

Fisheries in Vietnam are small scale, multi species, multi-gear and utilize traditional fishing techniques. Fishers have limited ability for capital investment.

The Fishing Fleet Structure and Fishing Area

The number of fishing boats increased considerably from 28 021 mechanized boats in 1980, to 71 800 boats in 1998. For the whole period, the average annual percentage growth in the number of fishing boats was 5.3%. The mean HP•boat^{-1} of 16.3 in 1983 increased to 26.2 in 1998.

The size and the number of fishing boats differ from region to region. In 1997, there were 20 409 fishing boats having an average of 16.4 HP•boat^{-1} in Northern Vietnam, 26 676 fishing boats and

16 HP•boat^{-1} in Central Vietnam, and 23 971 boats and 47.7 HP•boat^{-1} in the South. Those provinces where fisheries have developed strongly with many big fishing boats are Ba Ria-Vung Tau, Ca Mau and Kien Giang.

Catches of Marine Fisheries

The growth in catch rates of marine fisheries from 1981 to 1998 is provided in Table 2. The total fish catch increased from 419 749 t in 1981 to 1 130 660 t in 1998. However, when total HP is taken into account, before 1994 the total fish catch increased rapidly after which it became stationary. The total HP in 1998 had increased 4.14 times as much as that in 1981 while the total catch had increased only 2.7 times.

Fishing effort in coastal waters is still expanding since fishers in the coastal provinces are dependent on the near shore waters for livelihood. To address the issue, the Ministry of Fisheries has attempted the following approaches:

1. Provided funds to fishers as credit for invested capital to encourage them to shift fishing from near shore to offshore fisheries. This allowed the fishers to raise a bank loan at low interest rates of 0.61% to 0.81%.

2. Implemented programs of coastal aquaculture to provide alternative work.

3. Limited the number of small fishing boats active in coastal waters.

Table 2. The growth in total fish catch of marine fisheries in Vietnam from 1981 to 1998.

Year	Total catch of whole country (t)
1981	419 740
1982	476 597
1983	519 384
1984	530 650
1985	550 000
1986	582 077
1987	624 445
1988	622 364
1989	651 525
1990	672 130
1991	730 420
1992	737 150
1993	793 324
1994	878 474
1995	928 860
1996	962 500
1997	1 078 000
1998	1 130 660

Source: MOFI-Vietnam 1995 - 98.

Contribution of the Fisheries Sector to Economic Growth and Welfare

The Contribution of Fisheries to the National Economy

The annual total fish production (Table 3), in the Southern provinces is higher than that in the northern and central provinces. The average annual level of fish consumption in Vietnam is currently estimated at 13.5 kg•capita^{-1}.

Fisheries in Vietnam have rapidly grown to become one of the key economic sectors of the country. The fisheries sector contributes 3% of the total GDP. The average annual increase in GDP (gross domestic product) for the fisheries sector is 40%. In 1990, the GDP of the fisheries sector was 1 281 billion VN$ and in 1995 reached 6 664 billion VN$ (US$0.60 billion). The average indicator of GDP per fisher is about 160 US$•person^{-1}•year^{-1}, which is far below the average per capita standard of living throughout the country. Thus, fishers remain below the poverty line.

Contribution of the Fishing Industry to Income and Employment

From 1990 to 1995, fisheries labor (in aquaculture, processing, fishery services and fishing) increased from 1 860 000 to 3 030 000 persons giving a relative increase of 62.9%. The labor consisting of fishers only increased from 270 587 persons in 1990 to 420 000 persons in 1995, contributing

Table 3. Total value (billion VN$) of fish production from Vietnam 1986 - 95.

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

Source: Bureau of Statistics 1996.
Conversion: 1 US$ = 11 041 VN$ (in 1995); source: oanda.com

55.2% to the total increase in employment. On average, fishing labor increased by 29 882 persons•year^{-1} during this period.

In 1995, 420 000 employees worked for marine capture fisheries, of which 86% was male and 14% was female. Among these, 91% were employed by privately-owned businesses, 8.6% joined fishing cooperatives and 0.43% worked for state-owned enterprises. Of the 14% female employees, most are middle-persons or engaged in small fish processing businesses, sewing or making fishing nets. Of the total of 420 000 in 1995, 73% were involved in smallscale fisheries and 27% were engaged in offshore and commercial scale fisheries (Table 4).

Institutional Factors in the Fishery Sector

Four types of fishing enterprises exist in Vietnam's fisheries sector. These are state-owned fishing enterprises, fishing cooperatives, fishing groups and private businesses. The state-owned fishing enterprises are characterized by steel-hulled boats equipped with engines of more than 135 HP. In recent years, due to a reduction of the resource and management inflexibility, these enterprises have received very low economic returns, and the number of boats has declined.

Table 4. Number of persons involved in fisheries labor in Vietnam, 1990 - 95.

Year	Number of persons ('000)	
	Various fisheries activities	Fishers
1990	1 860	27 058
1991	2 100	27 508
1992	2 350	33 892
1993	2 570	36 348
1994	2 810	38 953
1995	3 030	42 000
Relative increase (times) 1995 - 90	1.629	1.552

Source: MOFI-Vietnam 1995 - 98.

After 1985, most of the fishing cooperatives withdrew because of poor economic returns (Table 5). In 1997 new cooperatives were established, with the purpose of raising bank loans. Earnings are distributed according to a share system in which the proceeds of sales, after deducting operational expenses, are divided between a ship owner (65%) and crew members (35%).

Table 5. Changes in number of fishing cooperatives and fishing groups in Vietnam from 1985 - 97.

Year	Number of fishing cooperatives	Number of fishing groups
1985	673	2 205
1990	398	2 884
1995	95	3 773
1996	94	3 886
1997	184	5 542

Source: MOFI-Vietnam 1995 - 98.

Fishers form groups to share investment costs. Private businesses in marine fishing can be classified according to: (a) households owning fishing boats and employing less than 5 persons; (b) skippers owning one or two fishing boats and employing more than 5 staff and (c) private capital owning more than two fishing boats with > 250 HP capacity. From 1985 to 1996, these three groups increased rapidly in number, but in 1997 the increase was not substantive (Table 6). This shows inter-generational change in the number of fishing households and boat owners. With the exception of boat owners with more than 250 HP, the numbers of skippers owning other categories of boats increased more than three times between 1985 and 1997. The highest growth rate was recorded for owners of boats of more than 90 HP. The private sector in Vietnam rapidly expanded as evidenced by a 2.45-fold increase in the number of boats with HP greater than 250.

In general, the educational level of fishers is low, with 68% not having finished primary school, about 20% having finished primary school, nearly 10% attaining secondary school level, and 0.65% reaching high school or college graduation.

Fisheries Management

The development of fisheries from 1980-1995 was very intense. The total fish catch grew from 419 740 t in 1981 to 672 130 t in 1990 and to 928 860 t in 1995. Concurrent with the expansion of total fish production, the number of fishing boats also increased from 29 594 units in 1984 to 68 000 units in 1995. However, this increase was in small and medium sized boats, suitable for coastal fishing grounds and the skills of the fishers.

In 1995 - 98, the sector was at a standstill. Although fish production increased the economic situation declined due to excessive growth of the fishing fleets in coastal waters. The productivity dropped from 1 $t \cdot HP^{-1} \cdot year^{-1}$ in 1987 to 0.6 - 0.65 $t \cdot HP^{-1} \cdot year^{-1}$ in 1995 - 98. Most of the fishing was in coastal waters with the total number of boats reaching 71 800 mechanized boats with a total of 1 880 000 HP, and 28 700 non-mechanized boats in 1998. The total fish catch in 1998 was 1 130 660 t but the fishing productivity was only 0.6 $t \cdot HP^{-1} \cdot year^{-1}$.

To improve the situation, the Ministry of Fisheries of Vietnam has developed policies and plans for the fisheries sector. These are:

1. Reduce the fishing pressure in coastal waters through:
   a. reduction in the use of fishing boats with engines of < 15 HP;
   b. spatial and temporal closure of fishing activities;
   c. limits on the number of small fishing boats;
   d. specifying the total allowable number of fishing boats by gear and by fishing grounds or sea area;
   e. promoting programs for aquaculture in the coastal waters as alternatives to small scale fishing.
2. Develop offshore fisheries as enumerated below:
   a. Running credit funds programs to support fishers in offshore waters where the resources are under-exploited. From 1997 to 1999, the Government of Vietnam provided a credit fund of 1 300 billion VN$ (US$92.8 million) at a low interest rate of 0.81% for new fishing boats and gear for offshore fishing. Other policies such as tax reduction, price supporting and low bank interest rates were developed to encourage offshore fishing.
   b. Investing and developing service systems through the following:
      - Establishment of fishing port systems and landing sites, such as construction of "Fisheries Services-Processing-Trading Centers".

Table 6. Change in marine fishing private enterprises in Vietnam from 1985 - 97.

Type	1985	1990	1995	1996	1997
1. Household	10 180	20 595	25 337	26 920	27 426
2. Skippers:	1 325	2 004	3 143	3 730	4 105
- Own 2 small boats with 2 employees	967	1 556	2 284	2 706	2 951
- Own 2 boats > 90HP	173	244	474	674	718
- Own 1 boat > 250HP	185	204	385	530	436
3. Private capital					
- Own 2 boats > 250 HP	115	130	160	302	282

Source: Institute of Fishery Economic and Planning (IFEP) - DANID 1998.

- Aside from the existing 20 fishing ports operating in the provinces with quay length of 15 - 270 m, the Government has also funded another 16 fishing ports in the islands.

- Establishment and management of fish markets in fishing ports and landing places to promote export products. Development of more processing plants.

- Strengthening the building capacity of ship yards to provide good quality fishing boats for offshore fisheries; reducing the use of wood as material for boats; encouraging the use of steel and composite as material for boat hulls.

- Providing grants for research programs in marine resources and offshore fisheries development.

- Strengthening resource management and conservation by regulating fishing gear structure and controlling fishing fleets in near-shore and offshore waters.

- Supporting human capacity development to provide qualified and skillful captains, chief engineers, crews and scientists.

- Promoting the development of the economic components of the fisheries sector.

State-owned business enterprises for marine fishing and fisheries services should be developed to serve as bases for fishers involved in offshore fisheries. Cooperatives for offshore fisheries, shipyards, processing units and fisheries services should be encouraged. The Government should offer incentives to encourage fishers to invest in offshore fisheries. New processing units should be built, and alternative jobs for fishers should be provided in the fishing communities.

Fleet Operational Dynamics of Vietnamese Fisheries

The State of the Fishing Fleet

From 1983 to 1998, the number of fishing boats increased considerably from 29 117 mechanized boats to 71 800 boats, an annual average increase of 6.2%. The mechanization level rose as well, with an average horsepower per boat of 16.3 HP in 1983 expanding to 26.2 HP in 1998.

Figure 1 shows the rapid increase in the number of fishing boats from 1980 to 1994. This expansion was influenced by changes in government fishery management policies. Before 1985, when fisheries were managed and operated in the form of cooperatives, there were no proper fisheries techniques for the fishers, resulting in low marine capture fisheries production. After 1985, when Vietnam applied a new policy ("*Doi moi*" Policy), privately owned business and market mechanisms were accepted. Development of the fisheries sector was improved with a remarkable increase in number and size of boats, catch and productivity. During 1994 - 98, the increase in the number of boats was low in spite of the increase in the total horsepower. Fishing boats built in this period were high-powered engine boats which allowed for offshore fisheries.

Table 7. The total number of fishing boats and engine capacities in Vietnam, 1980 - 98.

Year	Total number of motorized fishing boats (unit)	Total engine capacities (HP)	Average horsepower per boat (HP·boat^{-1})
1980	28 021	553 915	19.8
1981	29 584	453 871	15.3
1982	29 429	469 976	15.9
1983	29 117	475 832	16.3
1984	29 549	484 114	16.4
1985	29 323	494 507	16.9
1986	31 680	537 503	17.0
1987	35 406	597 022	16.9
1988	35 744	609 317	17.0
1989	37 035	660 021	17.8
1990	41 266	727 585	17.6
1991	43 940	824 438	18.1
1992	54 612	986 420	18.1
1993	61 805	1 291 550	20.9
1994	67 254	1 443 950	21.5
1995	68 000	1 500 000	22.1
1996	69 953	1 543 163	22.1
1997	71 500	1 850 000	25.9
1998	71 800	1 880 000	26.2

Source: MOFI-Vietnam 1995 - 98.

The number of fishing boats by HP classification presented in Table 8, shows that the number of fishing boats of less than 45 HP comprises 85.5% of the total Vietnamese mechanized fishing fleet. The Southern provinces have more high-powered fishing vessels than the north and central provinces.

Fisheries Structure and Gear Types

Fishing operations in Vietnam are conducted using different types of fishing gear. High catch rates are mainly recorded using trawl, purse seine, gill-net, long-line, hand-line, lift net, and stick-held falling net. Fishing grounds in Vietnam can be classified into the following types: (a) North: - trawl, gillnet, lift net, purse seine, hook-and-line fishery, (b) Central: - purse seine, lift net, gillnet, trawl fishery and (c) South: - trawl, purse seine, gillnet and line fishery, see Table 9.

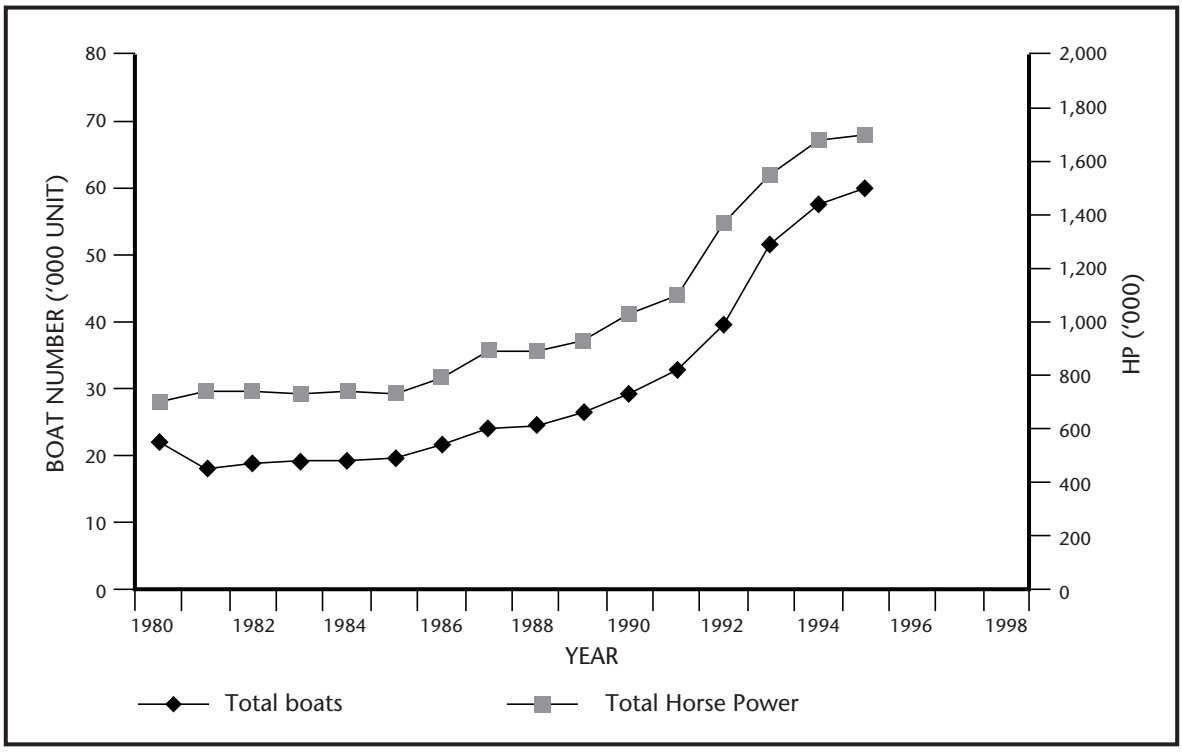

Fig. 1. Increase in the number of fishing boats during 1980 - 98.

Table 8. Number of fishing boats by horsepower capacity in Vietnam, October 1997.

	Number of fishing boats by horsepower capacity			
	North	**Central**	**South**	**Total**
Total motorized fishing boats	20 409	26 675	23 971	71 055
Average capacity (HP·boat^{-1})	16.4	16.0	47.7	26.8
< 45HP	19 161	24 651	16 988	60 800
46 - 84HP	198	1 839	3 922	5 959
85 - 150HP	57	185	1 459	1 701
151 - 200HP	21	0	416	437
250 - 400HP	19	0	928	947
> 400HP	0	0	21	21

Source: MOFI-Vietnam 1995 - 98.

Table 9. Total fish catch by type of fishing gear from the 14 provinces of Vietnam 1997.

Fishing ground	Fish catch (t) by fishing gear							
	Total catch	Trawl	Purse seine	Gillnet	Hook-and-line	Lift net	Fixed net	Others
North region (6 provinces)	73 703 100%	27 182 36.9%	4 880 6.6%	18 728 25.4%	4 773 6.5%	14 110 19.1%	1 240 1.7%	2 391 3.2%
Central region (4 provinces)	173 218 100%	31 078 17.9%	41 614 24%	34 674 20%	23 793 13.7%	36 534 21.7%	841 0.5%	4 504 2.6%
South region (4 provinces)	283 415 100%	169 958 60%	62 593 22%	18 729 6.6%	16 452 5.8%	– –	13 371 4.7%	2 322 0.8%
TOTAL (14 provinces)	530 336 100%	228 218 43%	109 087 20.6%	72 131 13.6%	45 028 8.5%	50 644 9.5%	15 452 2.9%	9 217 1.7%

Source: MOFI-Vietnam 1995 - 98.

Cost, Earnings and Profitability

The Development of the Trawl Fishery

The trawl fishery in Vietnam contributes 43% of the total marine capture production. Use of this fishing gear evolved in the different regions at various periods.

In the northern region, the trawl fishery was developed in state-owned fishing enterprises before 1985. At that time, almost all of the fishing boats used engines of more than 200 HP while the fishing pattern was single boat fishing (single trawl fishery). However, due to low economic returns, this gradually went into closure. Private businesses operating trawl fisheries mainly use small fishing boats of 15 to 84 HP constituting 99.3% of the total trawlers in the region. These fleets are used for shrimp trawling and operate in waters within 30 m depth.

In the central region, the trawl fishery is limited, due to the continental shelf sloping near to shore. Boats commonly employ an engine of 15 - 84 HP, constituting 98.4% of the total trawlers in the region.

In the Southern region, the wide and even continental shelf and abundant resources allow efficient trawl fishing, leading to a total of 7 798 trawlers. Of these, 23.5% or 1 838 trawlers utilize 90 - 750 HP engines. The capture fish production of trawlers in the region is 6.25 times as much as that of the north region and 5.47 times as much as that of the central region. The southern trawl fishery uses single trawl and pair trawl fishing methods.

Number and Size of Trawlers

According to the survey conducted in 1997 in 20 key provinces of Vietnam, the number of recorded trawlers was 18 240. Of these, 4 974 were from the north, 5 648 from the central region and 7 798 were found in the southern region. There were 4 941 small scale trawlers fishing in near shore waters in the Gulf of Tonkin, constituting 99.34% of the total trawlers in the region (Table 10). Fishing boats are small, almost all using engines of 15 - 30 HP, and with lengths of 9 - 13 m. Due to their small size, these trawlers mainly fish in coastal areas conducting one or two day fishing trips.

From the central region, 5 557 trawlers fished in the near-shore waters, i.e. around 98.44% of the total trawlers in the region. The fishing boats are bigger than those in the Gulf of Tonkin and have engines of 22 - 45 HP. The length of the boats ranges from 12 - 15 m, and one fishing trip takes about three to seven days.

There were 5 960 trawlers fishing in the near shore waters of the Southern region making up 76.4% of the total trawlers of the region. The fishing boats in this region were larger than those of the other areas, however there were only 1 838 trawlers with 90 - 750 HP capacity. The length of the boats ranges from 14 to 22 m. These boats can endure strong winds and one fishing trip can last from 15 - 25 days.

Table 10. The number of trawlers by horsepower class from 20 coastal provinces of Vietnam in 1997.

Fishing ground	Non-powered boat	< 23 HP	25-45 HP	54-84 HP	90 - 150 HP	155 - 225 HP	250 - 400 HP	440 - 750 HP	Total
North region	290 5.8%	3 351 67.4%	1 052 21.1%	248 5%	15 0.3%	8 0.16%	10 0.2%	– –	4 974 100%
Central region	– –	1 591 28.2%	3 540 62.7%	426 7.5%	89 1.6%	– –	2 0.03%	– –	5 648 100%
South region	– –	961 12.3%	2 589 33.2%	2 410 30.9%	877 11.2%	212 2.7%	732 9.4%	17 0.2%	7 798 100%
TOTAL	290 1.6%	5 903 32.2%	7 181 39.4%	3 084 16.9%	981 5.4%	220 1.2%	744 4.1%	17 0.1%	18 240 100%

Source: MOFI-Vietnam 1995 - 98.

Table 11. The cost of a wooden hull in the provinces of Vietnam 1997.

Province	Length of boat Lmax (m)	Length x Width x Height (m^3)	Cost price of hull (mil. VN$)
Da Nang	16.00 17.30 18.00 18.80	128.0 117.9 198.7 163.4	230 185 212 257
Khanh Hoa	15.20 16.20	88.9 137.2	150 152
Vung Tau	18.30 19.20 20.00	266.8 368.6 301.7	472 475 560
Kien Giang	13.45 15.00 17.40 18.00 18.94 19.91	70.3 102.0 187.6 183.4 247.0 260.7	225 270 350 460 620 640

Source: Research Institute of Marine Fisheries (RIMF) - DANIDA 1998.
Conversion: 1 US$ = VN$ 13 861 11 705 in 1997; source: oanda.com

Investment Capital for Trawlers

Cost of Hull

The cost of the hull depends on the size, the style, the technical specifications of the boat, and the quality of wood. Shortage of wood has pushed the price up (Table 11).

The cost of the hull in Da Nang and Khanh Hoa (Central provinces) is often 44 - 47% lower than in Vung Tau and Kien Giang (Southern provinces), mainly due to the architectural structure which is less robust; thinner wood is used, and the boat is not strong enough to sail during bad weather.

Cost of Engine

An investigation of 81 single trawlers and 268 pair trawlers showed that fishers are using diverse kinds of engines, made in the USA, Japan, Germany and Russia. There are three main kinds of engine used, brand new engines, second hand engines and high-power truck engines. The cost of a second hand engine is 40% of a brand new one for the same power. Thus, second hand engines are commonly used for fishing boats. Fishers also use second hand truck engines with a restructured gearbox. The cost price of a truck engine is 16.9% that of a brand new boat engine and 42% that of a second hand.

Cost of Fishing Gear

The fishing gear depends on the size of the engine used. For a single trawl vessel the trawl can have a length of head-rope from 12 - 42 m depending on the size of the engine. The price for a complete set of gear was 10 - 70 million VN$ (US$854 - 5 980) in 1997. For pair trawling the trawls used often have a length of head-rope from 12 - 52 m with a cost price of 7-65 million VN$ (US$598 - 5 553) for a complete set of gear.

Total Investment Capital of a Trawler

Table 12 presents the level of investment capital for single trawlers by engine power and by province.

Table 12. The level of investment capital for a single trawler in Vietnam 1997.

Province	Number of boat owners interviewed	Horsepower class (HP)	Total investment capital (x1000VN$)	Number of crew members
Minh Hai	10	91 - 135	154 216	5 - 6
	1	136 - 200	68 115	10
	5	201 - 300	238 552	6 - 8
	3	301 - 450	335 917	8 - 10
Kien Giang	1	61 - 90	296 650	8
	2	91 - 135	254 485	8 - 9
	7	201 - 300	468 970	10 - 15
	32	301 - 450	601 954	12 - 16
	1	> 450	1 206 010	16
Vung Tau	7	301 - 450	582 775	11 - 12
	3	> 450	720 925	12 - 13
Nam §inh	1	201 - 300	370 000	9
	2	> 450	812 500	10

Source: Research Institute of Marine Fisheries (RIMF) - DANIDA 1998.
Conversion: 1 US$ = 11 705 VN$ in 1997; source: oanda.com

Table 13. The level of investment capital for pair trawl fishing (2 boats) in Vietnam 1997.

Province	Number of pair trawler owners interviewed	Horsepower class (HP)	Total investment capital (x 1000VN$)	Number of crew members
Kien Giang	2	36 - 45	960 770	14 - 16
	2	61 - 90	840 315	10 - 14
	2	91 - 135	767 970	16
	1	136 - 200	1 021 990	16
	20	201 - 300	943 551	14 - 20
	7	301 - 450	1 271 667	16 - 20
Vung Tau	7	61 - 90	986 148	8 - 9
	29	91 - 135	785 683	8 - 10
	4	136 - 200	1 160 686	8 - 10
	3	201 - 300	1 130 270	10 - 15
Khanh Hoa	1	26 - 35	253 510	10
	8	36 - 45	339 160	10
	8	46 - 60	375 923	10
	1	61 - 90	375 330	10
Da Nang	1	26 - 35	169 104	8
	7	36 - 45	410 926	8 - 12
	4	46 - 60	470 217	7 - 14
	4	61 - 90	640 363	7 - 10

Source: Research Institute of Marine Fisheries (RIMF) - DANIDA 1998.
Conversion: 1 US$ = 11 705 VN$ in 1997; source: oanda.com

The capital cost includes fishing boat and equipment on board, as well as a complete set of fishing gear. The level of investment capital for trawl fishing varies by province because the quality of hull, type of fishing gear etc. differs, depending on the areas fished.

Economic Significance of Trawl Fishery

To evaluate the economics of the trawl fishery, the following indexes will be used:

- Catch (t) is the total fish catch per year per one gear unit excluding the discarded species.
- Revenue (VN$) is the total amount received from selling marine capture fish per one year per one gear unit.
- Variable cost (VN$) is the total amount of expenses and costs for operating one gear unit in one year. Expenses can be fuel and oil, ice, salt, provisions, salary/wages for crew in cash, repair and maintenance of boat and fishing gear, insurance, taxes and other miscellaneous expenses.

The annual depreciation costs and the interest payments on initial investments are excluded from this list. Net profit (VN$) is the remainder of the gross revenue after subtracting variable cost.

Net profit = Total Gross Revenue - Total Variable Cost

Table 14 presents the results of the analysis for the 81 single trawlers and Table 15 for the 134 pair trawlers in Vietnam in 1997.

Purse Seine Fishery

Development of Purse Seine Fishery

The purse seine fishery is one of the most important fisheries in Vietnam, contributing 20% of the total marine capture production. In the Gulf of Tonkin, the purse seine fishery is not fully developed. Almost all the purse seiners are equipped with an engine of less than 23 HP. Their catch constitutes only 4.5% of the total production of the purse seine fleet. Because of their small size, purse seine boats operate in near-shore waters within 30 m depth. However, there are 800 purse seine boats of 45 - 60 HP from the Southern and the central provinces active in this region every year. These boats are capable of fishing offshore and are equipped with more modern fish devices than the local boats.

In the central region, the near shore waters are deep, but have abundant resources. Thus the purse

Table 14. Economic operation of single trawlers in Vietnam 1997.

Province	Number of boat owners interviewed	Horsepower class (HP)	Catch per year of single boat (t)	Revenue per year of single boat (mil VN$)	Variable cost per year of single boat (mil VN$)	Net profit per year of single boat (mil VN$)
Minh Hai	10	91 - 135	106 632	390 765	284 318	106 447
	1	136 - 200	145 566	500 000	434 620	65 380
	5	201 - 300	135 662	411 122	351 608	59 514
	3	301 - 450	118 361	671 883	456 416	215 467
Kien Giang	1	61 - 90	324 000	710 000	512 500	197 500
	2	91 - 135	129 250	525 123	442 925	82 198
	7	201 - 300	272 643	1 034 685	793 313	241 372
	32	301 - 450	347 275	1 189 261	935 324	253 937
	1	> 450	550 000	1 634 500	1 151 000	483 500
Vung Tau	7	301 - 450	617 130	1 225 729	948 210	277 519
	3	> 450	685 866	1 375 183	1 014 297	360 886
Nam §inh	1	201 - 300	–	353 711	239 806	113 905
	2	301 - 450	330 000	1 100 000	883 900	216 100
Hai Phong	1	301 - 450	466 191	1 236 800	1 161 096	75 704
	4	> 450	417 763	2 101 000	1 763 767	337 233

Source: Research Institute of Marine Fisheries (RIMF) - DANIDA 1998.
Conversion: 1 US$ = 11 705 VN$ in 1997; source: oanda.com

Table 15. Economic operation of pair trawlers in Vietnam 1997.

Province	Number of boat owners interviewed (pair)	Horsepower class (HP)	Catch per year of 2 boats (t)	Revenue per year of 2 boats (mil VN$)	Variable cost per year of 2 boats (mil VN$)	Net profit per year of 2 boats (mil VN$)
Kien Giang	2	36 - 45	301.25	1 200.00	1 039.49	160.51
	2	61 - 90	231.30	885.500	693.431	192.069
	2	91 - 135	298.80	1 243.319	1 009.293	234.026
	1	136 - 200	400.00	1 664.00	1 270.00	394.00
	20	201 - 300	367.258	1 337.704	1 078.156	259.548
	7	301 - 450	396.529	1 569.200	1 270.636	298.564
Vung Tau	7	61 - 90	196.543	1 220.714	1 027.63	193.084
	29	91 - 135	194.23	1 098.113	880.433	217.68
	4	136 - 200	179.675	1 126.013	951.066	174.947
	3	201 - 300	661.40	1 521.550	1 056.00	456.55
Khanh Hoa	1	26 - 35	47.08	384.20	219.17	93.03
	8	36 - 45	35.063	246.25	185.40	60.85
	8	46 - 60	36.586	283.463	204.569	78.894
	1	61 - 90	49.23	346.00	255.88	90.12
Da Nang	1	26 - 35	56.32	370.00	259.26	110.74
	7	36 - 45	82.716	498.243	377.344	120.899
	4	46 - 60	42.739	397.50	309.401	88.099
	4	61 - 90	63.355	516.765	388.887	127.878
Nghe An	14	16 - 25	43.922	96.912	81.268	15.644
Nam §inh	1	91 - 135	210.00	396.600	310.360	86.240
	2	201 - 300	580.00	1 836.365	1 542.500	293.865
	1	301 - 450	440.00	1 980.000	1 774.500	205.500
Hai Phong	2	201 - 300	416.25	1 540.000	1 430.212	109.788
	3	301 - 450	736.666	3 167.949	2 354.960	812.989

Source: Research Institute of Marine Fisheries (RIMF)-DANIDA 1998.
Conversion: 1 US$ = 11 705 VN$ in 1997; source: oanda.com

Table 16. The number of purse seiners by horsepower class in 18 coastal provinces of Vietnam 1997 .

Fishing area	Non-powered boats	< 23 HP	25 - 45 HP	54 - 84 HP	90 - 150 HP	155 - 255 HP	250 - 450 HP	Total
North region	–	981 97.8%	9 0.9%	7 0.7%	6 0.6%	0	0	1 003 100%
Central region	142 5.4%	780 29.6%	1325 50.4%	372 14.1%	15 0.6%	0	0	2 634 100%
South region	–	213 13.8%	501 32%	404 26.3%	153 9.9%	146 9.5%	120 7.8%	1 537 100%
TOTAL of 18 provinces	142 2.7%	1974 38.2%	1835 35.5%	783 15.1%	174 3.4%	146 2.8%	120 2.3%	5 147 100%

Source: MOFI-Vietnam 1995 - 98.

seine fishery is more developed in this region. The number of purse seine boats of 25 - 45 HP constitutes 50.4% of the total fishing fleet of the region. The purse seine fleet in this area contributes 38.1% of the total production of purse seiners in the country. Purse seine boats are active in different fishing grounds around the region, and every year they fish in the Gulf of Tonkin and Southeast waters of Vietnam.

In the Southeast, the purse seine fishery is strongly developed. Fishing boats are equipped with engines of 15 - 400 HP. Of the total purse seine boats in the region, most have 25 - 45 HP engines, and many purse seine boats run big engines of 90 - 400 HP. The purse seine catch of the region constitutes 54.4% of total marine production of purse seiners in Vietnam.

Number and Size of Purse Seine Boats

Although the purse seine fishery constitutes 20.6% of total marine production of the whole country, the number of purse seine boats constitutes only 7.6% of the total number of fishing boats (Table 16). In 20 key provinces in 1997, the number of purse seine boats by region recorded is as follows.

In the Gulf of Tonkin, there were 1 003 purse seine boats, making 19.4% of the total number in the country. However, the common size purse seiner in this region was very small, with 97.8% of the boats less than 23 HP.

In the central region, there were 2 634 purse seine boats constituting 50.9% of the total number of purse seiners. Of this, 1 325 (50.4%) were purse seine boats of 25 - 45 HP, 780 (29.6%) were purse seine boats of less than 23 HP and 372 (14.1%) were purse seine boats of 54 - 84 HP.

For the Southeast, 1 537 boats made up 29.7% of the total number of purse seiners. Although the number of purse seiners was less than that in the central provinces, the catch was 1.5 times higher. This is because there were 419 big purse seiners (90 - 400 HP) in the southeast region, compared to only 15 in the central provinces.

Purse seine boats in Vietnam commonly have a length of 12.7 - 19.5 m with an engine size from 16 - 400 HP, and the big purse seiners are found mainly in the Southern provinces.

Investment capital for purse seine boats

Cost of Hull, Engine, Fishing Gear and Equipment

Most of the big purse seine boats fishing offshore in Vietnam belong to the Southern provinces such as Ba Ria-Vung Tau, Tien Giang, Ca Mau and Kien Giang. Costs are similar for the hull of a purse seiner and a trawler of the same size. As for the engines, it is very common for purse seiners to use second-hand engines, like the trawlers do.

For purse seiners 300 - 720 m long, 45 - 180 m high, the engines used are 33 - 300 HP, and the costin 1997 ranged from 110 million to 320 million VN$ (US$0.009 million to 0.027 million) depending on the height, the length of the net and the structure of the gear.

Modern fishing equipment is used. Most of the boats of more than 30 HP are using echo-sounder. The power supplied is 5 KW, 7.5 KW and 10 KW. Light systems and light-controlling techniques have been upgraded.

Total Investment Capital of a Purse Seine Boat

Table 17 presents the total investment capital of a purse seine boat, including hull, engine purchase and installment, complete set of purse seine gear, fishing equipment, light system, aggregating devices, and fishing machine systems. The level of investment capital depends on the size of hull, type of fishing gear etc.

Economic Factors for Purse Seine Fishing

The profit of a purse seine operation depends on several factors, such as fishing ground, size of boat, size of fishing gear and fishing technique. Therefore, in some cases, profits of big purse seine boats are lower than profits of smaller ones. The results of the analysis are shown in Table 18.

Line Fishery

Development of the Line Fishery

The line fishery has good prospects for fishing in the offshore waters of Vietnam. Production of the line fishery reaches 45 028 $t \cdot year^{-1}$, constituting 8.5% of the total marine capture production of Vietnam.

The line fishery in the Gulf of Tonkin mainly catches squid. This small scale fishery has been

Table 17. Total investment capital for one unit of purse seiner in Vietnam 1997.

Province	Number of boat owners interviewed	Horsepower class (HP)	Investment capital for one boat (mil. VN$)	Crew members
Minh Hai	1	91 - 135	346.5	16
	2	136 - 200	652.805	14
	3	201 - 300	550.289	14 - 16
	8	301 - 450	697.143	14 - 16
Kien Giang	3	46 - 60	501.585	10 - 20
	11	61 - 90	281.528	10 - 20
	8	91 - 135	488.814	10 - 20
	5	136 - 200	639.775	12 - 20
	13	201 - 300	699.970	11 - 20
Khanh Hoa	2	26 - 35	277.815	15
	10	36 - 45	266.177	15
	2	46 - 60	324.683	15
	1	61 - 90	318.210	15
Vung Tau	12	61 - 90	493.442	18 - 25
	13	91 - 135	633.635	16 - 28
	5	136 - 200	747.014	16 - 25
	2	210 - 300	728.935	25
	6	301 - 450	917.759	20 - 28
Da Nang	4	61 - 90	804.575	14 - 15
	1	91 - 135	396.625	14
	3	136 - 200	664.083	13
Nghe An	2	46 - 60	150.00	12
	5	61 - 90	374.360	12 - 15
	4	91 - 135	416.45	12 - 16
	11	136 - 200	682.763	12 - 17

Source: Research Institute of Marine Fisheries (RIMF) - DANIDA 1998.
Conversion: 1 US$ = 11 705 VN$ in 1997; source: oanda.com

widely introduced. Line boats are small and equipped with an engine of less than 30 HP. Squid line boats are often used in combination with purse seiners, lift netters, or stick-held falling net boats. Beside the squid line fishery, long-line fishing and line fishing for other species are very limited. Fishing boats are small and only active in near-shore waters. Production constitutes only 10.6% of the line fleet's total production.

The squid line fishery is strongly developed in the Central region. The long-line fishery for shark or ocean tuna is also developed. The common size of a long-line boat is 54 - 84 HP. The line fishery in this region provides 52.8% of the total production of the line fishery in the country. Long-line is also commonly used. Fishing boats of less than 20 HP use line of 2 - 5 km long with 900 - 2 000 hooks. Boats of 60 - 275 HP are using line 24 -30 km long with 8 000-10 000 hooks and are active in fishing grounds of 40 - 60 m depth. The main target species is pike conger (Congridae), which constitutes 80 - 90% of the total production of the fishery. The production of line fishing in the region constitutes 36.5% of the total line fishery production of the country.

Number and Size of Line Boats

In the Gulf of Tonkin, 1 364 (75.5%) of the total 1 806 line boats have motors of less than 23 HP, and the remaining 24.5% have 25 - 45 HP motors. In the Central region, 2 529 (55%) of the total 4 601 line boats have 25 - 45 HP motors, 1 490 (32.4%) have less than 23 HP and 439 (9.5%) have 54 - 84 HP. There are also 14 line boats of 90 - 150 HP.

Table 18. Economic analysis of purse seiners in Vietnam 1997.

Province	Number of boat owners interviewed	Horsepower class (HP)	Catch per year of one boat (t)	Revenue per year of one boat (mil. VN$)	Variable cost per year of one boat (mil. VN$)	Net profit per year of one boat (mil. VN$)
Minh Hai	1	91 - 135	213.95	517.53	404.378	113.152
	2	136 - 200	173.086	512.88	358.411	154.469
	3	201 - 300	159.482	422.644	340.038	82.606
	8	301 - 450	203.859	681.171	487.212	193.959
Kien Giang	3	46 - 60	195.102	251.013	171.805	79.208
	11	61 - 90	171.528	219.031	171.224	47.807
	8	91 - 135	160.824	236.398	174.111	62.287
	5	136 - 200	261.819	284.112	219.632	64.480
	13	201 - 300	250.37	337.756	284.887	52.869
Vung Tau	12	61 - 90	186.12	625.833	608.099	44.734
	13	91 - 135	188.628	728.205	584.688	143.517
	5	136 - 200	183.30	749.000	631.94	117.06
	2	201 - 300	252.00	930.250	786.016	144.234
	6	301 - 450	155.10	859.391	802.949	56.442
Da Nang	4	61 - 90	200.14	1143.33	676.754	466.576
	1	91 - 135	52.50	310.00	218.45	91.55
	3	136 - 200	126.453	460.00	283.814	176.186
Khanh Hoa	1	16 - 25	52.00	78.00	55.68	22.320
	4	26 - 35	168.00	252.00	175.155	76.845
	11	36 - 45	185.10	291.60	206.208	85.392
	2	46 - 60	81.00	121.50	96.658	24.842
	1	61 - 90	104.00	156.00	108.60	47.40
Nghe An	2	46 - 60	44.0	276.00	175.03	100.97
	5	61 - 90	41.9	288.90	158.857	130.043
	4	91 - 135	30.75	209.063	161.183	47.880
	11	136 - 200	45.93	407.372	282.875	124.497
Hai Phong	2	26 - 35	80.00	400.00	324.679	75.321
	12	36 - 45	63.90	332.33	258.22	74.613
	6	46 - 60	67.61	338.075	274.705	63.370
	9	61 - 90	61.893	299.745	241.803	57.942
	3	91 - 135	68.298	341.420	262.963	78.457

Source: Research Institute of Marine Fisheries (RIMF) - DANIDA 1998.
Conversion: 1 US$ = 11 705 VN$ in 1997; source: oanda.com

In the South, there are a total of 5 085 line boats. Of these, 4 415 (86.7%) have less than 45 HP and 670 (13.2%) have 54 - 400 HP. Big line boats are mainly from the southern part of the region.

The line boats in Vietnam have engines in the range of 6 - 450 HP and the length of hull ranges from 8 - 21 m. Line boats of less than 35 HP are often active in near shore waters while those of more than 36 HP are capable of fishing offshore. However, in order to be able to fish offshore, fishing boats should have a running engine of more than 135 HP to endure rough weather. Fishers in the Southern region often use high-powered capacity engines for medium sized fishing boats to increase boat speed and quickly transport fish to shore, thereby receiving better economic returns.

Table 19. Number of hook-and-line boats by horsepower class for 20 coastal provinces in Vietnam 1997.

Fishing area	Non-powered boats	< 23 HP	25 - 45 HP	54 - 84 HP	90 - 150 HP	155 - 255 HP	250 - 450 HP	Total
North region	–	1 364 75.5%	442 24.5%	–	–	–	–	1 806 100%
Central region	132 2.9%	1 490 32.4%	2 529 55%	439 9.5%	11 0.2%	–	–	4 601 100%
South region	–	2 673 52.5%	1 742 34.2%	507 10%	123 2.4%	31 0.6%	9 0.2%	5 058 100%
TOTAL for 18 provinces	132 2.9%	5 527 48%	4 713 41%	946 8.2%	134 1.2%	31 0.6%	9 0.2%	11 492 100%

Source: MOFI-Vietnam 1995 - 98.

Investment Capital for Line Boats
Cost of Hull, Engine and Line Set

Like the purse seine fleet, the big line boat fleet is mainly in the Southern provinces. The cost of the hull of a line boat depends on the size, as for other types of fishing boat. The use of second hand engines is again very common.

Based on the target species (groups), the line fishery can be divided into a long line fishery for yellowfin tuna and big-eye tuna, a long line fishery for shark and a long line fishery for pike congers. The common capacity of fishing boats is 22 - 400 HP with a length of line ranging from 2 - 40 km. The cost by type of line fishery is listed below.

- Long line for pike conger - The length of the line depends on the size of engine. The average long line is 1.4 - 42 km with 900 - 10 000 hooks. The average price for long line of 1 000 m is 400 000 - 600 000 VN$.
- Long line for tuna - The length of the line is 18 - 32 km with 558 - 1 322 hooks. The average price for long line of 1 000 m is 1 - 1.4 million VN$.
- Long line for shark - The length of the line is 24 - 32 km with 620 - 1 322 hooks. The average price for long line of 1 000 m is 680 000 - 830 000 VN$.
- Long line for mackerel, hairtail scad - The length of the line is 10 - 18 km with 1 500 - 2 700 hooks. The average price for long line of 1 000 m is 154 000 - 250 000 VN$.

Total Investment Capital of a Line Boat

The investment capital of one line boat includes the hull, engine, a complete set of long line, navigational equipment and hauler for long line.

Economic Variables of the Line Fishery
Gillnet Fishery

The gillnet fishery is a very traditional method of fishing in Vietnam. However, gillnet boats are very small in size. Most of the gillnet boats are less than 45 HP. The number of non-powered gillnet boats comprises 10.6% of the total, while those less than 23 HP comprise 49.5%. These boats are active mainly in waters within 30 m depth, using a gillnet of short length and small height. The main target species of the near shore gillnet fishery is shrimp (captured by shrimp trammel net), cuttlefish (captured by cuttlefish trammel net) and some other nearshore demersal fish species.

Although the boats of the gillnet fishery are small in size, their number is high, with a total of 18 694 boats in 1997. The gillnet fishery in Vietnam is a small scale fishery.

Other Fisheries

Apart from trawl, purse seine, gillnet and line fisheries, there are several other kinds of fisheries in Vietnam. Total marine production of these comprises 14.1% of the total production from a total of 13 800 fishing boats. These are small in size and fish mainly in estuaries and near shore waters.

Table 20. Investment capital for one unit of hook-and-line boat in Vietnam 1997.

Province	Number of boat owners interviewed	Horse power class (HP)	Investment capital for one boat of hook-and-line (mil. VN$)	Crew members
Minh Hai	6	45 - 60	124.983	9 - 12
	3	61 - 90	119.100	8 - 12
	1	91 - 135	110.970	10
	2	136 - 200	172.010	8 - 12
Kien Giang	3	26 - 35	103.65	10
	8	36 - 45	237.25	10
	2	46 - 60	208.362	9 - 12
	3	61 - 90	286.37	10 - 12
	1	201 - 300	150.45	10
Khanh Hoa	1	26 - 35	164.95	10
	4	36 - 45	171.71	10
	6	46 - 60	169.00	5 - 10
	2	61 - 90	186.875	9 - 10
	2	91 - 135	313.15	10
Da Nang	2	26 - 35	219.00	14
	4	36 - 45	212.567	12 - 15
	2	46 - 60	265.737	14 - 15
	5	61 - 90	386.676	16 - 18
Nghe An	7	< 15	25.040	6
	8	16 - 25	29.317	7 - 8
	8	26 - 35	31.211	6 - 8

Source: Research Institute of Marine Fisheries (RIMF) - DANIDA 1998.

Discard and By-catch

In April 1989, the Ministry of Fisheries of Vietnam introduced the "Resource Protection Regulations". This regulation limits the allowed mesh size by gear and minimum length of fish for capture. Unfortunately, this regulation has not been strictly implemented.

The fishing grounds for small scale fisheries are in the coastal waters and estuaries. The mesh sizes of fishing gear actually used are often smaller than the ones allowed while prohibited fishing gear such as tow net and push net is still very much in existence. Some of the traditional gear is of very small mesh size leading to 30 - 80% of the catch coming from juvenile and trash fish.

Most of the commercial scale fishing boats bring trash fish or by-catch to the shore for fish sauce or fish powder processing. Only trawlers that fish offshore for many days, discard the trash fish. The rate of trash fish captured by trawlers of less than 90 HP is 80.7% of the total catch, and 50 - 60% for trawlers of more than 90 HP.

Concerns of Fisheries in Vietnam

Small scale fishing predominates in Vietnam and concerns about this are described below.

Size of Fishing Boats

Fishing boats are mainly constructed of wood, are small and not able to sail in bad weather and conduct long cruises. This limits the offshore fishing.

The size of the boat hull varies according to region. In the northern region, fishing boats commonly use 15 - 30 HP engines. The size of the hull is small, usually 12 - 13 m, and fishing operations are mostly in coastal areas. Fishing trips last for one or two days. Boats are bigger in the central region compared to that in the North. The common length of the hull ranges from 12 - 15 m and engines are 22 - 45 HP. One fishing trip lasts for 3 to 7 days.

The southern region of Vietnam has the largest fishing boats. The average length ranges from 14 to 22 m and the size of engine ranges from 33 to

Table 21. Economic variables for hook-and-line boat in Vietnam 1997.

Province	Number of boat owners interviewed	Horse power class (HP)	Catch per year of one boat (t)	Revenue per year of one boat (mil VN$)	Variable cost per year of one boat (mil VN$)	Net profit per year of one boat (mil VN$)
Minh Hai	4	46 - 60	6.84	127.535	107.654	19.881
	2	46 - 60*	33.28	343.55	275.328	68.222
	3	61 - 90	8.3	153.46	126.697	26.763
	1	91 - 135	7.42	137.4	103.520	33.880
	2	136 - 200	7.72	147.3	130.176	17.214
Kien Giang	3	26 - 35	20.5	347.5	94.606	252.894
	8	36 - 45	42.75	727.684	654.797	72.887
	2	46 - 60	22.95	350.738	242.453	108.285
	3	61 - 90	19.8	331.00	294.274	36.726
	1	201 - 300	33.0	450.00	347.616	102.384
Khanh Hoa	1	26 - 35	41.4	770.000	440.600	329.400
	4	36 - 45	30.78	741.25	414.670	326.58
	6	46 - 60	16.47	463.34	301.893	161.447
	4	46 - 60*	23.34	647.5	376.750	270.75
	2	61 - 90	34.82	725.00	407.609	317.391
	2	91 - 135	29.26	705.00	427.350	277.650
Da Nang	2	26 - 35	7.433	298.39	231.842	66.548
	4	36 - 45	4.538	241.73	216.123	25.267
	2	46 - 60	2.538	192.945	172.110	20.835
	5	61 - 90	3.354	249.85	224.490	25.360
Nghe An	7	< 15	9.617	118.524	65.159	53.365
	8	16 - 25	10.681	150.319	87.228	63.081
	8	26 - 35	10.04	138.939	88.733	50.206
Hai Phong	1	301 - 450	40.0	3 000.00	2 403.360	596.64
	1	> 450	40.0	3 000.00	2 462.640	537.36

Source: Research Institute of Marine Fisheries (RIMF) - DANIDA 1998.
Conversion: 1 US$ = 11 705 VN$ in 1997; source: oanda.com

400 HP. One fishing trip can last for 15 - 30 days.

Boat Engines

To minimize the initial invested capital and optimize economic return against the decline of resources, many fishing boats have been equipped with second hand engines (with 70% - 80% remaining life). Ninety percent of fishing boats utilize second-hand engines. Except for newly-built fishing boats produced in the Government program for offshore fisheries development in 1997 - 99, almost all the boats of more than 200 HP are equipped with second hand engines.

Distribution of Fishing Gear

The structure of the fishing gear varies from area to

Table 22. Mesh size of some small scale fishing gear in Vietnam.

Type of fishing gear	Mesh size (mm)
Shrimp trawl	18 - 20
Shrimp trammel net	46 - 48
Fish bottom gillnet	60 - 90
Purse seine	18 - 30
Lift net	10 - 14
Stick-held falling net	20 - 25

Source: Research Institute of Marine Fisheries (RIMF) - DANIDA 1998.

area due to the characteristics of the fishing ground.

Gulf of Tonkin

The geographical characteristics of the Gulf are: (a) an even bottom with an average depth of 38.5 m and the deepest part under 100 m, which is suitable for trawl fisheries; (b) abundant aquatic resources thereby providing an estimated stock of 681 166 t. The provinces have developed various types of fishery as discussed below.

a. Trawl fisheries for shrimp - This type of fishery occupies 18% of the total in the region. Vessels are 10 - 12 m in length and commonly run two engines of 15 HP made in China. The fishing ground is the coastal zone where the depth ranges from 20 to 22 m. One fishing trip lasts for one to two days.

b. Gillnet fisheries, such as the bottom gillnet for fish, trammel net for shrimp and squid. This type of gear is used by 60% of the boats in the region. Boats are small with a length of 8 - 9 m, and engines of 15 - 22 HP. One fishing trip usually lasts for one day.

c. The squid line fishery is fully developed although the boats are small.

Aside from the above fishing gear, trawl and purse seine fisheries also exist but involve a small number of boats. In 2000, there were thousands of fishing boats of 33 - 45 HP from Central provinces fishing in this area and employing purse seine, gillnet, offshore squid line and lift net.

Central Region

The physical characteristics of the area include: (a) narrow continental shelf, depth not suitable for trawl fisheries; (b) abundant pelagic fish suitable for purse seine and tuna/mackerel gillnet fisheries; (c) an estimated stock of 606 399 t. The following fisheries are developed in this region:

a. Gillnet fishery - This is more developed in both near shore and offshore waters with around 25% of the total fishing boats in the region involved. The boats run engines of 30 - 45 HP and one fishing trip lasts from three to seven days.

b. Trawl fishery - Around 21% of the total fishing boats of the region are engaged in the trawl fishery which operates in nearshore waters. The boats have engines of 33 - 45 HP, and in general a single trawl is used for shrimp, and a pair trawl for capturing fish.

c. Purse seine fishery - This fishery is highly developed in Quang Nam, Quang Ngai and Binh Dinh, engaging approximately 5% of the total fishing boats in the region. The boats use engines of 33 - 45 HP.

d. Lift net fishery - This type of fishing is conducted in near shore areas engaging 8% of the total fishing boats of the region. The boats use engines of 10 - 33 HP.

e. Tuna long line fishery - This fishery recently started in the region with boats using engines of 45 - 60 HP. The target species are yellowfin tuna and big-eye tuna.

Southeast Vietnam Waters

This region is characterized by an even bottom with a large, shallow continental shelf very suitable for trawling. Aquatic resources are abundant with an estimated stock of 2 075 889 t. The fishing fleet is bigger in size and has more fishing boats than those in Central provinces and the Gulf of Tonkin. This region has developed the following fisheries:

a. Trawl fishery - This is mainly pair trawling by boats of 60 - 150 HP. It involves 37% of the total fishing boats of the region, and takes place in grounds around Con Dao island and the Southern waters. Fishing depth ranges from 30 to 60 m.

b. Purse seine fishery - This occupies approximately 5% of the total fishing boats in the region. The boats commonly use engines of 70 - 110 HP but there are some larger boats using engines of 300 - 350 HP. Fishing depth ranges from 40 to 60m.

c. Tuna gillnet fishery - This fishery occupies 15% of the total fishing boats of the region. Fishing boats use engines of 45 - 90 HP and the fishing depth ranges from 25 to 40 m.

Gulf of Thailand Waters

The Gulf of Thailand is characterized by an even bottom which is very suitable for trawl fishing. The average depth is around 52 - 55 m and the

estimated stock is 506 679 t. The Gulf has abundant shrimp resources. This region also has the highest density of fishing boats and has developed the following types of fisheries:

a. Trawl fishing for shrimp and fish - Trawling for shrimp is conducted by large fishing boats of 250 - 300 HP but these operate mainly in the 15 - 30 m depth zone and in the pattern of single-boat fishing. Trawling for fish is conducted by groups of two boats (called pair trawlers) commonly of 250 - 300 HP, at depths ranging from 20 to 35 m. Around 40% of the fishing boats in this region are trawlers.

b. Gillnet fishery - This fishery involves 30% of the total fishing boats in the region. The boats commonly use engines of 20 - 45 HP and make trips of one to five days. Fishing depth ranges from 10 to 25 m.

c. Long line fishery - The line boats used for this type of fishery are less than 20 HP and use a main line from 2 - 5 km long with 900 - 2 000 hooks. The bigger line boats with engines of 60 - 275 HP, use a main line from 24 - 30 km long with 8 000 - 10 000 hooks. Fishing depth ranges from 40 to 60 m. The target species is pike conger, which often constitutes 90% of the total catch. Around 17% of the total fishing boats in the region are long liners.

d. Purse seine fishery - Only 2.3% of the total boats in the region are involved in purse seine fishing. These boats use big engines of 45 - 350 HP. The size of gear used ranges from 400 - 60 m long and 50 - 80 m high and fishing depth ranges from 25 to 35 m.

Infrastructure of Fisheries

By 1994, Vietnam had built 52 fishing ports with a total berth length of 2 905 m serving big fishing boats. There are also small and medium scale fishing ports and other ports that provide basic supplies such as ice, fuel, fresh water and repair services as well as shelter for fishing boats. There is still a shortage of modern facilities especially for post-harvest activities such as fish sorting areas, vehicles for fish transport to market, ice plants or warehouses, to name a few. Many coastal locations have no fishing ports so that most of the catch must be transported by small boats to the shore. In some places, fish harvests are discharged directly from fishing boats to sandy beaches leading to post-harvest spoilage.

In recent years, the Government has made efforts to improve the infrastructure facilities for fisheries. Many new fishing ports have been built and the old ones modernized. New quays have been built.

Many fishing ports have been in operation since 1996 such as: Cat Ba (Hai Phong city), Cua Hoi (Nghe An province), Xuan Pho (Ha Tinh province), Gianh (Quang Binh province), Thuan Phuoc (Da Nang city), Phan Thiet (Binh Thuan province), Tac Cau (Kien Giang province), Phu Quy (Binh Thuan provine), Con Dao (Ba Ria-Vung Tau province), Ca Mau (Ca Mau province). The Government has made a total investment of 71 million US$, including Cat Lo fishing port (Vung Tau), a huge fishing port costing 24 million US$.

In 2000, there were 75 shipyards for fishing boats, providing a total building capacity of 4 000 boats and repairing around 8 000 fishing boats per year. Apart from these, there are many small shipyards at the district level, which build small fishing boats in the traditional way. In terms of post-harvest facilities, there are 126 freezer stores providing a total capacity of about 20 000 t and 120 ice-making enterprises throughout the country.

The fisheries communities constitute 2.5 - 3% of the total population of the whole country, of which 49% are male and 51% are female. The rate of population increase in the fishery communities is often higher than the average for the whole country, around 2.6 - 2.8%. The average number of persons per fishery household is 6 - 7. The rate of population increase particularly in the fisheries labor force is 3.5 - 4%. High density and high population in the fisheries communities causes difficulties in terms of employment. Many fishers, due to a shortage of capital, can invest only in small boats. This results in increasing fishing pressure in coastal waters leading to the over-exploitation of coastal resources.

Marketing

In Vietnam auction or bidding at fish markets does not exist. Thus trading for the fish harvests is done by middlepersons. Essentially, there are two types of trading. First, middle persons offer to buy the whole catch and in return, provide the skippers with supplies such as ice, fresh water, fishing gear,

and other provisions for the next fishing trip. Secondly, the middle-persons who have enough financial resources may provide contracts to the skippers/fishers, to take the whole catch. Middle-persons normally lend the fishers the capital of 20 - 70 million VN$ (US$1 709 - 5 980 in 1997) ·boat^{-1} to cover the fishing costs.

The fish harvest is often sorted and classified according to fish species and size to satisfy the two key markets. The export market takes high value fish given proper storage and handling. The middle-persons will sell the fish to export processing plants or export them directly to China and other countries. The other market is the domestic market, where the fish are classified for domestic consumers and are usually transported in frozen form by road to big cities, or to processing plants to make them into dried products for the domestic market. For fish sauce processing, about 40 - 50% of total production is provided by the trawl fishery. Trash fish and low value fish such as herring, and anchovies, are processed into fish sauce. The production of fish sauce reached 160 million litres in 1998.

Aside from middle-persons, there are minor business people in small fish landing areas. These are mostly women from coastal villages/communes or wives of fishers working on small fishing boats. They purchase the harvest from the fishers and resell the fish at local fish markets.

Processing and Exporting Marine Products

The number of processing plants in Vietnam increased from 20 plants in 1980 to 164 plants in 1995. The total capacity for freezing fish is 800 t•day^{-1} and for ice making it is 3 300 t•day^{-1}. The total processing capacity for the whole country ranges from 130 000 - 150 000 t•year^{-1}. Of the total processing plants in the country, 80% are state-owned and 20% are privately owned.

The majority of export products are frozen (fish, shrimp, squid), which comprise 90% of total exports. Of this amount, 66% of quantity and value comes from frozen shrimp. In addition to shrimp, cuttlefish, dried squid and filleted fish are also exported. Another export product is canned fish, but this is still limited in quantity.

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. The export value was also enhanced from 11.2 million US$ in 1988 to 550 million US$ in 1995, an increase of 40 times. In 1990 - 95, national export earnings also increased to 168%, with an average annual increase of 33.6%.

Implications for Fishery Management

In recent years, the number of fishing boats, their size and engine capacity have expanded rapidly. In 1983, the number of fishing boats was only 29 117 units with an average engine capacity of 16.3 HP•boat^{-1}. In 1998 there were 71 800 units with 26.2 HP•boat^{-1}. Most of the fishing boats are of small size. Fishing boats with less than 45 HP represent 85.5% of the entire number for the whole country although this varies from region to region; for example, in Northern Vietnam 93.9% of the boats are small, in Central region 92.4% and in the Southern region 70.9% .

The ratio of fish catch by type of fishing gear is: trawl fishing takes 43% of total catch, purse seining 20.6%, gillnetting 13.6%, long lining takes 8.5% and lift netting takes 9.5% of the total fish harvest. In general, all the fishing gear types have low economic returns because of the depleting resources in the coastal waters due to over-fishing.

Bioeconomic Modeling

Rationale

The total fish catch in the Vietnamese traditional waters (depth under 50 m) is 1.59 times greater than the total catch allowable. From 1991 onwards, total profits continuously declined, so that it is now necessary to reduce the number of fishing boats operating in the coastal waters and promote offshore fishing.

Relationship Between Fishing Capacity of Boats and Living Marine Resources

Based on research done in 1999 by the Research Institute of Marine Fisheries (Bui Dinh Chung et al. 1999), the living marine resources and total allowable catch (TAC) in Vietnam is given in Table 23. The coastal zone is the area having a depth of under 30 m in the North and the South regions, and under 50 m in the Central region.

Table 23. Marine living resources and TAC in Vietnamese seas.

Sea area	Resources (t)	TAC (t)
Coastal area	999 095	461 738
Offshore area	2 765 275	1 347 510
TOTAL	3 764 370	1 809 248

Source: Research Institute of Marine Fisheries (RIMF) - DANIDA 1998.

Fishing Capacity

From 1983 to 1998, the number of fishing boats expanded from 29 127 units to 71 800 units with a total horsepower of 475 832 HP to 1 880 000 HP giving an increase of 3.95 times. Based on the size and engine capacity, around 85.5% of the total motorized fishing boats have less than 45 HP capacity. This suggests that most of the fish catch is harvested from the coastal areas.

Framework and Estimation

The Influence of Fishing Operations in the Coastal Area

Vietnam has not yet established a statistical system that will account for and monitor the fish catch in coastal areas. Therefore, an estimation method was used to describe the current status of the fishing operations in Vietnam. The following formula was used to calculate the ratio of coastal catch to total fish catch.

$$T = \frac{\sum_{i=1}^{n} Ai \cdot Ni \cdot Yi}{\sum_{i=1}^{n} Ni \cdot Yi}$$

where

T is the ratio of the coastal catch to the total fish catch (%).

A_i is the coefficient for every type of fishing boat group's offshore operations. It depends on the size of the fishing boat group, the type of fishing gear and the fishing area or region. In the Vietnamese fishery, the coefficient A varies from 0.3 - 1.0. For example, shrimp trawlers with less than 45 HP and operating only in the coastal areas will have an A value equal to 1.0.

N_i is the number of fishing boats in group i (unit).

Yi is the average catch (t) per year for one fishing boat in group i .

n is the number of the fishing boat groups.

Using the above method, a survey was conducted in traditional fishing grounds (< 50 m depth) in six important coastal provinces for 700 fishing boats in 1997-1998. The results are given below:

- Northern region = T_1 = 95.9%
- Central region = T_2 = 72%
- Southern region = T_3 = 83%
- For the whole country = T = 82.1%

Based on the ratio for the whole country T, one can account for the fish catch in the traditional fishing grounds by the following formula:

$$C_C = C_T \cdot T$$

where

C_C is the catch in traditional fishing grounds of the country (t)

C_T is the total fish catch for the whole country (t)

T is the ratio of the fish catch in the traditional fishing grounds to the total fish catch in the country (%).

Assuming that the ratio of the fish catch in the traditional fishing ground to the total fish catch of the whole country has not varied since 1980, then the total fish catch in the traditional fishing ground per year can be estimated. However, this ratio varies every year. For example in 1990, the number of big fishing boats operating in the offshore fishing grounds of the Southern provinces increased rapidly, leading to a decreasing fish production ratio. During 1997-1999, the government implemented an offshore fishing program under which 721 offshore fishing boats with engine capacity 100 - 500 HP were built, but the ratio of the catch production decreased.

Based on the results of the research study for the assessment of marine living resources in Vietnam (Research Institute of Marine Products (RIMP)-DANIDA, 1998), the total allowable catch in the traditional fishing area is about 582 000 t, but the actual total catch of the area was higher in 1991 (Fig. 2, Table 24). The fish catch in the traditional fishing area in 1998 was 928 272 t, 1.59 times higher than the allowable level. This shows the fishing pressure in the coastal area is high, and requires a suitable management policy plan for sustainable fisheries development.

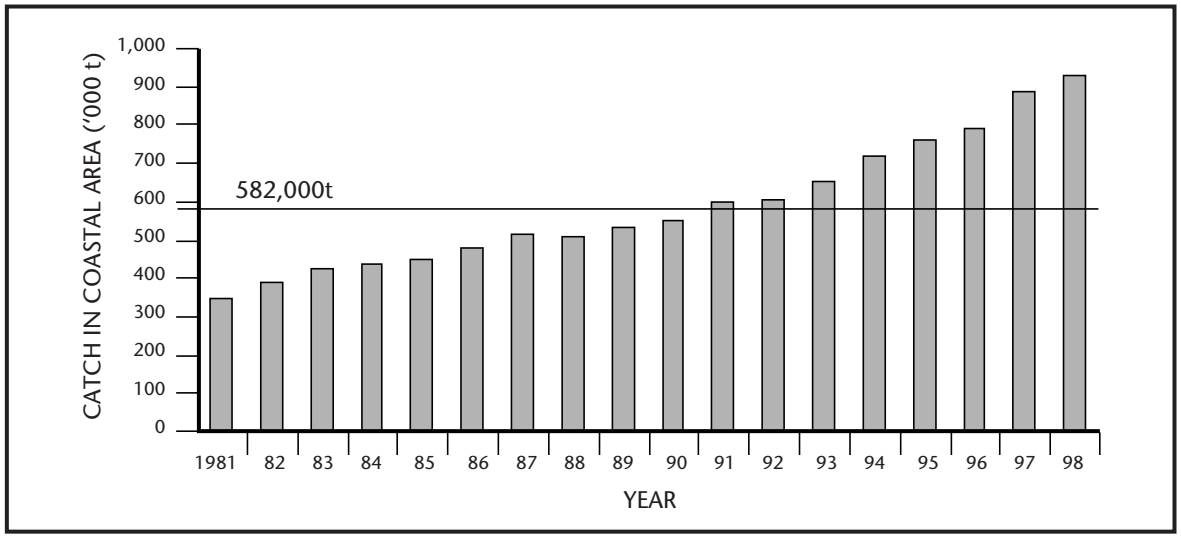

Fig. 2. The catch in traditional fishing areas in Vietnam 1981 - 98.

Table 24. The total fish catch in the traditional fishing areas of Vietnam 1981 - 98.

Year	Total catch of whole country (t)	Catch in traditional fishing areas (t)
1981	419 740	344 606
1982	476 597	391 286
1983	519 384	426 414
1984	530 650	435 664
1985	550 000	451 550
1986	582 077	477 885
1987	624 445	512 669
1988	622 364	510 960
1989	651 525	534 902
1990	672 130	551 818
1991	730 420	599 675
1992	737 150	605 675
1993	793 324	651 319
1994	878 474	721 227
1995	928 860	762 594
1996	962 500	790 212
1997	1 078 000	885 038
1998	1 130 660	928 272

Source: MOFI-Vietnam 1995 - 98.

Table 25. Average total fish catch per unit horse power per year in Vietnam 1981 - 98.

Year	Total catch (t)	Total of engine capacities (HP)	Average catch per unit HP ($t \cdot HP^{-1}$)
1981	419 740	453 871	0.92
1982	476 597	469 976	1.01
1983	519 384	475 832	1.09
1984	530 650	484 114	1.10
1985	550 000	494 507	1.11
1986	582 077	537 503	1.08
1987	624 445	597 022	1.05
1988	622 364	609 317	1.02
1989	651 525	660 021	0.99
1990	672 130	727 585	0.92
1991	730 420	824 438	0.89
1992	737 150	986 420	0.75
1993	793 324	1 291 550	0.61
1994	878 474	1 443 950	0.61
1995	928 860	1 500 000	0.62
1996	962 500	1 543 163	0.62
1997	1 078,000	1 850 000	0.58
1998	1 130 660	1 880 000	0.60

Source: MOFI-Vietnam 1995 - 98.

Fishing Operations in Offshore Areas

The total fish production at depths greater than 50 m was estimated at 202 388 t in 1998 while the total allowable catch in the offshore area was 1 227 000 t. This indicates a high potential for the development of offshore fishing in Vietnam.

Reduction of the Marine Living Resources in the Coastal Waters

Time series data on total catch (t) and fishing effort (HP) of motorized boats are available from 1981 to 1998. These data along with the information on catch per unit of effort (CPUE) measured as tonne of fish per unit of horsepower are given in Table 25.

During recent years, the Vietnamese boats have operated mainly in coastal waters as shown in Table 25. The coastal fish harvest in 1998 was 1.59 times higher than the allowable catch. It is also a reality that fishing effort (e.g. more fishing hours, more net hauling) will be increased in the coming years. This poses a serious problem in terms of the aquatic resources.

Figure 3 shows that the mean catch per horsepower decreased from 1.10 $t \cdot HP^{-1}$ in 1985 to 0.6 $t \cdot HP^{-1}$ in 1998. The reduction in catch of some of the main fishing gear in Tonkin Bay is reflected below.

a. Trawl fishery - annual catch of a trawler

   - 250 HP = 360 $t \cdot boat^{-1}$ in 1976; 200 $t \cdot boat^{-1}$ in 1990
   - 400 HP = 480 $t \cdot boat^{-1}$ in 1976; 240 $t \cdot boat^{-1}$ in 1990

b. Purse seine = 100 - 150 $t \cdot boat^{-1}$ in 1976; 20 - 30 $t \cdot boat^{-1}$/ in 1990

c. Lift net = 100 - 150 $t \cdot unit^{-1}$ in 1976; 30 $t \cdot unit^{-1}$ in 1990

Model Estimation

The data obtained above were used for estimating the Schaefer and Fox models. The results are given in Table 26.

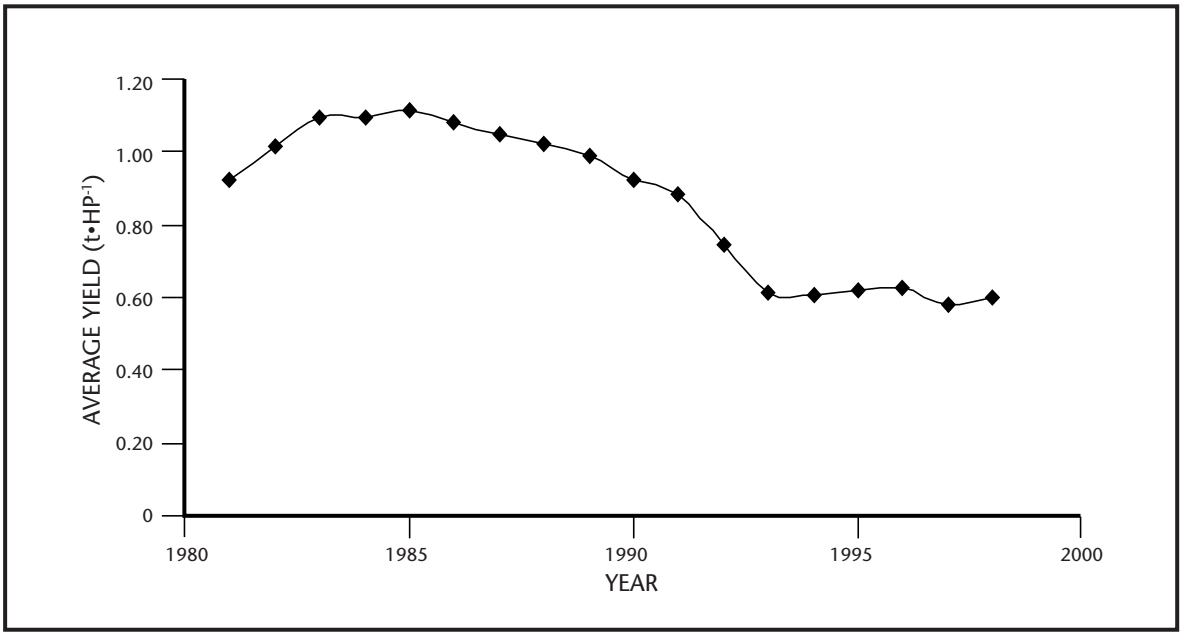

Fig. 3. Annual average catch per horsepower in 1981 - 98.

Table 26. Results of model estimation using Schaefer and Fox Model.

Model	Intercept	t-value for intercept	Slope	t-value for slope	R^2	d-statistics
Schaefer	1.22	34.42	$-38*10^{-6}$	-11.49	0.89	0.46
Fox	0.27	7.14	$-48*10^{-6}$	-13.32	0.92	0.51

Table 27. Comparison of catch and effort information from actual and estimated statistics for Vietnam fisheries.

	Schaefer Model	Fox Model	Actual
Catch: MSY (t)	976 378	1 006 850	1 130 660
Effort: MSY (HP)	1 595 650	2 079 478	1 880 000
Profit: MEY (million VN$) (1 US$ = 11 705 VN$ in 1997)	1 625 954	–	1 299 761
Effort MEY (HP)	1 025 410	–	1 880 000
Implication	Over-fishing	Over-fishing	–

Both models display good estimation results with their R2 values close to around 90%. The t-ratios for the estimated coefficients show that the estimated coefficients are statistically significant at 1% level of significance. The signs of the coefficients satisfy the expectations about the signs. The Durbin-Watson 'd' statistic values, however, indicate the presence of auto-correlated errors in these models. These models were estimated using the Cochrane-Orcutt iterative procedure adjusting for auto-correlated errors, but the auto-correlation problem could not be removed altogether. The original OLS (Ordinary Least Squares) regression results were therefore retained, considering all the criteria used for evaluating estimated models. The estimated coefficients of these models were then used in estimating the static maximum sustainable yield (MSY) and maximum economic yield (MEY) levels of catch and the corresponding levels of fishing effort. The estimated levels of catch and effort are compared with the actual levels of catch and effort in Table 27.

The above results indicate that the actual level of yield is much greater than the MSY levels obtained from both the Schaefer and Fox models. This means that biological over-fishing is taking place in Vietnam. The actual effort level is greater than the MSY level of effort in the Schaefer model but less than the MSY in the Fox model. This result implies that both the catch and effort level of fishing should be reduced in Vietnam. If immediate actions are not taken to prevent excessive fish harvesting, the fisheries resources will be exhausted. The results of the Schaefer model also indicate that the actual level of effort is much greater than the economic rent-maximizing level of fishing effort. The economy is actually losing a substantial amount of economic rent through over-fishing. Though the fishing effort level still falls short of the open access level, the sustenance of profit from fishing will induce more rent-seeking activities in the form of increased effort.

Bioeconomics of the Vietnamese Fishery

At present, because there are no proper statistical systems that keep track of fishery records in Vietnam, only minimal information is annually published. This information includes the total catch of the country, total number of fishing boats by horsepower group, total horsepower of boat engines and total export value of sea products. Hence the annual statistical data cannot be obtained for catch and number of fishing boats for every type of fishing gear and major fish species. Therefore, bioeconomic models cannot be made for every fish species and type of fishing gear. Nonetheless, an estimation method was used to analyze the economic status of the Vietnam fisheries.

The information provided below was collected from the survey of fishing boats using fishing gear such as trawl, purse seine, gillnet, long line and others, and from the survey of fishing boat groups

having different engine capacities and in various fishing areas such as the Northern, Central and Southern regions of Vietnam. These data were processed to calculate the following:

Total revenue (I) is obtained by multiplying the average price of one tonne of product (V) by total annual catch (Y) as given below

$$I = V \cdot Y$$

Assume that the average price of one tonne of product (V) did not change from 1981 to 1998.

Total cost defines the average cost of one horsepower for every fishing gear group mentioned above. This is based on the ratio of total engine capacity for every fishing gear group and accounting the average cost of one horsepower of all fishing gear groups in general (C). This can be obtained by multiplying the average cost of one horsepower (C) with the total annual horsepower (H) to give the total annual cost for the whole fishery (L) as shown below.

$$L = H \cdot C$$

Assume that average cost of one horsepower (C) did not change from 1981 to 1998.

The average price of one tonne of fish is 4.214 mil VN$ (US$304 in 1997), and the average cost of one horsepower is 1.843 mil VN$per year (equivalent to US$133 ($HP^{-1} \cdot year^{-1}$ in 1997) (Table 28)

Fig. 4 shows that from 1981 to 1998, the total engine capacity increased from 453 871 HP to 1 880 000 HP and the total cost of fishing operations expanded from 836 484.21 million VN$ to 3 464 840 million VN$ (an increase of 4.14 times). Although the total revenue grew from 1 768 784 million VN$ to 4 764 601 million VN$ (2.69 times increase), the total engine capacity also increased continuously (e.g. increased number of fishing boats) therefore the total profit declined gradually.

Table 28: Total annual revenue and total annual cost of Vietnamese fishery 1981 - 98.

Year	Total catch (t)	Total revenue (mil. VN$)	Total horse power (HP)	Total cost (mil. VN$)
1981	419 740	1 768 784.36	453 871	836 484.25
1982	476 597	2 008 379.76	469 976	866 165.77
1983	519 384	2 188 684.18	475 832	876 958.38
1984	530 650	2 236 159.10	484 114	892 222.10
1985	550 000	2 317 700.00	494 507	911 376.40
1986	582 077	2 452 872.48	537 503	990 618.03
1987	624 445	2 631 411.23	597 022	1 100 311.55
1988	622 364	2 622 641.90	609 317	1 122 971.23
1989	651 525	2 745 526.35	660 021	1 216 418.70
1990	672 130	2 832 355.82	727 585	1 340 939.16
1991	730 420	3 077 989.88	824 438	1 519 439.23
1992	737 150	3 106 350.10	986 420	1 817 972.06
1993	793 324	3 343 067.34	1 291 550	2 380 326.65
1994	878 474	3 701 889.44	1 443 950	2 661 199.85
1995	928 860	3 914 216.04	1 500 000	2 764 500.00
1996	962 500	4 055 975.00	1 543 163	2 908 012.57
1997	1 078 000	4 542 692.00	1 850 000	3 510 553.77
1998	1 130 660	4 764 601.24	1 880 000	3 464 840.00

Source: Research Institute of Marine Fisheries (RIMF) - DANIDA 1998.

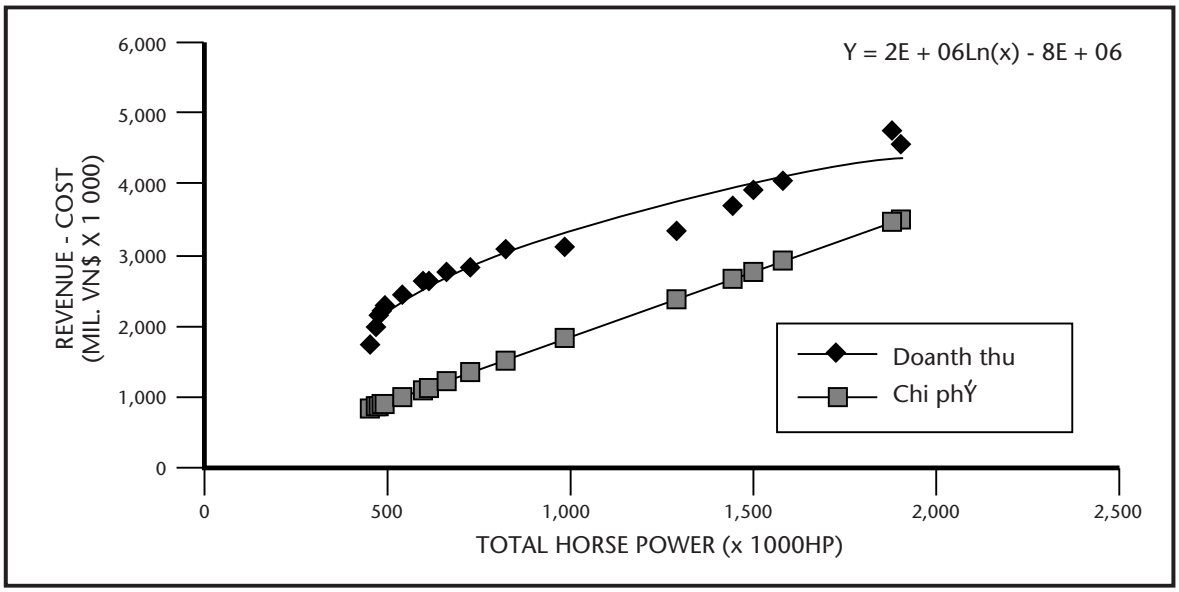

Fig. 4. Relationship between revenue and cost of fishing operations of Vietnamese fisheries, 1981 - 98.

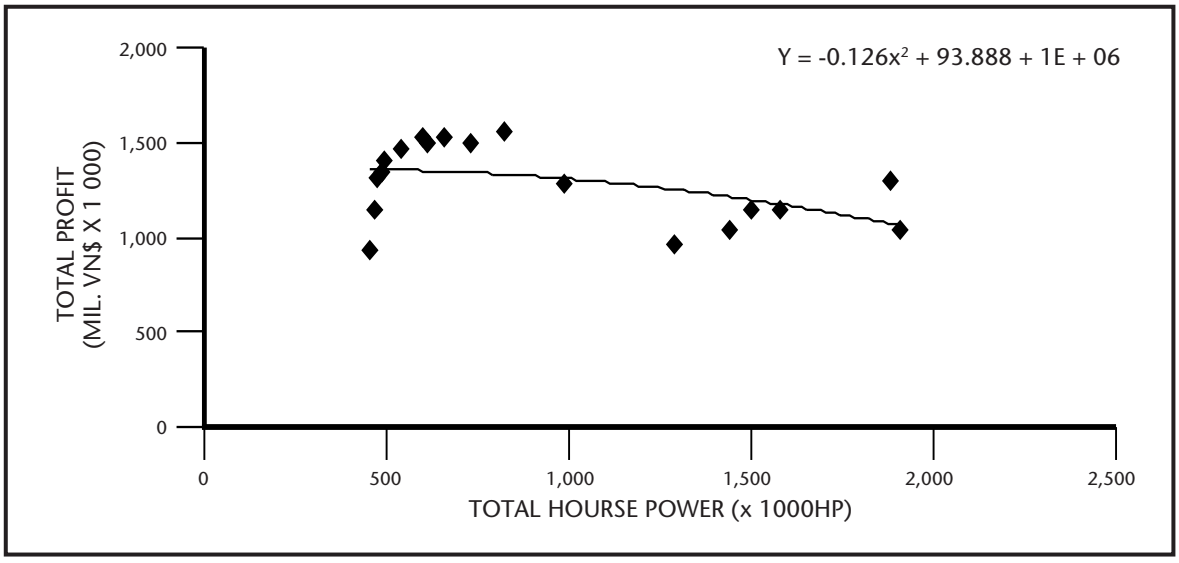

Fig. 5. Relationship between total profit and total engine capacity.

Table 29 provides information on the total annual revenue from 1981 to 1998 where the revenue was maximum from 1986 to 1991, ranging from 1 462 billion VN$ to 1 558 billion VN$. From 1991 to 1998 the total profit decreased, while the total engine capacity increased by 2.28 times between 1991 and 1998. This result shows the excessive fishing operations in the traditional fishing grounds yielding poor economic returns to the fishers. Thus for the development of a sustainable fishery in the country, the number of fishing fleets operating in the coastal areas must be limited, and the development of the offshore fishing vessels must be enhanced.

Table 29. Annual profit of fishing operations in Vietnam 1981 - 98.

Year	Annual profit (mil. VN$)	Year	Annual profit (mil. VN$)
1981	932 300.11	1990	1 491 416.67
1982	1 142 213.99	1991	1 558 550.65
1983	1 311 725.80	1992	1 288 378.04
1984	1 343 937.00	1993	962 740.69
1985	1 406 323.60	1994	1 040 689.59
1986	1 462 254.45	1995	1 149 716.04
1987	1 531 099.68	1996	1 147 962.43
1988	1 499 670.67	1997	1 032 138.23
1989	1 529 107.65	1998	1 299 761.24

Source: Research Institute of Marine Fisheries (RIMF) - DANIDA 1998.

Fishing Effort of Some Types of Fishing Gear in Different Sea Waters

Based on the survey results of about 22 000 net hauling times of fishing boats in 1996 - 98, the average fishing effort of some types of fishing gear in the Vietnam waters is provided below (Tables 30 - 33).

Relationship Between Total Engine Capacity and Total Fish Catch

The relationship between the total engine capacity and the total catch during 1985 - 98 shows that the total engine capacity increased by 4.14 times, but total fish catch had only expanded by 2.69 times, i.e. from 419 740 t in 1985 to 1 130 660 t in 1998 (Fig. 6). Given the dependence of the fishers on the resources, this trend may continue, resulting in over-exploited fishery resources with decreasing profit.

Table 30. Average fishing effort of pair trawl fishery in Vietnam.

Area	Size of fishing vessel (HP)	Coastal fishing		Offshore fishing	
		Number of net haulings surveyed (unit)	Fishing effort ($kg \cdot HP^{-1} \cdot hr^{-1}$)	Number of net haulings surveyed (unit)	Fishing effort ($kg \cdot HP^{-1} \cdot hr^{-1}$)
North region	≤ 45	1215	0.6337	153	0.489
	46 - 74	10	0.228	50	0.289
	75 - 140	24	0.705	7	0.364
	141 - 300	14	0.339	16	0.128
	301 - 600	–	–	2	0.235
Central region	≤ 45	538	0.324	964	0.584
	46 - 74	116	0.280	201	0.411
	75 - 140	9	0.337	42	0.382
	141 - 300	2	0.235	–	–
	301 - 600	–	–	–	–
South region	≤ 45	13	0.812	55	0.433
	46 - 74	19	0.944	132	0.440
	75 - 140	25	0.471	69	0.265
	141 - 300	28	0.243	46	0.491
	301 - 600	9	0.150	14	0.253

Source: Research Institute of Marine Fisheries (RIMF) - DANIDA 1998.

Table 31. Average fishing effort of single trawl fishery in Vietnam.

Area	Size of fishing vessel (HP)	Coastal fishing		Offshore fishing	
		Number of net haulings surveyed (unit)	Fishing effort ($kg \cdot HP^{-1} \cdot hr^{-1}$)	Number of net haulings surveyed (unit)	Fishing effort ($kg \cdot HP^{-1} \cdot hr^{-1}$)
North region	≤ 45	3941	0.186	6	0.167
	46 - 74	21	0.388	6	0.86
	75 - 140	3	0.27	1	0.22
	141 - 300	–	–	–	–
	301 - 600	1	0.04	2	0.06
Central region	≤ 45	5094	0.389	103	0.445
	46 - 74	251	0.407	16	0.186
	75 - 140	6	0.30	–	–
	141 - 300	–	–	–	–
South region	≤ 45	2044	0.427	21	0.488
	46 - 74	765	0.227	17	0.225
	75 - 140	219	0.168	19	0.194
	141 - 300	77	0.105	60	0.202
	301 - 600	35	0.108	86	0.482

Source: Research Institute of Marine Fisheries (RIMF) - DANIDA 1998.

Table 32. Average fishing effort of gillnet fishery in Vietnam.

Area	Size of fishing vessel (HP)	Coastal fishing	
		Number of net haulings surveyed (unit)	Fishing effort ($kg \cdot HP^{-1} \cdot hr^{-1}$)
North region	≤ 45	1175	0.890
	46-74	36	5.019
	75-140	6	0.54
	141-300	0	0
Central region	≤ 45	1232	0.931
	46-74	28	0.421
	75-140	5	0
South region	≤ 45	692	1.504
	46-74	38	1.55
	75-140	4	0.485

Source: Research Institute of Marine Fisheries (RIMF) - DANIDA 1998.

Table 33. Average fishing effort of purse seine fishery in Vietnam.

Area	Size of fishing vessel (HP)	Coastal fishing		Offshore fishing	
		Number of net haulings surveyed (unit)	Fishing effort ($kg \cdot HP^{-1} \cdot hr^{-1}$)	Number of net haulings surveyed (unit)	Fishing effort ($kg \cdot HP^{-1} \cdot hr^{-1}$)
North region	≤ 45	249	125.2	122	303.17
	46 - 74	-	-	25	376.938
	75 - 140	-	-	16	582.838
	141 - 300	-	-	8	491.668
Central region	≤ 45	1076	170.008	282	2 008.062
	46 - 74	439	295.509	136	1 246.386
	75 - 140	10	435.00	36	1 264.738
	141 - 300	1	500.00	1	428.57
South region	≤ 45	28	866.99	87	470.195
	46 - 74	50	758.653	94	886.836
	75 - 140	30	807.973	128	694.118
	141 - 300	70	910.020	90	864.97
	301 - 600	27	615.68	75	867.456

Source: Research Institute of Marine Fisheries (RIMF) - DANIDA 1998.

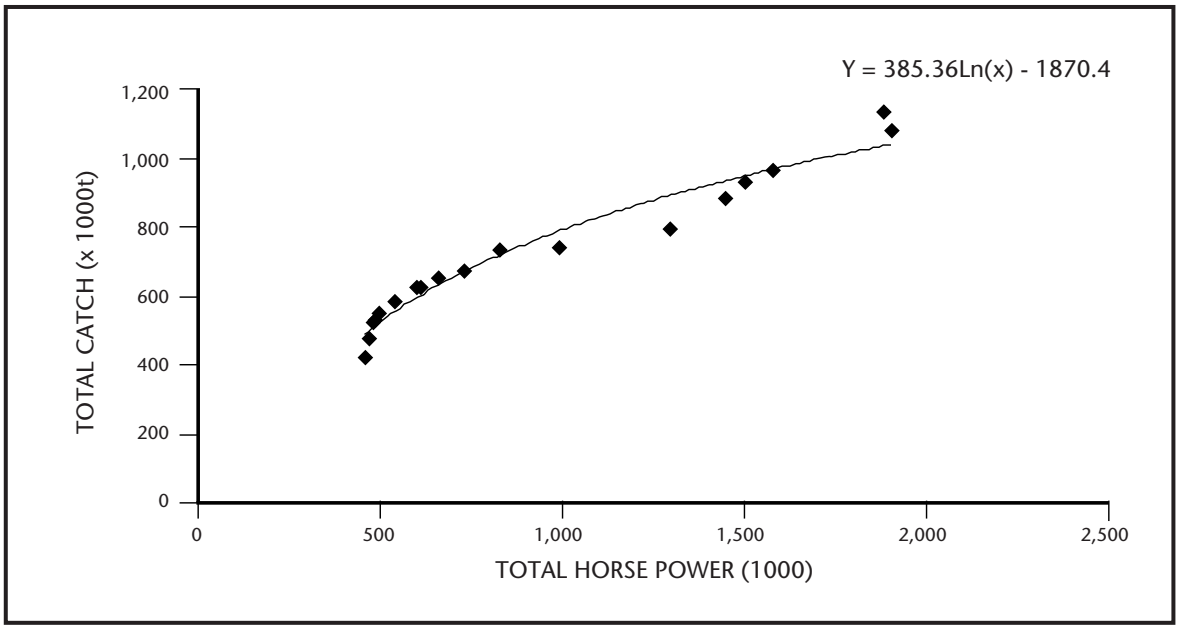

Fig. 6. Relationship between total engine capacity of fishing boats and total catch in Vietnam 1985 - 98.

Conclusions and Recommendations

The following recommendations are given for the development of the fishery sector in Vietnam:

1. Regulate the use of coastal fishery resources through the following:

    a. Control the number of fishing boats, e.g. in 2010, 15 000 non-powered boats and 38 900 motorized boats of less than 23 HP should not be allowed in the coastal fishing grounds; fishing boats of 24 - 45 HP should be limited to a maximum of 30 000 units and 46 - 89 HP to 20 000 units, making 50 000 units of fishing boat allowed in 2010.

    b. Resolve the labor problems. Currently, there are 423 600 fishers working on fishing boats in Vietnam. If the number of fishing boats is reduced, many fishers will lose their jobs. Therefore, the government will need to develop programs for offshore fishing, aquaculture, fish processing and other fishery services that provide alternative sources of income.

    c. Protect the marine resources through implementation of sound fisheries policies and regulations.

    d. Support credit funds that will enhance the development of offshore fishing. The government needs to institute credit policies that will support more fishing in the offshore waters.

2. Build high-powered fishing vessels for fishing operations in offshore waters. Based on the development plan for offshore fishing, by 2010 there will be more than 700 fishing boats with engine capacity of more than 90 HP for offshore fishing activities. This will result to a projected total fish catch ranging from 1 200 000 - 1 400 000 t in 2010.

3. Develop processing-service-market centers for post-harvest handling of fishery products. According to government plans, six centers will be established to accommodate post-harvest fish products:

4. Establish fishery statistic systems, monitoring an information system that will keep all fishery records through time and region. Also, to improve the safety of fishers, a two-way communication system between them and security services should be put in place.

From 1997, the Vietnamese government has implemented programs for developing offshore fishing. This government program provided a credit fund with a low interest rate of 0.81% to fishers to build new fishing boats. From 1997 onwards, the government supported the credit fund to build 918 fishing boats with an engine capacity of 135 - 500 HP with 728 units now in operation in offshore fishing.

References

Bui Dinh Chung, Dao Manh Son and Chu Tien Vinh. 1999. Proceedings of Marine Fisheries Research, Volume II. Agriculture Publishing House. Ministry of Fisheries, Research Institute for Marine Fisheries, Hanoi.

Bureau of Statistics. 1996. Annual Fisheries Statistics. Ministry of Fisheries, Hanoi, Vietnam.

Institute of Fishery Economic and Planing (IFEP)-DANIDA. 1998. Project of master plan for Vietnamese fishery.

MOFI-Vietnam. 1995 - 98. Annual reports of fishery departments in 28 coastal provinces from 1995 - 98.

Research Institute of Marine Fisheries (RIMF) - DANIDA 1998. Project on assessment of living marine resources in Vietnam. Phase 1.