ECONOMIC PERFORMANCE INDICATORS FOR COASTAL FISHERIES - THE CASE OF PURE-SEINING IN KHANH HOA, VIETNAM.

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ABSTRACT

A field study on the economic performance indicators for coastal fisheries are needed in order to implement fisheries policy in Khanh Hoa as well as in Vietnam. The research project "Economic performance indicators for coastal fisheries - the case of pure-seining in Khanh Hoa" established to fulfill these demands. A questionnaire about technical characteristics and economic data is used for data collection through interviews with vessel owners. This paper presents preliminary findings for 100 purse seiners, representeing 10% of the total population, in Nha Trang and Cam Ranh (Khanh Hoa province) in the group of vessels with engine power of less than 90 HP. The following indicators are presented: gross revenue, gross value added, gross cash flow, net profit and crew share. The results show that the coastal purse seine fishery in Cam Ranh is more profitable than in Nha Trang for each engine power group. The owner of an average purse seiner of all groups of horse power in both locations of Nha Trang and Cam Ranh is not only capable paying for all expenses, but also has a reward for the operating year. The boat owner of an average vessel in the group of horse power of 75 - < 90 Hp has the highest values of annual gross cash flow and net profit following location. Thus, the annual average of crew shares for this group of horse power was quite high. It was almost 2.0 times more than the average earnings of labor in the whole country. The boat owners of the engine power group of < 20Hp and 20-<45Hp have lowest values of annual vessel gross cash flow and net profit following location. Thus, the annual average of crew shares for those groups of horse power is quite low. They are almost 1.2 times more than the average earnings of labor in the whole country. Regression analysis of gross revenue using technical characteristics as independent variables is performed, and the results are demonstrated. The technical factors that impact on the gross revenue are the length of net, fishing experience of skipper and location. These are significant factors impacting on the gross revenue. Further work will include collection of more data, which will be analyzed with stronger techniques for in depth analysis such as Data Envelopment Analysis (DEA) or Stochastic Production Frontier (SPF).

***Keywords**: Economic performance, gross revenue analysis, coastal fisheries.*

1. INTRODUCTION

1.1 GENERAL INFORMATION

The sea plays a pivotal in Vietnamese lives, in term of food security, income generation and economic growth. So, fisheries development, exploitation of natural resources, and protection of the aquatic environment become the national targets.

Vietnam has a long coast of 3,260 km from Mong Cai (Quang Ninh province) to Ha Tien (An Giang province), passes 13 latitudes from $8^{o}23'$ N to $21^{o}39$ N with an area of the country's sovereign rights for 1,000,000 Km^2 referred as Exclusive Economic Zone (EEZ) (*RIMS, 2005*).

Beside marine fisheries, due to natural conditions there is a potential for development of freshwater and brackish-water aquaculture. Hence, it is important to improve the income and the living standards of the fishers and fish farmers.

The Vietnamese Sea has many suitable grounds for fish breeding, such as the gulfs (Gulf of Tonkin, Gulf of Thailand, Gulf of Van Phong), Bays (Ha Long Bay, Nha Trang Bay, Cam Ranh Bay), lagoons (Tam Giang lagoon), estuaries (Red river, Mekong delta), etc. In addition, Vietnam Sea has over 400,000 hectares of mangrove and rhyzophora forest in the shallow coastal lagoons and estuaries. It also has many coral reefs which are spread from the North to the South. Especially, they concentrated in the coastal provinces such as Da Nang, Phu Yen, Khanh Hoa, Ninh Thuan, Binh Thuan and around the gulf of Thailand, islands of Truong Sa and Hoang Sa (*RIMF, 2005*).

According to the sea depth and geographical position, Ministry of Fisheries divides the Vietnamese sea into four areas: The North part, Central part, South-East part and South-West part.

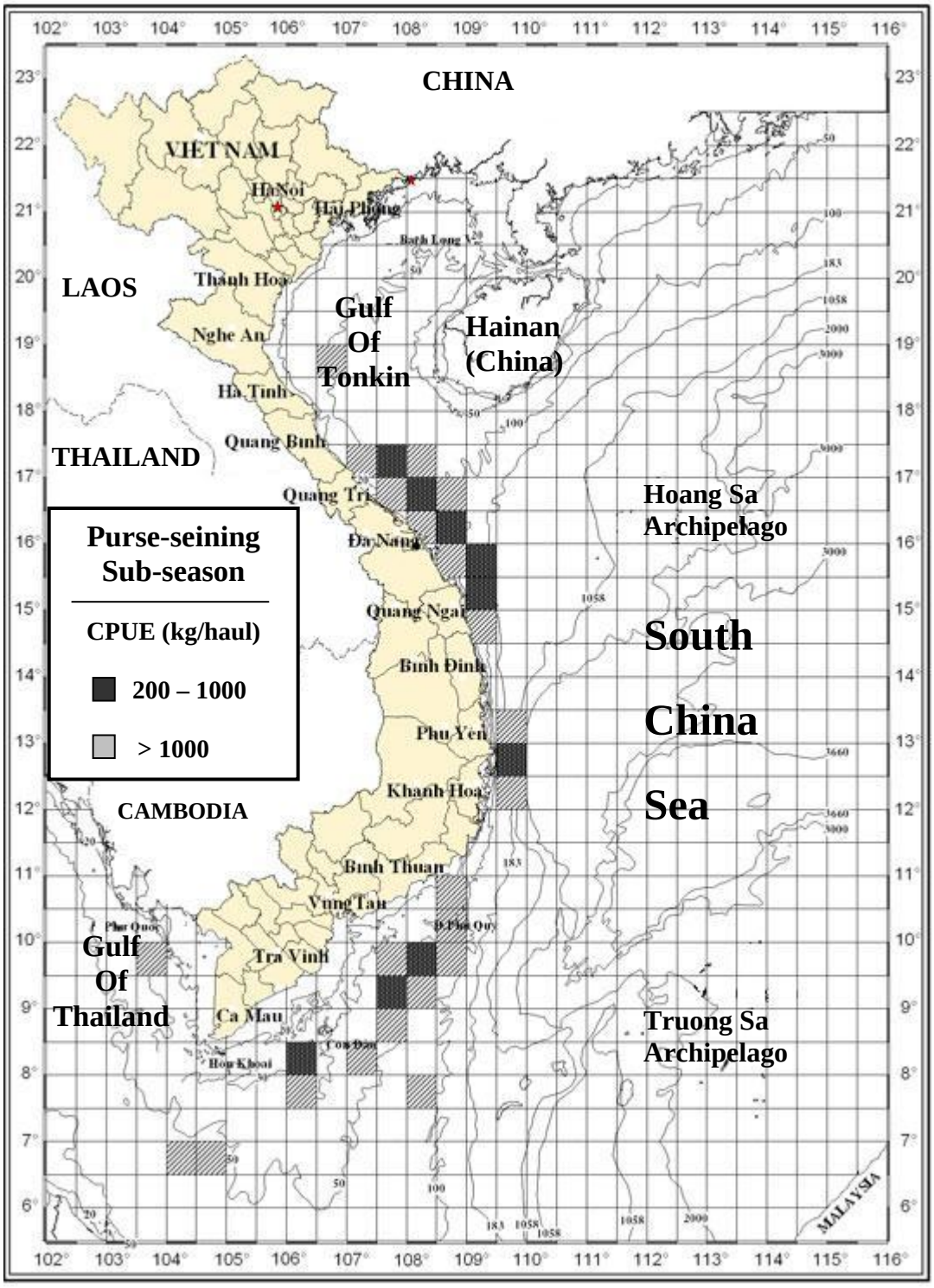

Figure 1.1: Vietnamese sea and the CPUE (kg/haul) in sub-season of purse-seine fishery in 2008.

(Source: RIMF, 2008).

The North, South-East and the South-West sea of Vietnam have shallow waters with more than 50% of the area under 50 meters in depth. The Central sea of Vietnam is deeper than other parts. Specifically, the average line of depth is 100 meters, only far from the coastline about 10 miles (1 mile = 1,852 m). The fisheries of Vietnam could be divided into offshore and inshore fisheries. In offshore fisheries the vessel capacity is equal or more than 90 Hp and operates in the sea with the depth over 30 meters in the North and the Southwest sea and 50 meters in the central sea of Vietnam. (*RIMF, 2005*).

In Vietnam, the number of fishing vessels especially in near shore, has increased continuously in recent years despite of the government's aim of reduction. Particularly, 80% of the fishing vessels operate in the coastal areas that make up only 11% of the Exclusive Economic Zone. Such heavy use of near shore fish resources could imply over-fishing and economic decline. In addition, aquaculture is facing uncontrollable development because of lacking careful planning. All of these affect considerably on the livelihood of a huge number of villagers. Therefore, it is a necessary to have effective solutions for these problems.

There are not much detailed studies in economic performance for coastal fisheries in Vietnam. Almost studies were rounded in determining resource and marine biodiversity. For example, the first phase of project ALMRV was carried out from 1996 with the goal of collecting a value biodiversity data, economic data of fishing performance. However, only variable costs were aimed for the cost section. Therefore, it could not be effective to assess exactly for fishing vessels. The second phase of project was carried out from 2001. It was an achievement of assessing economic performance for vessels by adding fixed cost to the evaluation. But, due to a limitation of the number of fishing vessel sampled, it was not strong enough to outline for the economic performance of fisheries.

In addition, the logical and systematic studies concerning the society issues for the fisheries is still poor or even not available such as lacking comparison between the income of fishers and boat owners to assess whether there is equity or the necessity of an adjustment.

Based on the research, the case for some small scale fisheries in Khanh Hoa province (Vietnam) will be used for evaluation. It is important to emphasize the fact that it is linked to other indicators for a comprehensive understanding on activities of small

scale fishing vessels. And it may be useful for fisheries managers in decision making for reducing the number of fishing boat in Vietnam.

1.2. RESEARCH PROBLEM AND OBJECTIVES

1.1.1. Research problem

"Economic performance indicators for coastal fisheries - The case of purse seining in Khanh Hoa province".

- Status of fisheries in Khanh Hoa province.
- Determining the costs (fixed costs and variable costs), revenues, profits of purse seine fleets that operate in coastal zone in Khanh Hoa.
- Determining the some technical factors impact on efficiency.

1.1.2. Research objectives

The goal of research problem approach to two main objectives.

- The first is to present the costs and earnings findings based on data collected. The indicators need to be presented: gross revenue, income, gross value added, gross cash flow, net profit and crew share, … per boat and per man. And investigating some econocmic indicators such as ratio of gross revenue to total costs, ratio of net profit to gross revenue, ratio of net profit to total costs, ratio of net profit to total invested capital, and and the years can get back invested capital of owners.

- The second objective is to investigate the impact of some important technical characteristics of the vessel on gross revenues and income. The main indicators are hull length, age of vessel, crew size, the length of net, experience of kipper, fishing location, and capacity of light.

In order to reach these objectives we need to answer some questions, such as:

Are the fishing boats profitable?

Do larger vessels perform better than smaller ones?

Does longer net perform better than shorter ones?

Does larger crew size perform better than smaller ones?

Does larger light capacity perform better than smaller ones?

What is the income of crew members?

What are the main determinants of annual vessel production (gross revenue and income after deduction of variable costs)?

2. OVERVIEW OF VIETNAMESE FISHERIES

2.1. MARINE RESOURCES

Vietnam Sea has 2,038 fish species including more than 130 commercial species with a total biomass of 4,200,000 tons and a total allowable catch (TAC) of about 1,700,000 tons per year (Table 2.1) (Tran Dinh, 1985)

Table 2.1: Fish stock and total allowable catch (TAC) of Vietnamese marine waters.

Marine waters	Stock (tons)	TAC (tons)	Percentages (%)
Tonkin Gulf	681,200	272,500	16.3
Central	606,400	242,600	14.5
South-East	2,075,900	830,400	49.7
South-West	506,700	202,300	12.1
The small and big Pelagic species	310,000	122,500	7.4
Total	**4,180,200**	**1,670,300**	**100**

(Source: RIMF, 2001).

Further, there are about 1,600 Crustacean species such as crabs and shrimps, and lobsters with the total allowable catch of 60,000 tons per year; seaweeds about of 50,000 tons per year *(RIMF, 2005).*

Depending on the biological and ecological characteristics, the distribution of fish species can be divided into four groups:

Group 1. The big pelagic fishes: They live mainly in the open sea and often in the surface layers and migrate over large distances. Big pelagic fishes are the main targeted species of Vietnam's offshore fisheries since they are the major exported species with high economic value. For example, Tuna; Swordfish; Marlin; Mahi Mahi; Indo pacific spahish mackerel; Wahoo; Narrow barred spanish mackerel. (*RIMF, 2001*).

Group 2. The small pelagic fishes: Small pelagic fishes include species living in surface layers and not migrating as far as big pelagic fishes. However, this classification is not very strict since small pelagic fishes can migrate to other suitable habitats during

their life cycle or during different seasons of a year. Small pelagic fishes are abundant in coastal areas of the North, Centre, and South of Vietnam. They spawn in March and April near the shore. In the gulf of Tonkin, small pelagic fishes are abundant in May and June, in the Central region – August and September and in the Southern region – December and January. For example, Redspot emperor; Layang scad; Roud scad; Japanese horse mackerel; Yellow stripe trevally; Indian mackerel; Gold tripe sardinella; Blue scaled herring . There are 260 species (both the small and big pelagic fishes) which is about of 13 % of total biomass in Vietnamese waters. (*RIMF, 2001*).

Group 3. The demersal fishes: Demersal fishes include fishes living in the bottom layers of the sea or near the bottom layers. They also have high economic value. Most of them are small in size and distributed in coastal areas. The captured species are normally 200 mm in length. They are the targeted species of bottom trawlers and are the major export species among marine fishes of Vietnam. There are 1,432 species, about of 69% of total number of species in Vietnamese waters, including: Speckled tongue sole; Largehead hairtail; Long spine seabream; Black pomfret; Silver pomfret; Silver croaker; Silver grunt; Bully mullet; Goldband goatfish; Pale-edged stingray, etc. (*RIMF, 2001*).

Group 4. The coral reef fishes: Coral reef fishes are group fish species dwelling in coral reefs. They are one of the most colorful and diverse groups of animals. Their extensive range of bright colors and bold patterns is beautiful to behold. There are 340 species, about of 16% of the total number of species in Vietnamese waters. Examples of coral reef species are: Red spotted grouper; Grouper; Shark; Greasy grouper; Ray; Snapper; Trevally; Sixbar grouper; Banded grouper; etc. (*RIMF, 2001*).

As the Vietnam Sea belongs to the tropical environment, it has specific characteristics as:

Oceanography:	Tropical and high temperature,
Biology:	High species richness, high biodiversity,
Fisheries:	Mixed species fisheries.

Because of the problems with mixed catches, it is very difficult to assess specific stocks for protection and setting of Toatal Allowable Catch (TACs). The TAC in Vietnam is used as the Maximum Sustainable Yield (MYS) in other countries to protect the marine resources with the basis of ensuring for conservation and development of fish resources.

This mean that, if the fishermen fish with the yield is less than or equal to TAC, the fish resources can not reduce for a long run. There have been many projects for research and stock assessment in the Vietnam Sea by many researchers such as Menavesta (1973), Nguyen Van Boi (1976), Pham Thuoc (1984), Bui Dinh Chung (1978, 1981), Le Trong Phan (1985) and Bui Dinh Chung, Chu Tien Vinh, Ngyen Huu Duc (2001). But the results varied a lot (Table 2-2).

Table 2.2: The demersal stock and total allowable catch of Vietnamese marine waters.

Marine waters	Stock (tons)	TAC (tons)	Researchers, year
Tonkin Gulf	440,000	280,000	Gulland, 1970
	290,000	145,000	Shindo, 1973
	446,000	223,000	Ayoama, 1973
	800,000	40,000	Le Minh Vien, 1973
Central	160,000	89,000	Shindo, 1969 – 1970
	52,000	26,000	FAO, 1969 – 1971
	193,000	96,000	Van Huu Kim, 1971
South-East	643,000	481,000	Shindo, 1971
	371,000	185,000	FAO, 1971 – 1972
	874,000	437,000	Ayoama, 1973
South-West	900,000	450,600	Isarankura, 1971
	528,000	264,000	FAO, 1969 – 1971
	1,223,000	611,000	Ayoama, 1973

(Source: Thao,N.T, 2005)

2.2. FISHING FLEET AND FISHERIES EMPLOYMENT

1.1.3. Fishing fleet

In general, most of the fishing boats in Vietnam are small, built of wood and operated in inshore areas. Marine fisheries in Vietnam are called *"fishers' fisheries"* or *"small scale fisheries"* which developed spontaneously. For a long time, fisheries development has been out of control of the Government and Ministry of Fisheries.

Figure 2.1: Fishing boats in Nha Trang city, Khanh Hoa province, Vietnam

(Photo by: Hai Chau. Source: Vietnamnet, 2007).

The number of fishing boats and the total engine capacity has unceasingly been growing annually. Specifically, there were 29,584 powered fishing boats in 1981. This number was 85,914 in 2005, which means that the number of powered fishing boats have almost tripled within 25 years and this number grew progressively at a rate of 2,929 boats/year in average. Many scientists of fisheries asserted that this increase is unsustainable. In addition, there are about 4,000 fishing boats without engine (unpowered fishing boats).

Along with the increasing number of fishing boats, the total engine capacity has also been unceasingly growing. There were 453,871 Hp in 1981, this number was 4,721,701 in 2004. It means that the engine capacity is increasing at a rate of 164,579 Hp/year.

The increasing number of fishing boats and total engine capacity implies more fishing effort and more pressure on the resources, causing a threat of over-exploitation of the marine resources. The length of the boat and type of gear varies over different segments of the fleet, as illustrated in Table 2-3.

Trawling is potentially one of the most detrimental fisheries for the marine resources, fishing grounds, and marine ecosystems (Jennings et al. 2001, Kaiser et al). Vietnam has about 21,641 trawlers with about of 25% of total number of fishing boats. The operation of trawlers in coastal areas has caused much damage to the seabed where many species dwell and hence reduced the resources. Trawling is major factor of degraded marine environment (Dong, N.V. 2000). In some other countries, like China, the Government

has banned trawling in inshore waters. But in Vietnam this still a problem, which is difficult to solve because most of fishers and millions of people are very poor and are fishing for subsistence. Therefore, it is difficult to ban an effective fishing method.

Most of the fishing boats is very small. There are 82,507 (90%) boats under 20 meters in length (Table 2-3). Besides, the engine capacity and the speed of fishing boats are low, making them unable to withstand high waves and strong winds. In fact they are vulnerable to bad weather.

Table 2.3: The structure of fishing fleet based on the engine capacity, the length of the boat and the fishery in Vietnam in 2005.

Basis of the engine capacity			**Basis of the length of boat**			**Basis of the fishery**		
Capacity (Hp)	Number (boat)	Rate of total (%)	Length (m)	Number (boat)	Rate of total (%)	Fishery	Number (boat)	Rate of total (%)
< 20	34,294	39.92	< 8	17,296	20.13	Trawling	21,641	25.19
20 -<50	27,096	31.54	8 -<12	28,127	32.74	Pure-seining	6,413	7.46
50 -<90	10,987	12.79	12 -<15	24,056	28.00	Gill netting	16,331	19.01
90 -< 150	4,969	5.78	15 -<20	13,028	15.16	Long line-trolling	15,272	17.78
150 -<400	6,963	8.10	20 -<30	3,373	3.93	Others	26,257	30.56
> 400	1,605	1.87	> 30	34	0.04			
Total	85,914	100	Total	85,914	100	Total	85,914	100

(Source: Vietnamese Ministry of Fisheries, 2005)

1.1.4. Fisheries employment

Vietnam has plentiful of human resources, most people are assiduous. This is a good condition for fisheries and other fields.

Poverty is a challenge for fisheries management. Millions of Vietnamese people depend on fisheries and aquaculture, directly or indirectly. The number of fishers and aquaculturists has grown rapidly. In 1990, it was estimated that 1,860,000 people worked full time as fishers and fish farmers, in 2002 the number has increased to 3,400,000 (Figure 2.2).

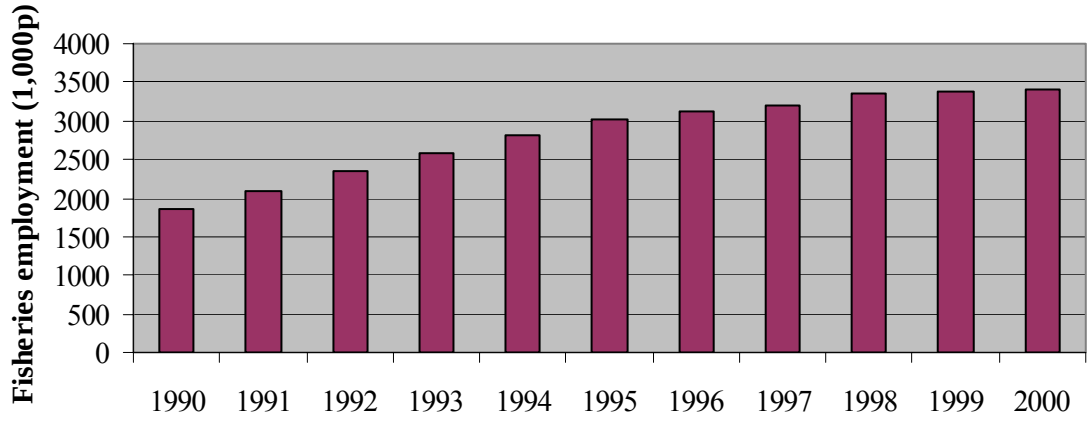

Figure 2.2: Fisheries employment in Vietnam during 1990-2000

(Source: Vietnamese Ministry of Fisheries, 2006)

However, the development of fisheries is not sustainable. It is very difficult for the Government to reduce the number of fishing boats in order to develop sustainable fisheries. Whereas, the education level of fishers is low. Specifically, only 20% of them have gone through primary education while 68% did not, less than 10% graduated from high school and just 0.65% graduated from vocational schools or universities. Hence, fishers have no alternatives to fishing. (Vietnamese Ministry of Fisheries, 2006)

2.3. THE CATCH

Together with the increasing number of fishing boats and the total engine capacity the catch has also been unceasingly growing annually. Although the total marine catch still increases by 46,431 ton/year on average, from 419,470 ton in 1981 to 1,724,200 ton in 2004 and 2,001,700 in 2006, the average productivity (ton/Hp/year) tended to decrease, especially since 1985. The productivity (CPUE) obtained from the peak of 1.11 ton/Hp/year in 1985 and only around 0.35 ton/Hp/year in 2003 and 0.04 ton/Hp/year reducing annually *(RIMF, 2005).*

The percentage of the by catch varies in each haul. The by catch was up to 30% (for offshore trawling) and 60% (inshore trawling) of the total catch, and undersized fishes were observed by a survey in Ba Ria – Vung Tau province (Luong, N.T, 2003).

In order to increase the catch, most of the fishing gears used are not in accordance with the mesh size regulations such as, the sizes of trawl cod end, purse seine's bunt net, trammel net, etc are so small that a large proportion of juveniles are also caught. A number of destructive fishing gears such as estuary set net and scoop net is still used. Furthermore, they exploit in the Marine Protected Areas (MPAs) and the spawning grounds, these are illegal fishing activity.

In addition, because of the resource decline, excessive number of fishing boats, both fishing productivity and income of each unit have dropped constantly. In order to compensate the expenses, fishing units are forced to increase fishing intensity by raising the number of hauls/day and the number active days and reducing mesh size of fishing gear, and increasing illuminating capacity of the lights, etc.

The uncontrolled development fishing effort has caused the marine resources to decrease and caused the extinction of commercially important species. Specifically, a large number of shrimps that used to be target species of the fisheries have become scarce such as shads croaker, giant tiger prawn, and banana prawn. The quality of fish products has also declined, the percentage of trash fish has increased and the proportion of valuable fishes has been reduced, and the profit of fisheries has fallen (Dong, NV, 2001, Tinh, H.V, 2004).

The catch is increasing due to over-fishing. In 2006 the catch was 2,001,656 tons and this volume was higher than the total allowable catch (TAC) of 1,700,000 tons. The overexploitation has impact on the fish stocks and is destroying the biodiversity.

2.4. THE VALUE OF FISHERIES EXPORT

Both capture fisheries and aquaculture products are increasing in volume and price. Its annual contribution to the total Gross Domestic Product (GDP) has been increasing from 1.7% in 1985 to 4.0% in 2004. Total value of the exports were 205,000,000 (USD) in 1990, and this number has increased to 3,357,960,000 (USD) in 2006 (Table 2-4).

Most of export products are frozen fresh seafood, alive fish, shrimp, dried fish, and fish sauce. Tunas and giant tiger prawn contribute the highest portion of export earnings. The main markets of Vietnam's seafood are the United States (USA), European Union (EU), Japan, etc. In the future the Vietnamese Ministry of Trade will promote Vietnamese fish products in order to penetrate other markets over the world.

Table 2.4: Fisheries data trend line of Vietnam in the period of 1990-2006

Years	Total Fisheries Products (tons)	Marine Fishing (tons)	Aquaculture (tons)	Export value (1,000USD)	Total Vessel (units)	Labors (1,000)
1990	1,019,000	709,000	310,000	205,000	72,723	1,860
1991	1,062,163	714,253	347,910	262,234	72,043	2,100
1992	1,097,830	746,570	351,260	305,630	83,972	2,350
1993	1,116,169	793,324	368,604	368,435	93,147	2,570
1994	1,211,496	878,474	333,022	458,200	93,672	2,810
1995	1,344,140	928,860	415,280	550,100	95,700	3,030
1996	1,373,500	962,500	411,000	670,000	97,700	3,120
1997	1,570,000	1,062,000	481,000	776,000	71,500	3,200
1998	1,668,530	1,130,660	537,870	858,600	71,799	3,350
1999	1,827,310	1,212,800	614,510	971,120	73,397	3,380
2000	2,003,000	1,280,590	723,110	1,478,609	79,768	3,400
2001	2,226,900	1,347,800	879,100	1,777,485	78,978	Unknown
2002	2,410,900	1,434,800	976,100	2,014,000	81,800	Unknown
2003	2,536,361	1,426,223	1,110,138	2,199,577	83,122	Unknown
2004	3,073,600	1,923,500	1,150,100	2,400,781	85,430	Unknown
2005	3,432,800	1,995,400	1,437,400	2,738,726	90,880	Unknown
2006	3,695,927	2,001,656	1,694,271	3,357,960	Unknown	Unknown

(Source: Vietnamese Ministry of Fisheries, 2006)

2.5. THE MANAGEMENT SYSTEM.

The set up of fisheries management system in Vietnam is fairly voluminous from Ministry of Fisheries and it is merged in to Ministry of Agriculture and Rural Development (Government) to office (commune) but due to lack of economic resources the required manpower are not sufficient. Most of the human resources were graduated from universities or colleges. However, some times the enforcement is not up to the mark, specially the monitoring on the sea, so that there were many fishers infringe the fisheries law and other regulation in fisheries sector. There are four Research Institutes of Fisheries, one Institute of Fisheries Economics and Planning and Bureau of fisheries to support the Ministry of Fisheries in working.

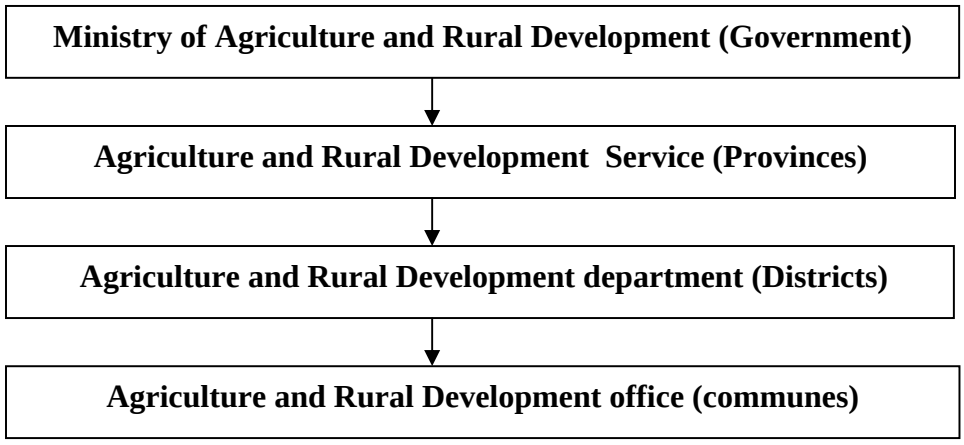

Figure 2.3: Set up of fisheries management system in Vietnam

Up to now, Vietnam's Government has issued one Ordinance of Marine Resources Protection in 1989, one Fisheries Law in 2003 and many fisheries regulations in order to control the fisheries sector. Besides this, the Ministry of Fisheries has issued many standards of fisheries such as fishing gear standard, the minimum length of fishes allowable catch, ect.

In fishing sector, there are five main legal documents.

First, the Regulation of the Ministry of Fisheries (in January 23, 1986) to administer the operation of fishing boats in the Vietnam Sea. In this regulation, the Vietnam Sea was divided in to three areas:

Coastal zone fishing with 10 meters in depth or far from the coastline 3.2 miles.

In-shore fishing with 10 - 30 meters in depth or far from the coastline 3.2 - 8.6 miles.

Off-shore fishing with the depth of the sea is over 30 meters or in areas located 8.6 miles or more from the coast line.

Permission to fish is granted on basis of gear and engine capacity.

Second, the Ordinance of Marine Resources Protection of Government in 1989. In the period of 1989 – 2003, the Ministry of Fisheries used it to control the fishing development and protected the marine resources. Content of this ordinance regulate the minimum of mesh size of fishing gear; the minimum size of allowable catch, ect.

Third, the Law of Fisheries of Government (No 17/2003/QH11 in November 26, 2003). It is a very important basis for managing the fisheries. It includes 10 chapters and covers all sectors of development and protection of marine resources; fishing operations; aquaculture; fishing vessels and service units for fisheries activities; state of fisheries activities.

Fourth, the Degree of Government (No 191/2004/ND-CP in November 18, 2004). The content of this degree to manage the foreign fishing boats in Vietnam Sea.

Fifth, the Degree of Government (No 59/2005/ND-CP in May 4, 2005) and explanation given by the Circular of Ministry of Fisheries (No 02/2006/TT-BTS in March 20, 2006). The purpose of this Circular is among other things to regulate the minimum of mesh size of 13 fishing gears (depend on the engine capacity and the target catch); to forbid some kind of destructive fishing gears such as estuary set net, scoop net and chemicals; to forbid the fishing for 21 species without the time-limit for example Pteria maxima, Tenualosa toli, Anguilla bicolor pacifica, Chitala and to forbid the fishing for 19 species with the time-limit.

In 2005, the Ministry of Fisheries of Vietnam built a strategy on fisheries management and sustainable development for the next 10 years (until 2015). The contents of this strategy were: Collecting daily fisheries data policy; creating a vessel registering system; dividing sea areas for fishing and preparing a plan of off-shore fishing

management; and building of vessel monitoring system for off-shore fishing, as well as reducing the number of fishing fleet to 50,000 boats (in 2010).

In summary, the Government needs to care about human development and education of fishers. The workers need an education policy of Government to improve their knowledge. This is a good condition to solve problems in fisheries.

The Government also has to find a good solution in order to restrict destructive fishing techniques. Enforcement of the Fisheries Law, implementation of FAO Code of Conduct for Responsible Fisheries and other regulations are future challenges. In addition, the Government needs to establish some fisheries management tools such as input control (gear restrictions, vessel restrictions, licenses restrictions, individual effort quotas) and output control (total allowable catch, trip limits and bag limits, individual vessel quotas).

In my opinion the main problems of Vietnamese fisheries to be focused:

1. Education and human resources development,

2. Over fishing in coastal areas,

3. Restrict or limit the use of damaging fishing gears and fishing methods,

4. Control the number of fishing boats,

5. Reduce the competition in marine fishing,

6. Improve the offshore fishing technology,

7. Strengthen the fisheries management sector.

3. OVERVIEW OF KHANH HOA FISHERIES

Khanh Hoa is a fishery province in the Southern Central of Vietnam with a coastline of 520 km, over 200 islands and more than 5,197 km^2. Fisheries in Khanh Hoa play important roles with regard to both socioeconomic and development. The number of fishing fleets is over 5,430, of which about 450 are offshore fishing boats. Hence, approximately 91% of the total fishing boats is small and operates in the coastal area. The fisheries in Khanh Hoa open access and multi–species fisheries. The fishermen use a variety of fishing gears, including gill-net, long line, trawl, seine net, set-net and hook. Thus, research and estimate of the factors affecting on the efficiency of inshore fisheries are very important for decision makers. (Khanh Hoa Fisheries services, 2007)

3.1. Fishing fleet

The number of fishing fleet in Khanh Hoa province was about 5.562 boats (12/2007), among these, the number of offshore fishing fleet (≥ 90 Hp) was 395 boats. Hence, approximately 92.8% of the total fishing boats is small and operates in the coastal area.

Table 3.1: Structure of fishing fleet in Khanh Hoa Province

Fishery / Horsepower	Trawling	Purse seining	Gill netting	Long lining, trolling	Others	Total
< 20 Hp	106	260	235	187	1.918	2.706
20 -<50 Hp	233	796	175	85	355	1.644
50-<90 Hp	289	270	157	82	19	817
90-<150 Hp	88	64	86	60	28	326
150-<400 Hp	6	5	22	9	24	66
> 400 Hp				2	1	03
Total	**722**	**1.395**	**675**	**425**	**2345**	**5.562**

(Source: Khanh Hoa Fisheries services, 2007)

The Table 3.1 presents the number of fishing boats by horse power groups and fisheries. The number of purse seiners was biggest 1.395, approximately 25% of total fishing boats in Khanh Hoa. Most of fishing boats in Khanh Hoa has small size and small horse

power. More than 78% of the motorized vessels have an engine of less than 50 Hp. Only a few fishermen and fishing boats can be able to participate in offshore areas. Hence, fishing is concentrated in the coastal water and this has resulted in high pressure on inshore marine resources. Many of these boats are considered medium-large in size and are powered by 30-60 Hp engines suitable for large push nets and purse seine. Smaller boats are used for the diving, tremmel net, traps, and trolling fisheries.

3.2. The fish production

Table 3.2: Production of fisheries and aquaculture in Khanh Hoa in the period of 2002-2007.

Year	2002	2003	2004	2005	2006	2007
Total production (ton)	68,100	70,547	68,265	80,581	79,147	81,992
Aquaculture (ton)	7,128	8,661	8,563	17,460	13,880	15,120
Fisheries (ton)	60,972	61,886	59,702	63,121	65,266	66,872
Capture fisheries (ton)	54,600	53,600	53,200	56,200	57,600	59,800
Value (million VND)	716.0	776.8	667.1	699.2	750.0	756.6

(Source: General statistics office of Khanh Hoa)

Like other coastal fisheries provinces, Khanh Hoa has fresh water fisheries, capture fisheries and aquaculture. The total fish production increased annually from 68,100 tons (2002) to 81,992 tons (2007) with the average increasing rate of 3.4% per year while aquaculture production was twofold from 7,128 tons (2002) to 15,120 tons (2007). The production of fisheries, capture fisheries and the economic value increased slowly.

3.3. Fishing process of purse seine fishery in Khanh Hoa

The skipper chooses the place for their fishing activity in the afternoon, when the darkness comes; they turn on the light system for attracting the fish around. The skipper monitors the quantity of fish on the echo-sounder (Figure 3.1).

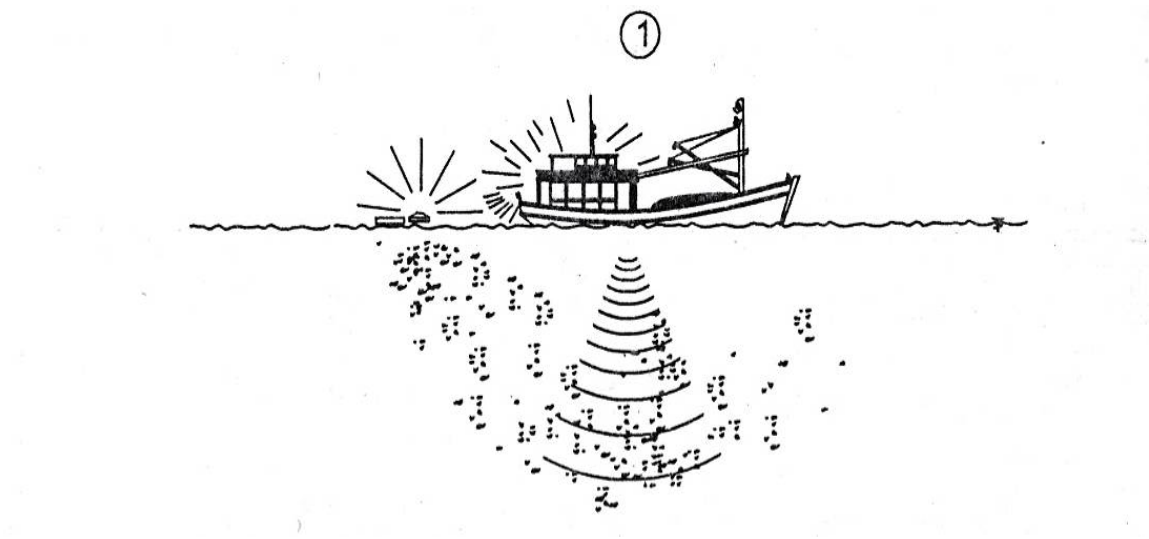

Figure 3.1: Attract fish by light

At the same time, the fishermen arrange, check the net and prepare everything for the haul. When the time lighting or/and amount of fish is large enough, they netting (Figure 3.2). Depending on the trend of current and wind, the skipper selects a suitable place and trend for netting.

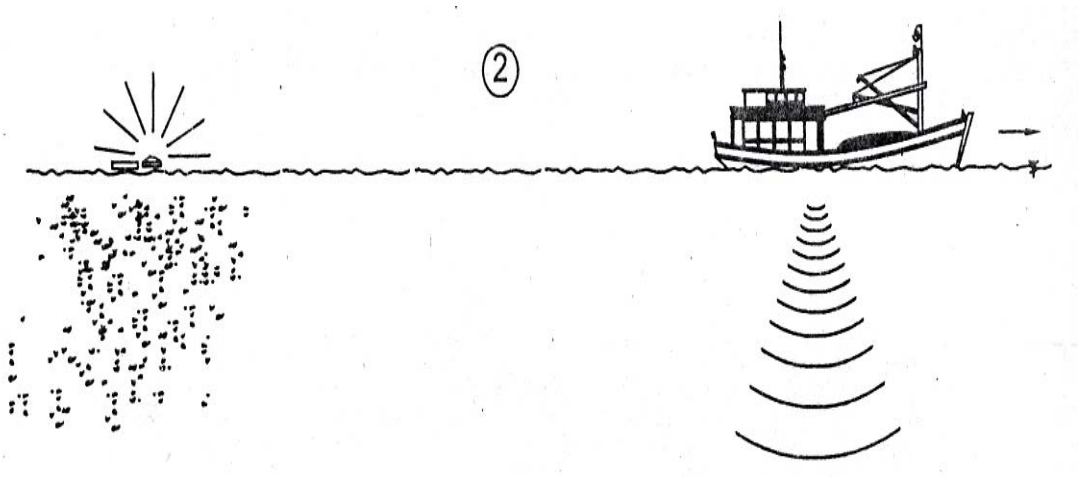

Figure 3.2: The vessel lives light raft for netting

The fishermen encircle around the fish school by wall of net (Figure 3.3). When the wall of net is closed, they haul the net on board from the wing to the body of net.

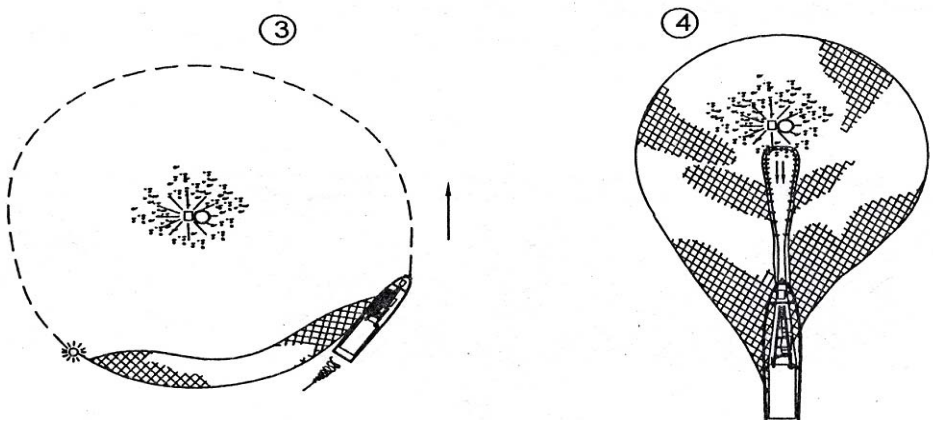

Figure 3.3: Setting (3) and hauling (4)

After finish of hauling the wing and body of net, the fish is kipped in the bunt of net then fishermen collect the fish by lending net (Figure 3.4)

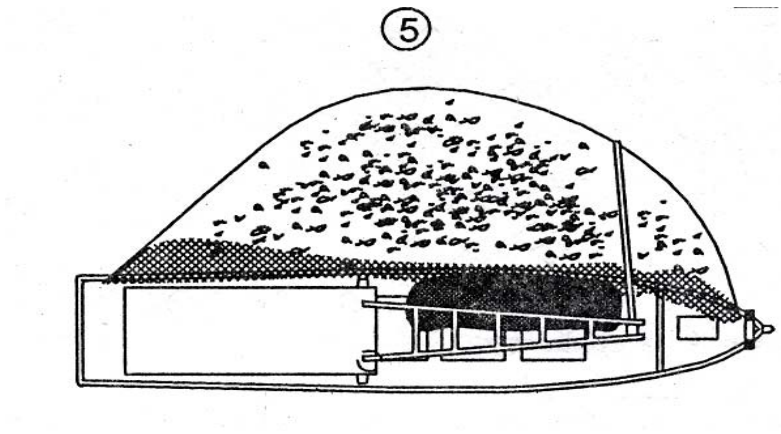

Figure 3.4: Fish collection

4. REVIEW OF THE PURSE-SEINING DEVELOPMENT AND LITERATURE

4.1. REVIEW OF THE PURSE-SEINING DEVELOPMENT ALL OVER THE WORLD

Purse seine is one of the selective kinds of fishing gears which has high productivity and is also very popular in fishing countries all over the world. The purse seine fishery was first found in various sea areas where other fishing gears could not operate or operated efficiently. (Ngan, T.V, 2005).

Purse seine was first used by American fishermen for catching the pelagic fish in inshore of Atlantic Ocean in 1860 and inshore of Pacific Ocean in 1866. Purse-seine fishery was early developed in Europe countries. In 1881, purse-seine fishery was introduced in Sweden and became popular by the year of 1903 with over 300 purse-seiners, 200 purse-seiners in 1914 in Norway, 100 purse-seiners in 1914 in Denmark. Some countries had developed industrial purse-seine fisheries, such as Spain, Russia, and France. Purse seine fishing fleets specialize in catching offshore tuna were equipped with all modern fishing mechanics, navigation equipments, echo sounders (fish finders), and large size of nets and initiative to found the fish stocks. Hence, they could be in the sea for long trips fishing operation (from 45 to 60 days per trip). In Asia, the purse seine fishery developed in China, Thailand, Philippine and Japan. (Ngan, T.V, 2005).

We can see that, in a short period from the first purse seine was used, the purse seine fishery in the world developed rapidly and occupied an important role in fisheries. The harvest from purse seine fishery occupied about 20 percents of total yield over the world. In some countries in Amarica, the purse seine catch was about 50 % of total landings. This figure was 40%, 35% and 33% in Japan, Indonesia and Thailand. (Ngan, T.V, 2005).

In recent years, the revolution in science – technology have affected on the purse seine fishery, many modern purse seiners are used with high speed, modern fishing equipments and new netting materials. All these factors created good conditions for purse seine fishery over the world to achieve a new period of development, the fishing grounds had expanded into oceans, and annual catch of purse seine fishery was increasing

4.2. REVIEW OF THE PURSE -SEINING DEVELOPMENT IN VIETNAM.

In Vietnam, purse seine was used to catch pelagic fish in gulf of Tonkin, gulf of Thailand, Central, South-East and South-West sea of Vietnam. The target species were Redspot emperor; Layang scad; Roud scad; Japanese horse mackerel; Yellow stripe trevally; Indian mackerel; Gold tripe sardinella; Blue scaled herring; anchovies and other pelagic fishes. The purse seine fishery in Vietnam was introduced later than that of other countries. The first purse seiner was appeared in the North of Vietnam in 1959. Although it was late, the catch of this fishery was quite high about 11.7 percents in 1960 and it obtained 17 percents of total catch in 1962. Up to 1975 the purse seine fishery was appeared in the South of Vietnam. Nowadays, the purse seine fishery has been introduced in 29 fishery provinces in Vietnam, among others Quang Ninh, Quang Nam, Da Nang, Ninh Thuan, Binh Thuan, Ca Mau and Ben Tre. (Ngan, T.V, 2005).

With the development of new technologies and fish attractive equipments like fish attraction light, color of light, fish aggregation device, netting material, the purse seine fishery has developed rapidly. However, most of the fishing boats in the North of Vietnam are small, 13 - 16 meters in length, and the engine power is less than 90 Hp. In the South, the boats are a bit bigger than those in the North, 16 - 23 meters in length and 90-450 Hp in engine power.

In Vietnam, there are two main fishing methods for purse seine fishery. Those are fishing with light and fish aggregation device, and those searching purse seine. The method of using light and fish aggregation device is very popular in many fishery provinces. For this method the average size of the net is about 250 - 500 meters in length and 45 -70 meters in depth. The fish schools are attracted by a fish aggregating device and lights, hence they does not need to be as long as those used in the search fishery. The searching purse seiners, who specialize in catching pelagic fishes which have high movement speed, also need to have high movement and setting operation speed. In addition, the nets have bigger size, the average size of net is from 500 – 1200 meters in length and 70 – 120 meters in depth. This fleet is also characterized by modern the fishing equipments, mechanical implements and fish finders. (Ngan, T.V, 2005).

Catching efficiency of purse seine largely depend on the speed at which the fish school can be encircled, how fast the long net wall sinks down, and how quickly the net can be closed by pursing. The highest possible speed is desired for all three operations to prevent the active fish school from escaping, and to reduce the influence of wind drift and water current on the operation. Sinking speed is influenced by the kind of netting materials as well as by the construction of the gear, including mesh size, the manner in which the net is hung, the weight of the lead-line and the coatings applied to the twine. The higher the specific gravity of the fiber, the smoother the surface and the smaller the diameter of the yarn, the faster the sinking speed of the net.

Materials used include both nylon and polyester, the choice often depending upon cost and availability; although nylon is stronger and often less expensive, polyester with its greater density often increases the sinking speed of the net, as does the use of knotless webbing. Ultra cross and similar materials are now coming into more general use, offering the potential for longer life while at the same time further reducing resistance to water flow. Plastic floats, made from PVC (Polyvinylchloride) or EVA (ethylenvinylacetate) are often used, especially on more sophisticated large net, while simple sponge types are common for smaller and lighter gear.

In general, the purse seine fishery is under development in Vietnam, fishing boats are still small in size and engine power, and the fishing equipment and fish finders are limited. However, the policies of government are encouraging in offshore fishery development especially for purse seine fishery for catching the pelagic oceanic schools.

4.3. LITERATURE REVIEW

In recent years, there are many projects and researchers studied on how the fisheries affected on marine biology, efficiency, technical efficiency, ect. Among those, some of studies relevant to economic efficiency can be presented as:

- In Norway

Flaaten et al. (1995) researched on the Norwegian purse seine fishery. They compared the profitability of the vessels who where already in the fishery when management was introduced, to that of those entering the fishery at a later stage. The first group got their licenses for free from the government, while the second group had to buy their licence

along with their vessels. The analysis of revenue and cost data, collected in 1983 and 1984, reviled presented that the second group of vessels had had a lower profitability than group one because they lost an amount of money to pay the license tax. Hence, the total cost increased but the revenue was not changed.

- In Thailand

One of the first economic researches in fisheries filed was belong to Huvanandana (1973). He studied and compared costs and earnings of purse seine and encircling fleets which operated in South China Sea. The results showed that encircling fleet could get more profit.

Panayotou (1980) considered if there was any conflict between small scale and large scale fishermen in socioeconomic conditions. Also, he assessed the benefits that fishermen received from the policies of government and the tendency of these. The research emphasized the importance of activities besides fishing in order to increase opportunity cost for small scale fishermen community. This was a basement to improve the income of fishers and renew the fisheries resource.

Kumpa (1981) analyzed the cost structure and profitability of small scale fishing fleets in Chumphon province. She revealed that experience, boat size, and fishing days are key factors affected on the amount of harvest. Besides, the revenue had positive effect on the type and size of fishing gear with all the inputs were used efficiently. Some pelagic fishing gears such as purse seine, gill net were more efficient than demarsal fishing gears like trawl.

- In Indonesia

Domingo (1978) and Baun (1978) studied costs and earnings of trawlers and purse seiners on the North Coastal of Java. However, their approaches were different. Domingo collected the data in May, 1978 and presumed this month was an average month of the year in catch and operation. Therefore, the revenues and costs could be extrapolated from this. Meanwhile, Baun calculated the costs and revenues mostly based on the secondary data. Also, the different methods for depreciation and opportunity costs resulted in different valuations. Baun’s estimates of the profits of both purse

seiners and trawlers were much lower than those found in Domingo results, but both of them agreed that the profit of purse seine fishery was higher than that of trawl fishery.

- In Cameroon

Oumarou (1996) studied the profitability of purse seining fleet which practiced in Coastal of Cameroon from September, 1994 to December, 1996. The results showed that the small scale purse seiners had high profits; the profitability on the investment was 62% and the net added value was about 69% of gross revenue. It was higher than the opportunity cost practiced in the Cameroonian baking system. The rate allowed owners to recover their invested capital in 21 months on average.

- FAO

From 1995 to 1997 FAO did a survey on the fisheries economic development possibility in 15 countries in 4 continents: Asia, Africa, Europe, and America. The results showed that there were positive net cash flows and fully recovered their cost operation for the purse seine fisheries in Ghana, Peru, France, Argentina, North Korean, Taiwan and Malaysia etc. The purse seiners in China, India, and Senegal showed net losses. There were many reasons for this such as overexploitation of their main target species (like mackerel and oil sardine in India); overcapitalization, high maintenance costs and low yields on fully exploited resources fished (in Senegal); and some reasons for Chinese purse seniers were caused by overfishing in the East China Sea, restrictions and closing of fishing grounds of Government.

Besides, there was growing interest in the measurement of technical efficiency of different fishing fleets. Most studies aimed to establish the underlying factors (Kirkley et al., 1998) and to evaluate the effect of management measures on technical efficiency. The fishery decision makers could therefore adjust technical efficiency by constraining the use of inputs (Pascoe et al., 2001). By using stochastic frontier models for a case on the Gulf of Cádiz (Spain), Juan José et al. (2004) concluded the longer the useful life vessels was, the smaller the technical efficiency was. For Tom Kompas et al. (2004), the authors indicate that technical efficiency was increasing in a measure of vessel size and engine capacity that was controlled by the regulator form 1985 to 2001, and decreasing in an unregulated input, gear head rope length. In the study of Abdoulkarim Esmaeili

(2006), the results showed that both skippers' socio-economic drivers and vessel instrumentation had a significant impact on efficiency. Owner-operated vessels and younger skippers were more efficient than others.

- Viet Nam:

In general, there are no comprehensive studies assessing the technical efficiency of fisheries in Vietnam. Some of the research projects were concentrated on the efficiency and analyzing economic performance for offshore fisheries aiming to encourage the fishermen develop offshore fisheries such as tuna longlining, purse seining, trawling, and gill netting in some regions or fishery provinces. However, most of them were qualitative or overview analyses due to lack of detailed data on costs and earnings at vessel level or household. Since in 1997, the Vietnamese Government had made strenuous efforts to develop its offshore fisheries. These efforts had aimed at attaining two broad policy objectives: those were expanding marine fish production for domestic consumption and as well as for export; and reducing the pressure on coastal marine resources. In the case of coastal fisheries, they concentrated on the improving the selectivity of fishing gears for protection and conservation of marine resources.

4.4. ECONOMIC PERFORMANCE INDICATORS

There are many indicators can be presented the economic performance. However, there is some confusion about the concepts of economic efficiency and economic indicators. The economic efficiency concept is theoretically or well established. While indicators is a analytical tool to structure information about economic efficiency and it is not a theoretical concept. Some of the economic variables that can be used to analyze the fisheries as economic efficiency are: net profit, harvest, the possibility of contributing to GDP, export, employment, effort and fleet capacity, ect (Hans Frost, Erik Buisman, Ayoe Hoff, Arantza Murillas, (Review on economic indicators; p. 15). In my research project, I use some econocmic indicators such as ratio of gross revenue to total costs, ratio of net profit to gross revenue, ratio of net profit to total costs, ratio of net profit to total invested capital, and investment retune (and the years can get back invested capital of owners).

5. METHOD

5.1. DATA COLLECTION

1.1.5. Secondary data

Collecting and referencing from the results of surveys and studies most closely concerned about fishing operations, particular purse seining fishery of the relevant departments, institutes, universities, research centres, foreign projects such as: Research institute for marine fisheries, Fisheries services, Ministry of Agriculture an Rural development, general statistics office.

1.1.6. Primary data

Data is collected from a survey of costs and earnings, as well as technical and operational characteristics of small-scale pure-seine fishery in Khanh Hoa province (in Nha Trang city and Cam Ranh district) in 2008. We chose to collected the data in Cam Ranh and Nha Trang based on the statistics of Khanh Hoa fisheries services, both have high density of purse seining in some fisheries communities.

The data was collected through questionnaire and a direct interviewed with boat owners or their wife in order to capture information relevant to the research problem. The interviews were undertaken at their home or onboard the boats by individual or group.

The pure-seiners surveyed were 100 of the total 1,000 boats. The samples concentrated in fishing boats which were less than 90 engine horse-power and operated in coastal zone of Khanh Hoa sea. The samples were collected by random method on the basic of the number fishing boats for each group of engine horse-power. Depending on the engine horse-power, we divided the coastal fisheries in to four groups as less than 20 Hp, 20 - < 45 Hp, 45 – < 75 Hp, and 75 - < 90 Hp. For each group of fishing boats, we concentrated on technical information such as hull length, engine power, length of net, number of lights, light capacity, type of light, etc; operational information such as days of fishing, number of fishermen on board associated with their education level, average income, experience in purse seining; and economic information: Fixed costs, variable costs, total revenue, harvest, etc. A copy of the questionnaire is attached in the appendix.

Table 5.1: Samples of purse seiners are allocated based engine power and geography (up to 31/12/2007)

Group of engine power (Hp)	Cam Ranh district			Nha Trang city		
	Population	Sample	Rate of population	Population	sample	Rate of population
<20	519	21	4.04	155	18	11.61
20 - < 45	147	13	8.84	60	16	26.66
45 - < 75	67	8	11.94	44	10	22.22
75 - < 90	4	2	50.00	4	2	50.00
Total	737	44	5.97	263	46	17.49

However, we faced many difficulties in the investigative duration. The first could be mentioned that the education level of fishermen, skippers, and their wife is quite low. Hence, they limited in calculated and estimated all of detail information. The second, when they supplied their economic information, they were afraid that the government, local government and the relevant departments cut or reduced the subsidy program of fuel price and other relevant policies. Hence, the quality of data was supplied might not exactly. The third, the boat owners might not remember exactly the year of building, year of purchased as well as purchased prices. Hence, it was very difficult to estimate the invested capital at that time. However, as similarity other economic surveys of fisheries for estimating the economic values of fishing boat were often subject to measurement errors and could not have high ambition for all input factors, we concentrated analysis on some main factors that effect efficiency.

5.2. DATA ANALYSIS

We used regression analysis to determine how annual gross revenue of purse-seine fishery was affected by the technical characteristics.

Software of Microsoft Excel was used to calculate and estimate the unknown parameters in production function.

5.3. CALCULATION METHODS

** **Definition of terms and calculation methods***

Vietnamese fisheries is quite different from other forms of business in that fishing operations are based on seasons and rather affected by natural conditions. Some costs such as fuel cost, ice cost, food expense, engine and fishing equipments maintenance, etc, depend on effort rather than catch. Therefore, we cannot apply the method of costs classification based on catch (yield). In this case, we proposed to apply the method of costs classification based on trips because the number of trips in one year are rather stable and the fishing capacity can be changed depend on main or sub-seasons. Hence, we fixed some of cost items such as capital and maintenance of boats, fishing equipments, and fishing gear to allocate annual. Moreover, because of limited time and finances, along with careless book keeping of boat owners, we could not survey detailed costs for each trip. Thus, we applied mean method to calculate the mean of variable costs, mean of revenue for each trip, and then extrapolated the total costs, total revenue and net benefit. The general calculation methods approach is presented as follows:

	Gross annual vessel revenue
-	Operating cost (fixed and variable), except labor cost
=	Gross value added
-	Labor cost
=	Gross cash flow
-	(Depreciation + Interest loan payment)
=	Net profit

Figure 5.1: Calculation method

Gross annual vessel revenue is the total vessel revenue at the average price. Basis for the calculations is the average yield per trip in the main season, multiplied by the total of number fishing trips and the fish price, plus average yield per trip in the sub-season, multiplied by the total of number fishing trips and the fish price. In other words, that is the result of multiplying the total of the average fishing trip revenue by the number of trips in the main and sub seasons in 2008.

Operating costs is the total of fixed costs and variable costs. The variable costs of a vessel include fuel cost, lubricant cost, preservation cost, foodstuff and other inconsiderable repairs. It is the total of the average variable cost per fishing trip, multiplied by the number of trips in both the main and sub-seasons in 2008. The fixed cost is the total of yearly maintains costs of hull, fishing gear, engine, overhaul, and other equipments on boats.

Labor cost is calculated based on total revenue, if the total revenue is larger than the total cost. Labor cost is positive if total cost exceed total costs, zero otherwise.

Gross value added is total gross annual vessel revenue minus the total operating cost, that is the cost paid to suppliers, including fixed cost (except depreciation, loan interest) and variable cost (except labor cost). In other words, it is the sum of cost of labor, depreciation, interest and net profit.

Gross cash flow is calculated as gross value added minus the total of labor cost. In other words, gross cash flow is the gross annual vessel revenue minus all expenses, except depreciation and interest.

Net profit is the gross annual vessel revenue minus all expenses and it equals gross cash flow minus depreciation and loan interest payment.

These definitions and calculation methods ware in accordance with those used in Flaaten *et al*. (1995). However, since the Vietnamese fishermen often have no written documents and account books as mentioned above, we should have appropriate adjustments for applying.

**** Estimation the invested capital of boat owners.***

Invested capital is defined as the present value of a boat. That is the value converted at the surveyed time (2008) depends on the inflation index and original purchased price. Specifically, how much they can buy or can sell their boat or the same quality's boat? This is the calculation method that Assessment of the Living Marine Resources in Viet Nam Phase I (ALMRV) and Vietnamese institute of fisheries economic and planning (VIFEP) applied to investigate the invested capital.

**** Estimation Depreciation of boat owners***

The annual depreciation is the total of boat, engine, fishing gear, fishing equipments and navigations. Due to lack of the information about capital as well as depreciation time, we use the linear method to calculate the depreciation. In order to calculate the annual cost of depreciation we need to know the lifespan of vessel and fishing gear. In the case of vessel, the lifespan is 15 years, estimated by Vietnamese Ministry of Finance (Ministry of Finance). The lifespan of fishing gear is 3 years, estimated by owners.

All vessels surveyed in the coastal purse seine fisheries in Khanh Hoa were built in the 1990s. At that time, the inflation in Asia affected to the socioeconomic in Vietnam, Vietnamese economic faced high inflation. Hence, gold was normally used for exchange instead of currency. Like other goods, boats with the same hull length, quality might have different prices depending on the bargaining capacity and gold prices. And hull purchased prices were conditional on year of building, year of purchase, wood prices as well as the market prices. All factors above are indispensable for depreciation.

**** Comparison method***

Comparison method applies to analyze how the fishing operation's results depend on the geographical areas and rank of engine power.

6. RESULTS

6.1. DESCRIPTIVE STATISTICS OF THE PURSE SEINE FLEET IN KHANH HOA

100 fishing boats were surveyed in Khanh Hoa, representing about 10% of purse seiners in Cam Ranh and Nha Trang. Some of the main characteristics of purse seiners are hull length of vessel, engine horse power, length of net and light capacity (Table 6.1).

Table 6.1: Descriptive statistics of the main technical characteristics of purse seining by vessel groups and locations.

Hull length of vessel (meter)										
Horse power	**Cam Ranh**					**Nha Trang**				
	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
< 20	21	7.40	11.50	9.52	0.97	28	7.40	12.70	10.04	1.30
20-<45	13	11.70	16.00	13.36	1.11	16	11.59	14.80	13.00	13.00
45-<75	8	12.00	15.50	13.78	1.17	10	13.70	16.30	14.66	0.86
75-<90	2	16.70	16.70	16.70	0.00	2	15.50	16.50	16.00	0.71
Engine horsepower (Hp)										
Horse power	**Cam Ranh**					**Nha Trang**				
	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
< 20	21	11.00	15.00	13.14	1.53	28	11.00	16.00	14.07	1.78
20-<45	13	20.00	39.00	31.69	7.12	16	20.00	40.00	35.81	4.83
45-<75	8	45.00	56.00	48.88	5.36	10	56.00	70.00	61.50	4.33
75-<90	2	80.00	80.00	80.00	0.00	2	80.00	80.00	80.00	0.00
Length of net (meter)										
Horse power	**Cam Ranh**					**Nha Trang**				
	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
< 20	21	280	330	310.48	18.57	28	300	340	322.50	13.78
20-<45	13	300	380	350.77	22.16	16	340	450	371.88	23.73
45-<75	8	400	480	435.00	27.77	10	440	500	468.00	24.40
75-<90	2	550	580	565.00	21.21	2	540	540	540.00	0.00

Light capacity (watt)										
Horse power	**Cam Ranh**					**Nha Trang**				
	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
< 20	21	2400	3200	2838.10	307.37	28	2400	3200	2985.71	254.90
20-<45	13	2800	3400	3046.15	202.55	16	2800	3400	3075.00	204.94
45-<75	8	2800	3400	3075.00	212.13	10	2800	3400	3100.00	194.37
75-<90	2	3200	3200	3200.00	0.00	2	3200	3200	3200.00	0.00

**** The hull length of vessel***

From Table 6.1 we see that the majority of purse seiners in the two locations were small-scale vessels. The length of fishing boats ranges from 7.4 to 16.7 meters, and depends on the engine capacity. The mean length of boats increases among the increase of horse power groups.

**** Engine horsepower***

The engine power ranges from 11 Hp to 80 Hp. In general, the mean horse power of boats in Nha Trang is larger than in Cam Ranh among the groups power of vessel.

**** The length of net***

The length of net is measured in meter increase with increasing hull length and horse power. For the coastal purse seine fishery, the length of net fluctuates from 322.5 to 565.0 meters depending on the engine power. The mean net length in Cam Ranh is longer than in Nha Trang. Because of the use of fish attraction light in fishing operation, the net can be shorter than the searching purse seine in both locations. Other reason could be that the two fleets (purse seine with light and searching purse seine) target different species. The main target species for the coastal purse seine fishery in Khanh Hoa is anchovies which has low speed movement and likes the light.

**** Capacity of light***

The capacity of light using in the purse seine fishery depends on the experience of skipper and capacity of the auxiliary engine – generator. The capacity of light is measured in watt (W). The number of capacity fluctuates from 2400 to 3200 watts. The

light used is neon, the number of light is from 40 to 80 tubes and is attached to each other in a light raft. Each light raft has from 5 to 8 tubes. The light raff disposes on the right, left and behind the cabin of vessel, so the fish can see the attractive light and moves around the light.

Table 6.2: Descriptive statistics of the main characteristics of skipper and crew of purse seining by vessel groups and locations.

Experience of skipper (year)										
Horse power	**Cam Ranh**					**Nha Trang**				
	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
< 20	21	8.00	14.00	10.86	1.59	28	7.00	14.00	10.39	1.64
20-<45	13	10.00	18.00	12.77	2.59	16	7.00	18.00	12.13	3.34
45-<75	8	7.00	18.00	13.00	3.70	10	7.00	15.00	11.00	2.36
75-<90	2	10.00	12.00	11.00	1.41	2	17.00	18.00	17.50	0.71
Crew size (people)										
Horse power	**Cam Ranh**					**Nha Trang**				
	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
< 20	21	7.00	10.00	7.90	0.77	28	7.00	10.00	8.11	0.83
20-<45	13	8.00	10.00	9.00	0.82	16	8.00	10.00	8.56	0.73
45-<75	8	8.00	12.00	10.00	1.41	10	9.00	12.00	10.50	0.97
75-<90	2	12.00	12.00	12.00	0.00	2	11.00	12.00	11.50	0.71
Yearly average income per crew man (million VND)										
Horse power	**Cam Ranh**					**Nha Trang**				
	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
< 20	21	8.75	21.31	13.81	3.40	28	7.71	14.46	11.04	1.86
20-<45	13	10.06	30.42	15.58	5.04	16	7.63	20.23	13.16	3.45
45-<75	8	13.34	23.99	18.32	3.46	10	13.55	19.97	16.44	2.12
75-<90	2	18.48	19.84	19.16	0.97	2	15.79	17.61	16.70	1.28

The Table 6.2 presents the average experience of skippers, crew size and income of purse seine fishery in Nha Trang and Cam Ranh in 2008.

**** Experience of skipper***

The fishing experience of skippers is measured by the number of years since they became skippers. The fishing experience of skippers fluctuates from 7 to 18 years. However, if estimating the fishing experience when the fishermen participated in fishing activity, the year of experience is reliable larger because in Khanh Hoa if fisherman wants to be come a skipper, he must have at least 5 to 10 years of experience. The mean of fishing experience of skipper is from 11-13 years in Cam Ranh and 11 to 17.5 years in Nha Trang (Table 6.2). With this figure, the total years of fishing experience since they work as fishermen are estimated from 16 to 28 years. 91.5 percents of fishermen interviewed said that "*fishing experience is very important factor in fishing; they do not have enough information about the fish, fishing ground like fishermen in developed countries. Thus, they are able to predict the direction of its moving of fish, fishing ground with high fish density. Moreover, they are able to predict the speed of current, trend of wind*". These are very important factors to catch more fish, save fuel; limit the net's break and other accidents". This is also the answer to the question of why the owners always confide their boat to the high skill and full experience skipper. It is very interesting to see that, the Vietnamese fishermen accumulate the fishing experience from generation to generation and practice without training from technical schools. The elders teach fishing skill to their sons when they were very young.

**** Crew size***

The crew size of purse seining is rather large; it fluctuates from 7 to 12 members and depends on the size of vessels as well as the size of nets. It requires more fishermen pull and arrange the net if it is large. Because the coastal purse seine fishery in Khanh Hoa is using the manpower for fishing activities, they do not install a net hauler on boat. Compared to the coastal trawlers in Khanh Hoa, the coastal purse seiners employ a larger number of employees.

**** Income of fishermen***

The income of individual is calculated based on his effort, skill and experience. Hence, the income of each fisherman may vary while they work on the same vessel. In general, the income of fishermen in the coastal purse seiners in Khanh Hoa is reliable high

compared to the coastal trawlers in Nha Trang (Nhan, D.X, 2008). The mean income of fishermen in Cam Ranh is higher than in Nha Trang, and fishermen who work on larger vessel have a higher income than those working on small ones. The highest income is that of fishermen working on the vessel group of 75-<90 Hp in both locations of Nha Trang and Cam Ranh. The lowest income is the vessel group of < 20Hp in both locations. However, the coefficients of Standard Deviations (SD) of income in Canh Ranh are larger than in Nha Trang, indicating that fishermen in Nha Trang have more stable income than in Cam Ranh. The average of operating time is 10 months per year, from January to October. The main season from April to August, other months are sub-season. Each month they operate from 20-25 days and one day per trip. With 10 months of fishing operation, the average income of fishermen is quite high compared to the average income of 9.8 millions VND per inland manual labour in Khanh Hoa in 2008 (Khanh Hoa statistic office). However, the average income per capita of fishermen is low because men are the main labors in almost fishing communities.

**** Average yield***

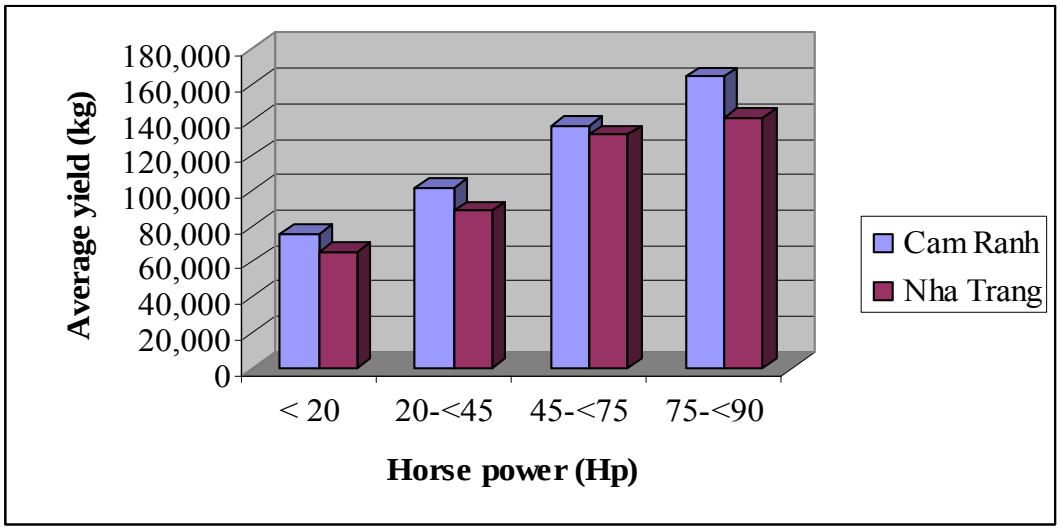

Figure 6.1: The average yield among the vessel size groups in Cam Ranh and Nha Trang in 2008.

The Figure above presents the average yield per vessel per year in both locations of Nha Trang and Cam Ranh. In general, the average yield increases following the increasing of engine power group in Nha Trang as well as in Cam Ranh. And the average yield per vessel in Cam Ranh is larger than in Nha Trang for the same of group. Moreover, for the

large engine power, the vessel can surround the fish with high speed and consequently the fish can not escape from the wall of net. Hence, the yield can be higher. However, the length of net is based on the target species, the size of fish school and its speed movement. In the case of anchovies, and with using the fish attraction light, the length of net need not too long. It proves that the length of net affects the catch.

**** Average productivity of fishing operation***

The Figure 6.2 shows average productivity per fisherman per year of the coastal purse seine fishery in Nha Trang and Cam Ranh. Essentially, like average yield per vessel, the average yield per fisherman increases when engine power group is increased and the average yield per fisherman in Cam Ranh is higher than in Nha Trang.

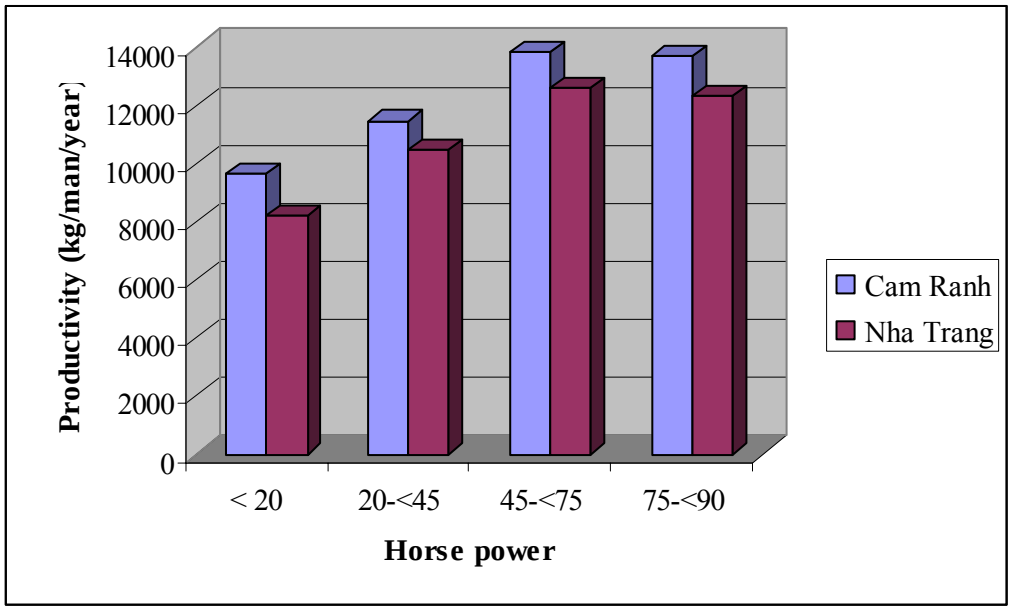

Figure 6.2: The average productivity among the vessel size groups in Cam Ranh and Nha Trang in

6.2. ECONOMIC PERFORMANCE

**** Invested capital***

In the research, we want to know how long it takes for the boat owners to get back the invested capital. The invested capital was estimated at the present, it means that how much the owners can buy or sell their boat or others with the same quality and other characteristics. With this method, we estimated the invested capital of 100 boats (Table

6.3). 85 percents of fishermen interviewed said that *"In 2008, due to the price of fuel increased rapidly and was high, then the variable cost of fishing operation increased while the price of fish increased slightly. Hence, many boat owners were unprofitable. Since the fishing boat market was frozen and no one wanted to invest in fishing sector then the price of fishing boat was lower before"*.

Table 6.3: Descriptive statistics of invested capital for 100 purse seiners

Unit: Million VND

Composition of invested capital	Cam Ranh								Nha Trang							
	< 20		20-<45		45-<75		75-<90		< 20		20-<45		45-<75		75-<90	
	N = 21		N = 13		N = 8		N = 2		N = 28		N = 16		N = 10		N = 2	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Hull	73.33	11.55	81.54	12.14	127.50	27.12	155.00	7.07	71.07	13.70	75.63	16.72	163.00	18.29	175.00	7.07
Engine	16.10	1.58	18.23	3.11	25.25	1.67	27.50	3.54	15.79	1.77	18.13	2.75	25.20	1.87	25.00	4.24
Auxiliary engine	3.76	0.64	3.96	0.56	6.38	1.36	7.75	0.35	3.82	0.56	3.78	0.84	8.10	0.97	8.75	0.35
Mechanic equipment	6.38	0.67	6.38	0.65	6.88	0.83	6.50	0.71	6.46	0.79	6.38	0.72	6.90	0.99	7.50	2.12
Electronic equipments	14.95	1.09	14.85	1.14	15.00	1.07	15.50	0.71	14.86	1.008	14.75	1.06	14.5	0.97	16.00	0.00
Fishing gear	74.51	4.46	84.18	5.32	104.40	6.67	135.60	5.09	77.40	3.31	89.25	5.69	112.32	5.86	129.60	0.00
Total	189.04		209.15		285.40		347.85		189.40		207.91		330.02		361.85	

The Table 6.3 shows that the invested capital is increased parallel with the increase of engine power group (as well as the increasing of size of vessel and size of net). There is little difference in the invested capital of boat owners in both locations of Nha Trang and Cam Ranh.

The invested capital of hull and fishing gear are considered biggest in proportion of from 78 to 84% of total invested capital for each group of vessel, next is those of main engine and electronic equipments (diesel generator, light system, echo-sounder, communication radio and compass). The invested capital of mechanic equipments (capstans, combination winch and lifter) is smallest.

**** Variable cost***

The variable costs of 100 boats of the coastal purse seine fishery in Khanh Hoa are presented in Table 6.4 and 6-5. These are the cost of fuel, lubricating oil, foodstuff for crew, and inconsiderable repairs such as change the light tube which are decayed and the yarn for mending the net if the net is broken.

Table 6.4: Descriptive statistics variable costs per trip for 100 purse seiners

Unit: Million VND

Creteria	Cam Ranh								Nha Trang							
	< 20		20-<45		45-<75		75-<90		< 20		20-<45		45-<75		75-<90	
	N = 21		N = 13		N = 8		N = 2		N = 28		N = 16		N = 10		N = 2	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fuel	0.316	0.019	0.508	0.091	0.638	0.044	0.725	0.091	0.312	0.016	0.516	0.054	0.625	0.035	0.725	0.035
Lubricating oil	0.005	0.000	0.005	0.000	0.005	0.000	0.005	0.000	0.005	0.000	0.005	0.000	0.005	0.000	0.005	0.000
Foodstuff	0.062	0.015	0.061	0.013	0.205	0.282	0.135	0.013	0.064	0.015	0.067	0.018	0.186	0.252	0.135	0.021
Inconsiderable repairs	0.100	0.000	0.100	0.000	0.113	0.023	0.110	0.023	0.100	0.000	0.106	0.015	0.111	0.019	0.100	0.000
Total	0.484		0.673		0.960		0.975		0.481		0.693		0.927		0.965	

Table 6.5: Descriptive statistics variable costs per year for 100 purse seiners (in 2008)

Unit: Million VND

Creteria	Cam Ranh								Nha Trang							
	< 20		20-<45		45-<75		75-<90		< 20		20-<45		45-<75		75-<90	
	N = 21		N = 13		N = 8		N = 2		N = 28		N = 16		N = 10		N = 2	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fuel	69.85	5.96	114.27	20.25	141.56	6.91	167.25	28.64	69.00	5.45	114.50	14.06	141.30	12.07	156.00	12.73
Lubricating oil	1.10	0.07	1.13	0.06	1.11	0.05	1.15	0.14	1.11	0.07	1.11	0.06	1.13	0.06	1.08	0.04
Foodstuff	13.77	3.44	13.67	2.77	18.41	0.05	30.75	1.06	14.04	3.41	14.91	4.34	22.47	4.34	28.95	3.61
Inconsiderable repairs	22.10	1.34	22.54	1.27	25.13	5.89	25.10	0.14	22.11	1.34	23.43	3.53	25.23	5.56	21.50	0.71
Total	106.82		151.60		186.21		224.25		106.26		153.95		190.13		207.53	

In general, the average of total variable cost increases with increasing horse power group. The mean of fuel cost is largest with in proportion of from 65 to 75 percentages of total variable cost for each group of vessel. It is sensible to understand that the larger horse power of engine is the more fuel is consumed. Moreover, the number of fuel cost depends on operating time on the sea and the distance from port to fishing ground. The average total variable cost is nearly the same in both locations of Nha Trang and Cam Ranh for each group of vessel. With these figures, it is sensible to judge that the operating time on the sea in both locations is nearly the same.

**** Economic performance indicators***

The descriptive statistics of some important economic performance indicators such as gross revenue, operating cost, gross value added, labor cost, gross cash flow, and net profit are presented by the groups of vessel and locations in Table 6.6.

Table 6.6: Descriptive statistics of economic criteria for 100 purse seiners

Unit: Million VND

Criteria	Cam Ranh								Nha Trang							
	< 20		20-<45		45-<75		75-<90		< 20		20-<45		45-<75		75-<90	
	N = 21		N = 13		N = 8		N = 2		N = 28		N = 16		N = 10		N = 2	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Gross revenue	302.34	44.11	407.79	84.24	548.33	86.64	658.12	4.41	263.74	26.92	355.59	50.31	526.85	60.75	564.79	3.95
Fixed cost	29.90	2.15	33.59	2.53	47.12	5.12	57.44	1.47	29.85	2.76	33.31	3.14	54.47	3.59	59.59	1.48
Variable cost	106.82	8.63	151.60	20.74	186.21	61.45	224.25	27.58	106.26	8.26	153.95	16.45	190.13	62.81	207.53	9.86
Subsidy	20.00	0.00	20.00	0.00	26.00	0.00	26.00	0.00	20.00	0.00	21.13	2.42	26.00	0.00	26.00	0.00
Gross value added	185.62	45.04	242.59	72.67	314.00	52.27	402.43	24.64	147.63	24.73	189.46	49.96	288.25	31.12	323.67	7.40
Labor cost	107.76	22.11	138.09	36.33	180.56	25.41	229.93	11.58	88.74	13.03	111.38	25.82	171.36	16.51	191.63	2.96
Gross cash flow	77.86	22.97	104.50	36.39	133.44	27.08	172.49	13.05	58.89	11.82	78.07	24.21	116.89	14.78	132.04	4.44
Depreciation + Interest loan payment	34.72	1.99	38.81	2.76	48.85	3.26	62.62	3.18	35.00	2.29	40.10	3.20	53.10	2.48	59.42	2.33
Net profit	43.15	23.57	65.69	36.17	84.59	26.49	109.88	16.24	23.89	11.61	37.97	24.46	63.79	13.61	72.62	6.78

Like average catch gross revenues increases with increasing horse power group. The mean of gross revenue for each horse power group of vessel in Cam Ranh are higher than in Nha Trang. The horse power group of 75-<90Hp has the highest gross revenue and the smallest gross revenue for group of <20Hp in both locations.

The fishermen's demand for loans to maintain their boats and fishing gears is very high. However, the banks can not meet these demand because of lack of financial or/and the complexity of administrative formalities. Hence, it is very difficult for fishermen to approach this capital resource. Most of fishermen have to loan from the creditors with higher interest rate compared to the interest rate of banks. Therefore, the annual interest payment is quite large. This means that, the total cost is higher, and the net profit is lower consequently.

Interestingly, net profit positive is positive for all vessel groups. The coastal purse seine fishery in Cam Ranh is more profitable than in Nha Trang. The mean of net profit of the purse seiner vessels was ranged from 23.89 to 109.88 millions VND. It means that not only are the boat owners of purse seiners capable of paying for all expenses, but they also have a reward for the operating year. Table 6.6 also shows a preliminary comparison of some important economic performance indicators among four vessel groups which are categorized based on engine power in both locations. The results show that the group of vessel of 75-<90Hp has the best economic performance indicators with gross cash flow of 172.49 (in Cam Ranh) and 132.04 (in Nha Trang); and net profit of 109.88 (in Cam Ranh) and 72.62 (in Nha Trang) millions VND. The lowest economic performance indicators is belong to the group of <20Hp in both locations. This demonstrates that the vessel group of <20Hp is the least profitable group. Due to the increasing price of fuel, the government subsidized for each registered vessel based on the size of engine power. It was divided in to three groups, for the group of engine power less than 40Hp, each boat owner received 20 millions VND, for the group of 40 - <90Hp, 26 millions VND and group of ≥ 90Hp, 30 millions per year. This policy of government can temporally help fishermen and owners remain the incomes, profits, and subsistence especially for the small size engine power group while the increase of fuel price. Nevertheless, these are not big objectives of policy. The most important objective of this policy is nationwide implemented vessel and licensing register for all fishing boats in Vietnam. Because the government's regulations there was no incentives, neither

compulsory to register their boats with an engine capacity <20Hp before. In order to *"implement the planning of fisheries sustainable development to 2010"* of government and reduce the number of fishing boat to 50.000 boats in 2010, especially the small size, unprofitable or/and least profitable engine power groups operating in the coastal areas. Based on the data of vessel was collected and the potential of marine resources, the Ministry of Agriculture and Rural development is going to restructure the number of fishing boats and fisheries in nationwide.

The fixed costs include yearly maintain costs of hull, fishing gear, engine, overhaul, and other equipments on boats. The structure of fixed costs is presented in Figure 6.3.

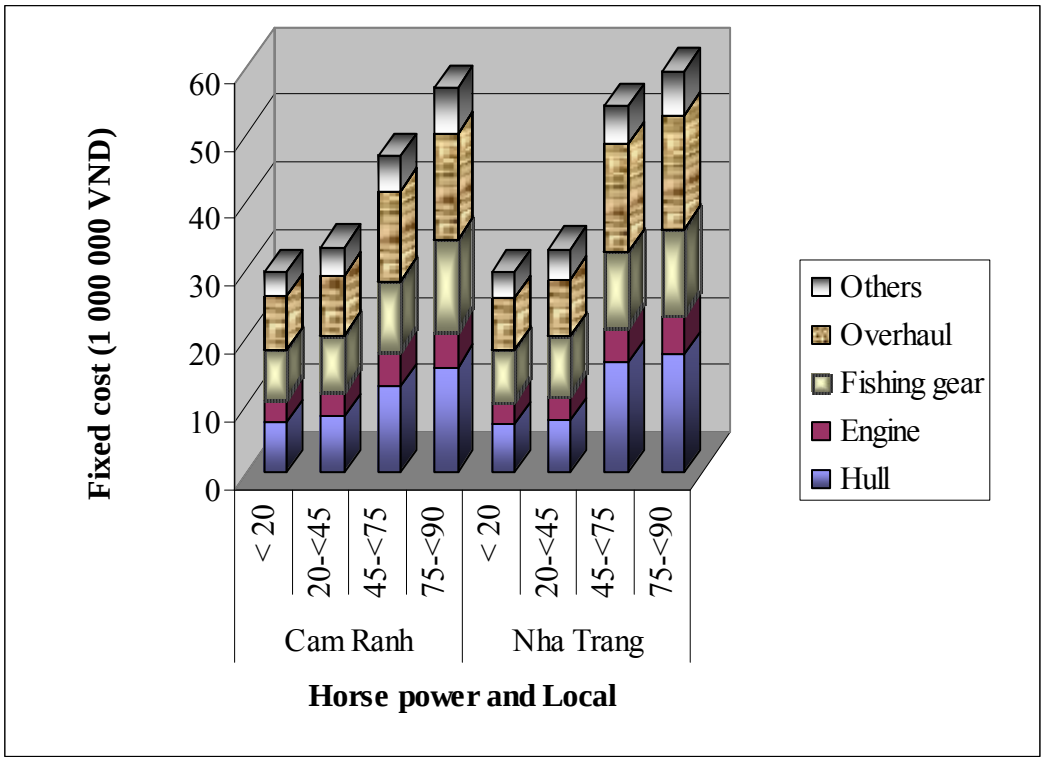

Figure 6.3: Structure of fixed cost among horse power groups and locations

From the figure above, we see that the mean of fixed cost increased with increasing horse power group. The largest element of fixed cost is overhaul, next is the maintenance of hull. The mean of fixed cost fluctuated in a range of 28 to 58 millions VND. These figures are quite large. The reason may be the average age of vessel is high. The average age of vessel estimated from 15 to 30 years. This means that the age of vessel may affect the fixed cost directly, when the total cost increases, the net profit decreases.

Table 6.7: Descriptive statistics of economic performance indicators of purse seine fishery in Khanh Hoa

Unit: Million VND

Criteria	Cam Ranh								Nha Trang							
	< 20		20-<45		45-<75		75-<90		< 20		20-<45		45-<75		75-<90	
	N = 21		N = 13		N = 8		N = 2		N = 28		N = 16		N = 10		N = 2	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Ratio of Gross revenue to Total costs	1.16	0.08	1.18	0.07	1.18	0.06	1.20	0.04	1.10	0.04	1.12	0.07	1.14	0.03	1.15	0.02
Ratio of Net profit to Gross revenue	0.14	0.06	0.15	0.05	0.15	0.04	0.17	0.03	0.09	0.04	0.10	0.06	0.12	0.03	0.13	0.01
Ratio of Net profit to Total costs	0.16	0.08	0.18	0.07	0.18	0.06	0.20	0.04	0.10	0.04	0.12	0.07	0.14	0.03	0.15	0.02
Ratio of Net profit to Total invested capital	0.24	0.13	0.32	0.17	0.31	0.11	0.32	0.06	0.13	0.06	0.18	0.12	0.19	0.04	0.20	0.03
Investment retune (year)	6.26	4.81	4.19	2.73	3.86	1.96	3.18	0.62	12.04	11.20	9.38	7.65	5.35	1.16	4.96	0.65

The Table 6.7 presents the important criteria of coastal purse seine fishery in both locations of Cam Ranh and Nha Trang. These are the ratio of gross revenue to total costs, the ratio of net profit to gross revenue, the ratio of net profit to total costs, the ratio of net profit to total invested capital, and the years can get back invested capital of owners.

In general, the ratio of Gross revenue to total costs of coastal purse seine fishery in Cam Ranh is higher than that in Nha Trang for the same group of horse power. The highest ratio concentrates on the group horse power of 75-<90Hp, and the smallest for the group horse power of <20Hp following locations. This ratio presents that how much VND the owners can get in gross revenue when they spend one VND on fishing.

The ratio of net profit to gross revenue (net profit margin) shows the fraction of each VND in profit available to equity owners after they pay all expenses as similar to the ratio of gross revenue to total costs. This figure in Cam Ranh is higher than that in Nha Trang for the same group of horse power. It fluctuates from 0.15 to 0.17 in Cam Ranh, and from 0.09 to 0.13 in Nha Trang.

The ratio of net profit to total costs presents that the owners spend one VND, how much VND they can get in net profit. This ratio in Cam ranh is larger than in Nha Trang.

The ratio of net profit to total invested capital tell us what profit the owners get if theys invest one VND. Like other indicators, this figure in Cam Ranh is higher than in Nha Trang for the same group of horse power. This figure fluctuates from 24 to 32 percents in Cam Ranh and, and from 13 to 20 percents in Nha Trang. This ratio might be high because the fishing vessel market in Vietnam was frozen in 2008 and the price of vessel was low. This percentage is not very good compared with the opportunity cost regard to the interest rate in the banks. Due to high inflation in 2008, interest rate in the banks was quite high from 15.25 to 20 percents. Those are widespread in Vietnam in 2008 (The State Bank of Vietnam, 2008). Thus, it is not very good to reinvest in fishing section in 2008. However, for the boat owners, they have boat, thus they can get profit from fishing activity. For the new owners, it is very risk to invest capital in this section.

Investment return presents the number of years that owners can get back invested capital. The average years those owners can get back the invested capital in Cam Ranh

is smaller than in Nha Trang. It fluctuates from 3.18 to 6.26 years in Cam Ranh, and from 4.96 to 12.04 years in Nha Trang. Although the invested capital of larger group of engine power is bigger, the time for return the invested capital is shorter than smaller groups. It means that the larger group of engine power is more profitable than the smaller ones. In addition, the coefficients of Standard Deviations (SD) of investment return in Nha Trang are higher than in Cam Ranh for each group of engine power, and larger for smaller vessels. This indicates that the purse seiners in Cam Ranh and larger groups of horse power are more efficient than purse seiners in Nha Trang.

6.3. REGRESSION ANALYSIS

A log linear function is specified for regression analysis. The reason why a logarithm function is used depends on the easiness that the coefficients from the estimation can be read directly in form of elasticities. With a log linear function estimated, the elasticities can be obtained by using an ordinary least squares (OLS) regression. Although its simplicity, the evaluation still reflects the effect of each input variable on the output. The logarithm function can be defined as:

$$\ln(revenue) = \alpha_o + \alpha_1 \ln(lightHP) + \alpha_2 \ln(netlenght) + \alpha_3 \ln(\exp erience) + \alpha_4 \ln(location) + \mu$$

Where α_o is constant and $\alpha_1, \alpha_2, \alpha_3, \alpha_4$ are elasticities for each factor. μ is an error (disturbance) term, captures non systematic errors if the estimation diverges from the true model. (Dougherty, 2007)

In this study, the output is the average revenue per year. The physical inputs such as net length, light capacity are used as the proxy measures of capital utilization in fisheries. The experience of skipper is also added in the model as an input variable. In addition, a dummy variable is utilized to distinguish how the characteristic of locations and resource conditions can affect on the revenue, with 1 for Nha Trang area and 0 for Cam Ranh area. The area dummy variable can be explained by the variation between the stock, the practice of fishing village, etc.

An ordinary least square (OLS) regression is used to estimate the technical efficiency of purse seine fishery. It implies that the regression line is fitted in a way that minimizes the sum of the residuals.

The value of tested correlation figure among these input and output variables show that multicollinearity is not existed except the case *netlength* variable. However, since this is a very expected input that can affect on revenue according to the survey from fishermen, we decide to include the model to check if its value is significant enough or not.

Table 6.8: Correlation matrix

	LN(Revenue)	*LN(light HP)*	*LN(net length)*	*LN(experience)*	*D(location)*
LN(Revenue)	1				
LN(light HP)	0.2163241	1			
LN(net length)	0.8100686	0.38322164	1		
LN(experience)	0.3593042	-0.0083369	0.24367562	1	
D(location)	-0.208166	0.1605777	0.11702100	-0.1243045	1

Lagrange multiplier test and the plots for residuals are also used.

$$\chi^2 = N \times R^2 = 100 * 0.03399828 = 3.399828 \prec 7.815 = \chi^2_{(0.95,3)}$$

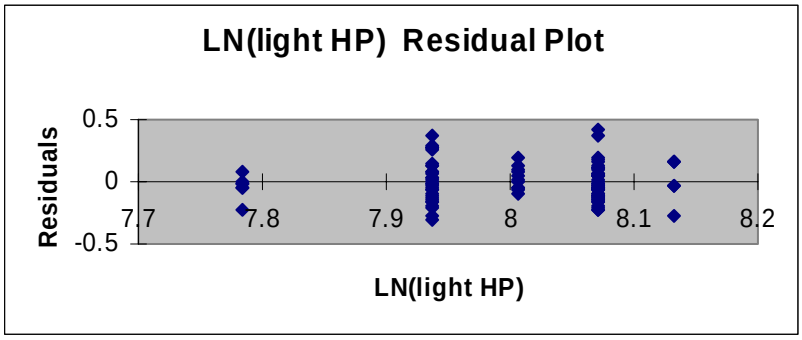

Figure 6.4: Residual plot of LN(light HP)

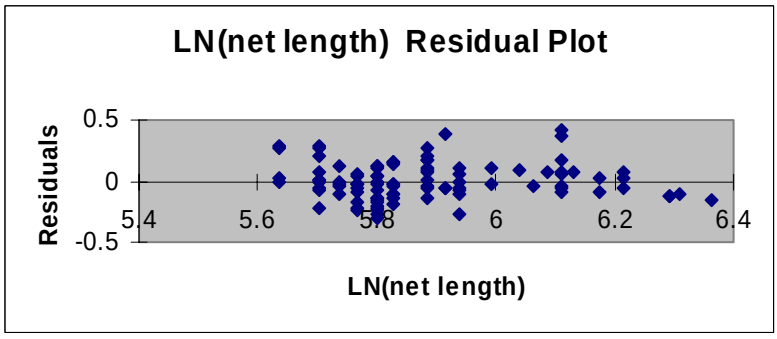

Figure 6.5: Residual plot of LN(net length)

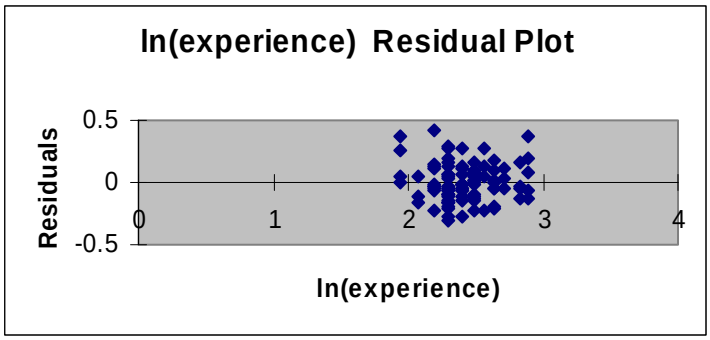

Figure 6.6: Residual plot of LN(experience)

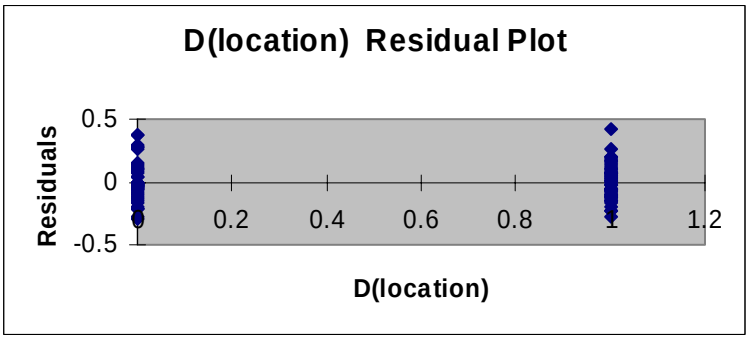

Figure 6.7: Residual plot of D(location)

The results indicate there is no evidence of existence of heteroskedasticity. This means that OLS estimation is suitable or estimated model is well specified.

Table 6.9: The results of parameter estimates and test statistic

Variables	Coefficient (elasticities)	S.E	t- value
α_o Constant	-1.727	1.340	-1.234
α_1 Ln(light HP)	-0.200	0.188	-1.062
α_2 Ln(netlength)	1.510	0.101	14.933*
α_3 Ln(experience)	0.167	0.072	2.309**
α_4 D(location)	-0.172	0.031	-5.539*
R^2 adjusted	0.757		
Observations	100		
F-value	77.947		

(** = statistically significant at the level of 5% (t-value>1.96), * = statistically significant at the level of 1% ($|t - value| > 2S.326$))

As regard to the theory, the coefficient R^2 in the model is used to measure the variation of the output because of the independent inputs and to explain the relation between inputs and output. The empirical results show that the coefficient R^2 is 0,766 (equivalent to 77.6%). This means that there are 77.6% variation of revenue is influenced by the input variables as light capacity, net length, experience of skipper and location. The value of F is 77.95 according to validity of 99% shows that there is at least one input variable impacts on the revenue. The effects of parameters in the model on the vessel revenue are statistically significant at less than 5%, except for the case of light capacity.

Net length is considered as a proxy of technical effects. Of interest to look at its P value and sign. The positive sign of this parameter expresses that the technical efficiency is likely to increase with the increase of net length. This may make sense since as the net length increases, the possibility of rounding a larger water area is increased and the possibility of catching more quantity of harvest consequently is increased. In conclusion the *t*-value is rather large and the corrected sign can be a good evidence for acceptance this variable in the model (Hoai, N.T and Thai, P.T). The length of net goes up 1% will be expected a larger increase of average revenue by 1.51%.

Skipper's experience is expected to contribute an important factor to technical efficiency. As regard to the results, the skipper's experience positively affects the revenue in specific or the efficiency in general. This means that when the skippers' experience increases 1%, the average revenue will be expected increased 0.167%.

The light capacity is also an important input which can be an indication on technical efficiency. Unfortunately, light capacity is not significant.

For the dummy variable *location*, the negative sign and significant P value shows that the purse seiners in Cam Ranh area are more technical efficient than those in Nha Trang area. There is a 17.2% differential revenue between Cam Ranh and Nha Trang. More exactly, the percentage difference between revenues of Cam Ranh and Nha Trang is $100(e^{\delta} - 1)\% = 100(e^{-0.172} - 1)\% = -15.8\%$. This figure is different from the result above. Its standard error is 0.31% which is made by software. It induces this exact

calculation more than one standard error different from the approximate value of -15.8%. It might be the consequences of the abundance of resource and this is suitable because the main fishing ground of anchovies in Khanh Hoa is located in the sea of Cam Ranh area (ALMRV, 2006). Immigration is characteristic of anchovies, they immigrate belong to the seasons, and the current of waters to find the edibles, reproduce. The anchovies always concentrate in the sea of Cam Ranh area with high density from March to August yearly (RIMF, 2006). However, why the fishermen in Nha Trang did not come and go fishing at the sea area? It is very easy to understand that the distance between Nha Trang and Cam Ranh is large, if the fishermen in Nha Trang move to Cam Ranh for fishing, the variable costs are going to increase because of consuming more fuel and the higher price of fuel in 2008. Hence, the net profit and income of fishermen might be lower, even they might not cover all expenses.

Squires, 1987; Kirkley et al., 1995, 1998 analyzed the relationship between the input variable as the number of labors on board and the output variable as the productivity in long-line fishery. The result showed that the increased number of labor would induce the productivity goes up. Michael Habteyonas Z, and Frank Scrimgeour had the same conclusion in the small scale fisheries in Eritrea, New Zealand. Michael Habteyonas Z. and Frank Scrimgeour considered the fishermen increase the fishing effort per trip would reduce the productivity. They should increase the fishing trip per month instead. However, in the case of coastal purse seine fishery in Khanh Hoa is different. The number of labors is also an important input which can be an indication on technical efficiency. Unfortunately, number of labors is not significant.

Sharma and Lueng (1999) claimed that the skipper's experience can affect positively on the technical efficiency of long-line fishery in Hawaii. This means that if fisherman had higher experience, the productivity or/and the revenue goes up. In the case of coastal purse seine fishery in Khanh Hoa, the result is the similarity.

Pascoe et al. (2001, 2002) approved the age of vessel is a factor that can negative affect on the technical efficiency. This means that a new vessel is always more effective than an old one. On the other hand, the age of vessel increased, the fishing effect will be reduced. If 1% of vessel age increases, then there will be a 1.6% of decrease in productivity. The results which are relevant to the age of vessel that Pascoe *et al* (2001, 2002) had given are determined by the repairs and maintenance period. It is however,

very difficult to apply in Vietnam. Sharma and Lueng (1999) also found the relation between these variables although it is insignificant. Long (2006) concluded that the revenue of long-line fishery in Nha Trang city, Khanh Hoa provine, Vietnam is not affected by the age of vessel.

7. DISCUSSIONS AND CONCLUSIONS

The study preliminary gives some important economic performance indicators and starts further investigation of the impact of technical characteristics on gross annual vessel revenue based on the data collected of 100 samples of inshore purse seiner in Khanh Hoa with their 2008's cost and revenue.

The results may give some implications for management of coastal purse seine vessels in Khanh Hoa province and these are the basics that the Ministry of Agriculture and Rural Development can use to restructure the Vietnamese fisheries generally and the fisheries in Khanh Hoa particularly following the planning of Fisheries Development of Vietnam of government up to 2010.

Firstly, the coastal purse seine fishery in Cam Ranh is more profitable than in Nha Trang for each engine power group of vessels due to the characteristics of fishing grounds and the main target species.

Secondly, the owner of an average purse seiner of all groups of horse power in both locations of Nha Trang and Cam Ranh not only is capable paying for all expenses, but also has the reward for the operating year. Furthermore, the boat owner of an average vessel in the group of horse power of 75 -< 90 Hp has the highest values of annual gross cash flow and net profit following location. Thus, the annual average of crew shares for this group of horse power is quite high. It is almost 2.0 times more than the average earnings of labor in the whole country. The boat owner of the engine power group of < 20Hp and 20-<45Hp has lowest values of annual vessel gross cash flow and net profit following location. Thus, the annual average of crew shares for those groups of horse power is quite low. They are almost 1.2 times more than the average earnings of labor in the whole country.

In order to implement the objective of sustainable fisheries development, strengthen the fisheries management, and the planning of reducing the number of fishing boats to 50.000 from the whole of 100.000 for fisheries development up to 2010 in Vietnam, the Ministry of Agriculture and Rural development need to reduce the number of the unprofitable vessel groups, as well as vessel groups with destructive fishing gear operate in near shore areas. In the case of coastal purse seine fishery in Khanh Hoa, the writer

suggests to reduce number of vessel in groups of <20Hp and 20-<45Hp, following with this suggestion, the local government need to have subsidy policy of vocation training for the poor and their children since they can find the income from other jobs instead of fishing activity.

As regards to the regression analysis method, we found the technical factors that impact on the gross revenue are the length of net, fishing experience of skipper and location. These are significant factors impact on the gross revenue. Therefore along with costs, they impact on other economic criteria of coastal purse seine fishery in Khanh Hoa such as yearly income of fishermen, gross cash flow, net profit, and time for return invested capital of owner. In addition, we also did the test for other factors of vessel technical such as hull length of vessel, age of vessel, number of crew, and light capacity but they did not impact statistically on the revenue. With technical characteristics of vessel and fishing equipments, the owners can apply results for improving those factors in fishing activity, then they can get higher gross revenue, net profit, and as well as economic criteria.

Because of the small size and small engine power, the fishermen can only operate in the coastal areas. Many fishermen do not remember or know the year of building, and use of their engine because they often used second hand engine which had been bought from other fishermen or other countries. Hence, they do not know the age of their vessel exactly.

These main characteristics, evidence that the small purse seiners in Khanh Hoa operate near-shore areas, and can not operate in bad weather like storm, large wave and windy. Hence, the life of fishermen faces to many difficulties. In long term, Vietnamese government wants to reduce or/and converse the small fishing boat to other sections like tourism services. Khanh Hoa has large potential of tourism development. It may useful for owners and fishermen to find other jobs and get higher profit/income if the government issues a pilot project and guidance or/and policy programme.

It is very difficult to solve these employees with low education background when the government implements the policy of reducing number of fishing boat to 50.000 in 2010. It may be better if the government or local government issues the policy of vocational training for fishermen instead of implement the government’s policy of

subsidy price of fuel, and then they can change their job. That is a social security refers to public programs for providing income to individuals.

Although we have some experience in collecting data from fishermen and fisher households, training on fishing boats for four fisheries as trawling, purse-seining, gill netting and long lining, and we also have a few experience to communicate with fishermen – who have low education level in Vietnam. Hence, the data was collected not very exactly and reliability. In addition, because of limited time and finance, we just survey coastal purse seiners in two locations in Khanh Hoa province with 100 samples. It is not large enough to have good suggestions for government managers, local managers and boat owners in their decision making. Moreover, the regression analysis of economic performance is rather limited since only gross vessel annual revenue is concerned. Therefore, further work is recommended to collect more data, regression analysis of gross cash flow, net profit and also may use other stronger methods for in depth analysis of economic performance.

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APPENDICES

APPENDIX 1: SUMMARY OUTPUT OF REGRESSION ANALYSIS

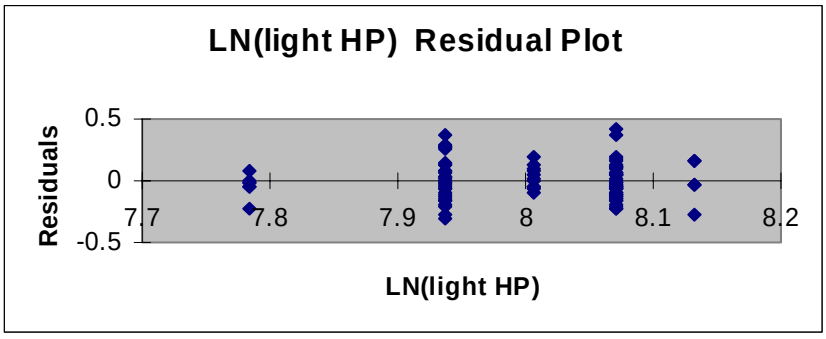
SUMMARY OUTPUT

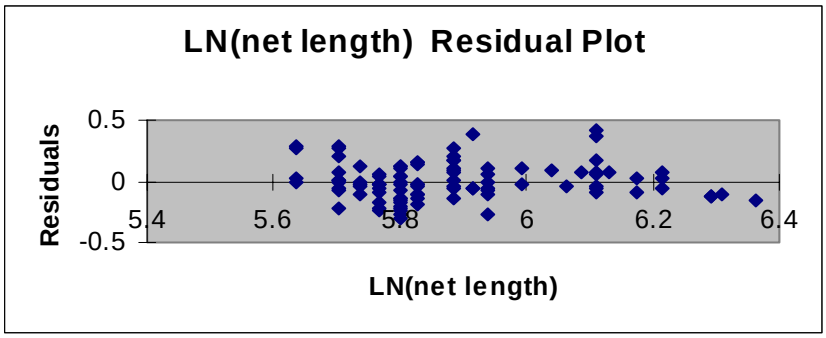
Regression Statistics	
Multiple R	0.8754785
R Square	0.7664627
Adjusted R Square	0.7566296
Standard Error	0.1503870
Observations	100

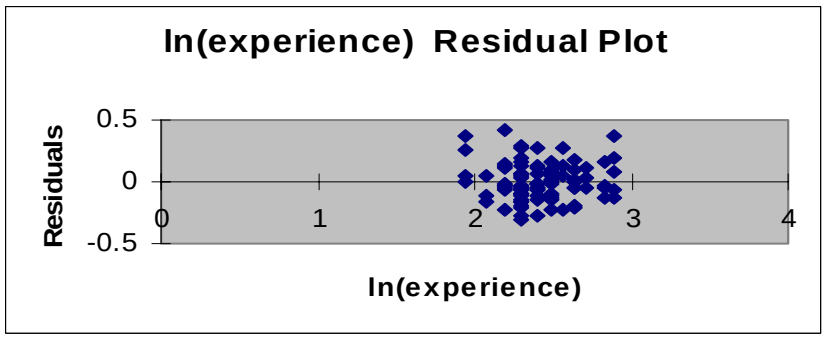
ANOVA

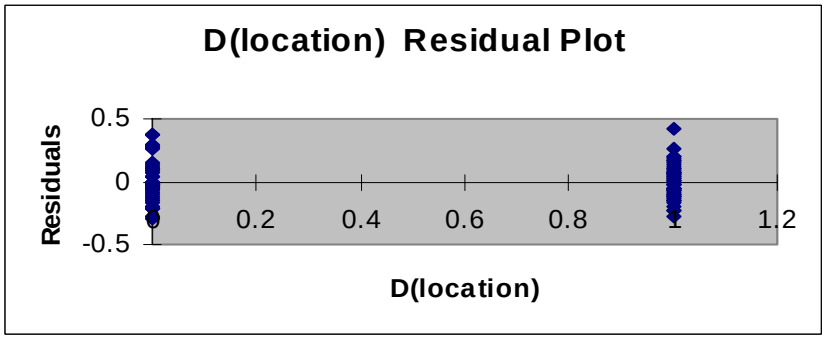
	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	7.051461609	1.762865402	77.9468354 9	3.7142E-29
Residual	95	2.148544096	0.022616254		
Total	99	9.200005706			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-1.7273347	1.399608442	-1.234155666	0.22018923 5	-4.50590868	1.0512393	-4.50591	1.051239
LN(light HP)	-0.2001906	0.188383018	-1.062678623	0.29062162 3	-0.57417817	0.1737969	-0.57418	0.173797
LN(net length)	1.5097987 2	0.101105512	14.93290218	1.15942E-26	1.30907891	1.7105185	1.30907 9	1.710519
ln(experience)	0.1672561 6	0.072436652	2.30899901 4	0.02311103	0.02345123	0.3110610	0.02345 1	0.311061
D(location)	-0.172181	0.031086794	-5.538717107	2.7064E-07	-0.23389604	-0.1104658	-0.2339	-0.11047









RESIDUAL OUTPUT

Observation	*Predicted LN(Revenue)*	*Residuals*	*Observation*	*Predicted LN(Revenue)*	*Residuals*
1	5.7510709	-0.2159438	51	5.8538070	-0.0063487
2	5.7334487	-0.0296663	52	5.8426019	-0.1939858
3	5.7137488	-0.1677904	53	5.6803625	0.2920481
4	5.7334487	-0.0263385	54	5.8994040	0.1333813
5	5.7510709	-0.0922858	55	5.8679496	0.1974954
6	5.8414120	0.0446920	56	5.7726599	-0.1441329
7	5.8134712	0.1224807	57	5.8421540	-0.2750749
8	5.8242617	-0.2996059	58	5.9861257	0.0773259
9	5.8242617	-0.1379645	59	6.0668073	-0.0553402
10	5.8805387	-0.2148043	60	5.9448408	0.1089383
11	5.8242617	-0.2783033	61	6.0953092	0.3785281
12	5.5761971	0.0325418	62	5.9577608	-0.0648138
13	5.7242445	0.2745928	63	6.0797273	-0.0004692
14	5.5761971	0.2690849	64	5.8730963	0.1540600
15	5.5921384	0.2800921	65	6.0055140	-0.0340336
16	5.5921384	-0.0131635	66	5.8071951	-0.0555474
17	5.7417164	-0.2192960	67	5.9061658	0.1087512

18	5.7674991	-0.0557484	68	5.8129957	0.1792215
19	5.7766693	-0.0183986	69	5.7237943	0.2639625
20	5.7271632	-0.0114522	70	5.8512693	0.0520416
21	5.7766693	-0.0450122	71	5.8001331	0.0127195
22	5.5695355	0.0018578	72	5.8542905	-0.1128535
23	5.5695355	0.0792745	73	5.8333330	0.1646991
24	5.5386759	0.0092329	74	5.9231283	-0.0596082
25	5.4905593	-0.0690861	75	5.7872131	0.0946352
26	5.5400654	0.1244621	76	5.8383493	-0.0669431
27	5.5203654	-0.1049962	77	5.6795305	0.1485236
28	5.4980315	-0.0044383	78	6.1065405	-0.0912410
29	5.5788900	0.0646853	79	6.3465380	-0.0495225
30	5.5612678	-0.2323648	80	6.1571698	0.1022011
31	5.5415678	0.0461947	81	6.2061454	0.3757989
32	5.5612678	-0.0191892	82	6.0758363	-0.0247445
33	5.5788900	-0.0612583	83	6.4204678	-0.0961459
34	5.6692310	-0.2295727	84	6.2131036	-0.0426242
35	5.6412902	-0.0694491	85	6.3545523	-0.0411100
36	5.6520807	0.1271095	86	6.2866788	0.0865253
37	5.6520807	-0.1659928	87	6.1031054	0.0737911
38	5.7083578	-0.2009768	88	6.2656137	-0.0496818
39	5.6520807	-0.1551626	89	6.0759983	0.4165245
40	5.6825751	-0.1316111	90	6.0814840	0.1681381
41	5.6680219	-0.0195536	91	6.2856089	0.0282734
42	5.6558434	0.0468519	92	6.3089707	0.0177188
43	5.7009154	-0.0169018	93	6.0339644	0.0537937
44	5.7009154	-0.1466094	94	6.1203522	0.0684646
45	5.6704210	-0.1050541	95	6.1572986	0.0670251
46	5.6077268	0.1073557	96	6.2686349	0.0668471
47	5.6704210	-0.0483994	97	6.4576402	-0.1261470
48	5.4814498	0.2000745	98	6.4672003	-0.1258250
49	5.6704210	-0.1020537	99	6.5992682	-0.1146328
50	5.8693336	-0.0278968	100	6.6489590	-0.1548496

APPENDIX 2: TEST HETERSKEDASTICITY

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.18438622
R Square	0.03399828
Adjusted R Square	-0.00667548
Standard Error	0.03240535
Observations	100

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.003511043	0.000878	0.835878	0.505718
Residual	95	0.099760143	0.00105		
Total	99	0.103271186			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.01588434	0.301587231	0.052669	0.958106	-0.58284	0.614610682	-0.5828	0.61461068
LN(light HP)	0.00565146	0.040592719	0.139223	0.889568	-0.07494	0.086238191	-0.0749	0.08623819
LN(net length)	0.0018898	0.021786187	0.086743	0.931058	-0.04136	0.045140851	-0.0414	0.04514085
ln(experience)	-0.01865822	0.015608629	-1.19538	0.234915	-0.04965	0.012328823	-0.0496	0.01232882
D(location)	-0.01005942	0.006698574	-1.50173	0.136485	-0.02336	0.003238933	-0.0234	0.00323893

$$\chi^2 = N \times R^2 = 100 * 0.03399828 = 3.399828 \prec 7.815 = \chi^2_{(0.95,3)}$$

APPENDIX 3: QUESTIONNAIRE

ANNUAL SURVEY ON FISHING VESSELS IN KHANH HOA PROVINCE, VIETNAM (PURE-SEINING)

I. General information:

1. Data of the year: Period of data from……..to……
2. Time of survey: Date.....month.....year.....
3. Main fishery …… Other……
4. Name of interviewee:……5. Phone number of interviewee……

II. Vessel characteristics, fishing gear, light

1. Registered Number …….
2. Name of Vessel Owner.....
3. Address ……. ……..Phone number: …….
4. Hull length (m):…….
5. Year of building……If vessel owner does not know, please tick here……
6. Engine (HP):……
7. Length of net (m)……
8. Number of light (lights)……Capacity of light (KW)……

III. Information about labour

Skipper	Crew (including skipper)
1. Skipper information a. Skipper educational level..... b. Skipper age ..... c. Skipper experience (years)..... d. Skipper vocational training time..... e. Does skipper come from traditional fishing household?.....	2.Average annual crew size (persons)……. 3. Income/person/ trip (1000 VND) a. in the main season:..... b. in sub-season:.....

IV. Information about harvested quantity, operating time, fishing ground and weather

	Main season	Sub season
1.Number of trips*		
2. Quantity of harvested species per trip		
a. Main species 1 (kg)		
b. Main species 2 (kg)		
c. Main species 3 (kg)		
d. Main species 4 (kg)		
f. Others (kg)		
3. Average duration per trip (days)		
4. Number of operating months		
5. Fishing ground		
6. Special weather? (serious storms)		

V. Capital Items

	Year of purchase	Monetary units			Purchase (old or new)	Life-span
		Purchase price (1000 VND or gold)	Current estimated price	Estimated price if buy a the same new one		
1.Hull						
2. Engine						
3. Auxiliary engine (generator)						
4. Mechanic equipment						
a. Winch						
b. Normal lighting system (batteries and lamps)						
c. Special lighting system for fishing						
d. Other mechanic equipment1						
e. Other mechanic equipment2						
4. Electronic equipment						
a. GPS						
b. Compass						
c. Short-range radio						
d. Long-range radio						
5. Gear		-			-	-
a. Fishing net						
b. Long-lining						
d. Subgear1		-			-	-
e. Subgear2						
6.Freezing equipment						

VI Annual Repair and Maintenance

	Costs (1000VND)
1. Hull	
2. Engine	
3. Fishing gear	
4. Others	
5. Total	

VII. Improvement/Investment

	Last year of improvement	Costs (1000 VND)	Duration (years)
1. Hull			
2. Engine			
3. Gear			
4. Others			
5. Total			

VIII. Insurance and Tax

	Costs (1000 VND)
1. Insurance	
2. Fishing port fee	
3. Business tax	
4. People insurance	
5. Other	

IX. Loan

	Debt at end of year (1000 VND)	Interest payment	
		Total / year (1000 VND)	% per month
1.Bank			
2. Private loan			
3. Government project loan			

X. Average operating costs/trip

	Main season		Other season	
	Quantity	Value (1000 VND)	Quantity	Value (1000 VND)
1.Fuel				
a. Oil (diesel) (liter)				
b. Lubricant (unit)				
2.Ice				
3.Food				
4.Minor repair and maintenance				
5. Other costs				
Total (from 1-5)				

XI. Average revenue of vessel (1000 VND) and crew share (%) per trip

	Main season	Other season
1.Total revenue for all (1000 VND)		
2.Average revenue per trip (1000 VND)		
3.Crew share in % after accounting for operating costs (revenue–variable costs)		
4. Crew share in % after accounting for total costs		
4. Average annual price (VND/kg) of	-	
a. Main species 1		
b. Main species 2		
c. Main species 3		
d. Main species 4		
e. Other		

XIII. Note of interviewer

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