OPEN-ACCESS INSHORE FISHERIES – THE ECONOMIC PERFORMANCE OF THE PURSE SEINE FISHERY IN NHA TRANG, VIETNAM

TRAN THI THU HOA

Master Thesis in Fisheries and Aquaculture Management and Economics FSK-3911
(30 ECTS)

The Norwegian College of Fishery Science
University of Tromso, Norway
&
Nha Trang University, Vietnam

May 2012

ACKNOWLEDGMENTS

I would really like to express my deep gratitude to my supervisor, Professor Ola Flaaten, University of Tromso, for his wholehearted devotion in my study. His profound comments have been actually extremely useful in my completing of this thesis. He also arouse in me bigger passion for fisheries economic study. I have learnt a great deal, both from his expertise and working attitudes.

I would also like to to express my great gratitude to Dr. Quach Thi Khanh Ngoc, my supervisor, Nha Trang University, for her great ideas, encouragement and valuable guidance as well.

I would like to express my thanks and gratitude to Dr. Reithe Siv and Professor Armstrong Claire (Tromso University) who carefully taught the course of Fisheries Economics and Management which set my foundation knowledge about fisheries economic theory. Many of my thanks are also for other lecturers and staffs in NOMA-FAME program during my study.

I would like to give my thanks to Dr. Le Kim Long, PhD student Pham Thi Thanh Thuy, MSc Nguyen Ngoc Duy, Nha Trang University, for their generous assistance with the data collection.

I extend my sincere thanks to the NOMA program, NORAD project and Nha Trang University for giving me the opportunity to study in Fisheries and Aquaculture Management and Economics.

At least but not last, I am so in debt to my family, colleagues and friends, who have supported and helped me during my study.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

In Vietnam, the number of fishing vessels, especially near the shore, has increased continuously, despite the Government's aim for reduction. In particular, 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 overfishing and economic decline. Therefore, the economic performance of the inshore purse seine vessels in an open-access fishery have been investigated, based on a 2011 survey of cost and earnings data of a sample of 62 anchovy purse seiners, representing about 46 % of such vessels in Nha Trang, Vietnam. The empirical results show that an average purse seiner was able to cover all the costs and earned a profit margin of 17.41% and crew members earned their opportunity cost of labour or above. Engine power, number of crew size, number of fishing days and dummy variable for location are identified as the main factors affecting the annual vessel performance, represented by gross revenue. An application of the Salter diagram shows that a large number of vessels with high relative standardised effort are the most cost-efficient vessels. The majority of these vessels earned intra-marginal rent despite the open-access characteristics of this fishery.

Keywords: Economic performance; Intra-marginal rent; Standardised effort; Cost and earnings; Nha Trang puse seine fishery.

Chapter 1

INTRODUCTION

1.1. GENERAL INFORMATION

In Vietnam, the fisheries sector is a significant contributor to the economy. Approximately 3.4 million people, or approximately 10% of the labour force, are employed in this sector (Long et al., 2008). In addition, the fisheries sector has contributed to both the domestic income development and the international trade relation development for the country. One-tenth of the export earnings for Vietnam stems from fisheries products, and was worth US$2.2 billion USD in 2003 (FAO, 2005a). Specifically, the density of the GDP of the fisheries sector increased from nearly 3% in 1990 to 3.4% in 2000 and reached about 4% in 2006 (MPI, 2010; Pomeroy et al., 2009). However, the economic opportunities and the open access to the marine resources are attracting increasing numbers of people to become involved in fisheries annually. The catches per unit of effort have, however, decreased. The earnings from fishing activities have fallen and have sometimes been insufficient to cover the fishing cost (FAO, 2005a). Therefore, an assessment of the annual performance is needed for the monitoring and improvement of Vietnam's fisheries policy (Kim Anh et al., 2006).

Vietnam has a coastline of 3,260 km, which crosses 13 latitudes, from 8°23'N to 21°39'N, more than 1 million km^2 of EEZ (exclusive economic zone), 12 lagoons and 112 estuaries. There are four main fishing areas: the Gulf of Tonkin, shared with China; Central Vietnam; South-Eastern Vietnam; and South-Western Vietnam (part of the Gulf of Thailand), shared with Cambodia and Thailand. The marine catches are highest in Central and South-Eastern Vietnam. The Mekong River delta provides over 75% of the total marine landings and therefore most of the fishing industry is concentrated in the southern provinces, from Khanh Hoa to Ca Mau (FAO, 2009).

Apart from these geographical zones, the fishing areas can be divided into inshore–coastal fishery and offshore fishery. Inshore waters are considered to be waters less than 30 m deep in the Tonkin Gulf and the south and less than 50 m deep in the centre of Vietnam (FAO, 2009). In recent years, the number of fishing vessels, especially near the shore, has increased continuously despite the Government's aim for reduction. In particular, 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 overfishing and economic decline

(Luong, 2009). Therefore, a study on the economic performance of the fisheries is an essential requirement for fisheries management.

Khanh Hoa is located in South Central Vietnam, with a coastline of 520 kilometres and more than 200 islands (Long et al., 2008). Nha Trang is the central city of Khanh Hoa province. This city is not only an attractive destination for tourism, but also a potential area for further development of fisheries (Thanh Thuy et al., 2008). In recent years, fisheries in Nha Trang have grown extensively, which has contributed to the overall development of the city's economy and improved the life of fishermen; especially, the purse seine fleet is the main kind of inshore fishery. However, the fisheries in Nha Trang are still open access, and as such are currently facing many problems, such as the overexploitation of marine resources and excess harvesting capacity (Hien, 2011). Hence, this study aims to investigate the economic performance of vessels in an open-access fishery. It is well known in the fisheries economics literature that the potential resource rent is wasted under open-access equilibrium if the fleet consists of homogenous vessels. However, a homogenous fleet hardly exists in actual fisheries; in the case of heterogeneous vessels, an intra-marginal rent may be generated even under an open-access regime. Therefore, this study not only paints an up-to-date picture of the current economic performance of the fisheries but also provides evidence to support the reason why the purse seine fisheries are still able to generate profits for society even under open-access equilibrium. This may be useful for fisheries managers in managing and developing the purse seine fisheries in Vietnam.

1.2. RESEARCH PROBLEM

Vietnamese fisheries are mostly small scale in nature. Fishing is thus concentrated in coastal waters and this has resulted in heavy pressure on near-shore resources. Referring to Research Institute Marine Fisheries (RIMF) information that the exploitable potential of marine waters up to the 50 m depth range is an estimated 582,000 tonnes/year, it has been emphasized that from 1991 onwards the catch has exceeded its sustainable limits, and that the overall profitability of the fishing fleet had decreased (FAO, 2005a). This indicates that the inshore fisheries face serious constraints to further development, at least from a biological perspective. Moreover, the Ministry of Agriculture and Rural Development proposed two major development goals for Vietnam's coastal fisheries up to the year 2015: first, to make appropriate adjustments to coastal fishing and restore and preserve the coastal marine resources and their eco-system; and second, to improve the livelihoods of the fishers dependent on coastal marine resources in order to contribute to food security and poverty alleviation among them (FAO, 2005a).

To reach these goals, Vietnamese policy makers require not only reliable assessments of inshore resources, but also an understanding of the economic realities of each inshore fishing fleet (Long et al., 2008). Therefore, it is necessary to carry out a study on the economic performance of the inshore vessels in an open-access fishery; some questions that may arise are “What are the economic performance indicators of inshore fishing vessels”, “Is the fishing fleet profitable?”, “What is the income of crew members and how does this compare with that of other people in the city?”, “Which vessels are more or less economically efficiency than others?” and “What are the main determinants of annual vessel production?”. Fisheries managers, at the industry level, may use the information to design and implement policy instruments to achieve the above two major development goals. Fishermen, at the vessel level, may also use this information to improve their fishing benefits.

1.3. RESEARCH OBJECTIVES

This thesis will address three main objectives. The first is to present the cost and earnings findings in 2011 based on data collected through a representative survey of 62 anchovy vessels, accounting for about 46% of the anchovy purse seine vessels in Nha Trang, and then a set of economic performance indicators are analysed, including gross revenue, income, gross cash flow, profit, profit margin and return on investment. The second objective is to investigate the impact of some important technical and operational characteristics of the vessel regarding its performance represented by annual gross revenue. This is performed by regression analysis of the vessel’s gross revenue by means of some technical and operational characteristics of the vessel, such as horsepower, crew size, the number of fishing days and a dummy variable for location. Gross revenue is used as a proxy for production since we lack catch volume data. The third objective is to investigate why profits are still generated even under an open-access regime. In the case of heterogeneous vessels, we have seen that the most cost-efficient vessels make above-normal profits, called intra-marginal rent. Therefore, these vessels may create net benefits for society. For this reason, I want to find out which vessel group is the most cost-efficient. This can be achieved by calculating the average cost per relative standardised effort and and the average revenue per relative standardised effort for each vessel. In addition to the main objectives, we also demonstrate that even a relatively small survey may provide statistically reliable information. This is of particular importance in a developing country, where fishing industry data are scarce and costly to collect (Raakjaer et al., 2007).

Chapter 2

BACKGROUND OF VIETNAM'S FISHERIES INDUSTRY AND KHANH HOA'S FISHERIES INDUSTRY

2.1. VIETNAM'S FISHERIES INDUSTRY

Vietnam has a coastline of about 3,260 km and its exclusive economic zone (EEZ) extends over more than 1 million square kilometres. Its coast has many bays and estuaries as well as diverse coastal and marine resources, with more than 2,100 species of fish, over 75 species of shrimp, about 653 species of marine alga and other species of high economic value (Nga, 2009; Thao, 2002). Its sea areas are divided into a number of regions, as shown in Table 2.1. The fish stock estimates total almost 4.2 million tonnes and the maximum sustainable yield (MSY) 1.67 million tonnes (MOFI, 2005; RIMF, 2001). These favourable natural conditions have created many opportunities for Vietnam to develop its marine capture as well as aquatic farming activities.

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

Marine waters	Stock (tonnes)	TAC (tonnes)	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: MOFI, 2005; RIMF, 2001

Consequently, the fisheries sector plays an important role in the national economy, accounting for about 4% of the gross domestic product (GDP) in 2006 and generating 9–10% of the total Vietnamese export revenues. This sector also provides jobs for approximately 4 million people (Pomeroy et al., 2009). The total export value from the fisheries sector was US$3 billion in 2006 and $3.49 billion in 2009; it reached a peak of $5 billion in 2010. The total export volume for 2006 was 811.5 thousand metric tons, a 29.4% increase over 2005. Catfish and shrimp constitute by far the largest share of aquatic exports, accounting for over 22% and 44%, respectively, of the total export earnings in 2006. Vietnamese fishery products have now reached more than 120 countries and territories on 5 continents. The markets of the United States and Japan are the two largest export destinations, by country, while European Union nations, as a group, received the largest share of exports by volume (364 thousand tonnes) and by value ($1.2 billion, making up 23.5%) in 2010 (Duc, 2011). These figures combined help Vietnam achieve a leading position, joining the group of the ten largest seafood exporters in the world.

However, Vietnam's marine fisheries are referred to as small-scale, multi-species, multi-gear and open-access fisheries (FAO, 2009). The marine fisheries production has increased continuously over time and the number of fishing vessels has increased significantly and far exceeded the control (FAO, 2005a). By the end of 2001, the number of powered vessels was approximately 79,000, with a total capacity of 3,722,557 hp, an increase of 172.41% and 714.92% in terms of vessel numbers and horsepower, respectively, when compared with 1985 (FAO, 2005a). This figure continued to increase to 85,914 vessels with a total capacity of more than 4,721,701 hp in 2005 (Luong at al., 2009). According to a report by the FAO, the total engine power of the marine fishing fleet increased by about 12% per annum in the earliest years of this century. About 84% of the marine fishing vessels have an engine size of less than 90 HP. The fishing grounds of these vessels have focused mainly on coastal sea areas[3] (FAO, 2005a; Pomeroy et al., 2009), which has resulted in heavy pressure on inshore resources (FAO, 2005a).

The coastal fishing pressure has increasingly threatened and possibly depleted the coastal aquatic resources. Long (2002) investigated the trend in fishing capacity and fishery outputs during the last two decades. The fast increase in the number of vessels and engines has led to a decrease in the catch per unit of effort, from 1.11 tonnes/hp in 1985 to 0.61 tonnes/hp in 1993 and 0.36 tonnes/hp in 2004 (FAO 2005a; Long, 2002; Pomeroy et al., 2009). This is a consequence of the overexploitation of the coastal resources in Vietnam, resulting in an unbalance between the potential coastal stock abundance and the fishing capacity in terms of the amount of fishing vessels (FAOa, 2005).

In order to reduce the pressure on coastal fisheries resources, the Vietnamese Government has formulated a policy to develop the offshore fishery and a programme of investment in offshore vessels has thus been implemented since 1997 (FAO, 2004 and 2005a). However, the majority of coastal fishermen's communities are poor and lack the capital as well as the knowledge necessary for offshore fishing activities; therefore, few fishers have been able to afford investments in offshore vessels. As a result, the offshore fishing programme has not perfectly obtained its goals (FAO, 2005a). In order to maintain and develop the fisheries in a sustainable way, it is necessary to have appropriate management policies to reduce the fishing pressure on coastal waters, promote offshore fisheries and regulate coastal fishing activities in correspondence with the current stock status.

2.2. Khanh Hoa Fisheries Industry

Khanh Hoa is located along the coastal zone in Central Southern Vietnam. It is bordered by Phu Yen in the North, Ninh Thuan in the South, Dac Lac and Lam Dong in the West and the South China Sea in the East. On the map, Khanh Hoa extends from 108°40’33’’ to 109°27’55’’ across eastern longitudes, and from 11°42’50’’ to 12°52’15’’ across northern latitudes. Its land area is approximately 5,260 km^2 and the coastline stretches for 520 kilometres. This coastline is made up of territorial waters and more than 200 islands (Kim Anh et al., 2006; Kim Anh et al., 2007; Long et al., 2008). Khanh Hoa’s marine resources are considered to be abundant and diversified. According to a report by the IEFP and RIMF (2005), the Khanh Hoa sea area is inhabited by about 600 fish species, of which there are 50 species with a high economic value. The pelagic fish species make up a large proportion, with an estimated amount of 115,800 tonnes. The maximum sustainable yield (MSY) is estimated to be about 38,000 tonnes per year (IEFP and RIMF, 2005). Thanks to these natural advantages, Khanh Hoa has had a long tradition of development for marine capture fisheries (Kim Anh et al., 2006; Kim Anh et al., 2007).

Therefore, the fisheries sector has become an important economic sector for Khanh Hoa province and has played an important role in restructuring agriculture and reducing poverty. An example of this achievement in Khanh Hoa is the increase in the export value from 120 million USD to 265 million USD. Aquaculture alone increased by 16% per year during the 2001 to 2007 period, contributing substantially to the local GDP and creating about 48,000 jobs (Hong Nga, 2010). From now until 2015 and with a view to 2020, Khanh Hoa province will be striving to reach a fishing output of 120,000 tonnes, including natural catching of 90,000 tonnes and aquaculture of 30,000 tonnes. The export revenue will exceed US$500 million a year (VCCI, 2010).

Due to the favourable conditions, Khanh Hoa fisheries have made considerable achievements and are continuing to do so. However, the fisheries in Khanh Hoa are still open-access and multi-species fisheries in nature. The number of fishing vessels has increased significantly over time. In 2008, Khanh Hoa had 10,188 fishing vessels with a total capacity of 354,121 horsepower, equivalent to 35 hp/vessel, an increase of about 16.7% compared with 2000 (Nga, 2010). With the increase in the number of vessels, the total engine capacity of the fleet has increased remarkably – an average annual increase of 18%. By the end of 2009, the number of vessels in Khanh Hoa province was about 12,802 boats, an increase of about 26% in comparison with 2008 (DECAFIREP, 2009).

Table 2.2: The distribution of vessels by fishing gear and engine power in Khanh Hoa, 2009

Gear type	Range of engine power						Total	Rate
	0-<20	20-<50	50-<90	90-<250	250-<400	400-<4000		
Gill net	394	144	82	105	88	15	828	6.50%
Longline	860	277	55	86	19	2	1299	10.10%
Trawl	400	791	291	187	16	3	1688	13.20%
Purse seine	642	260	74	17	1	1	995	7.80%
Purse seine using light	1871	1194	169	83	5	0	3322	25.90%
Lift net	239	52	59	56	6	3	415	3.20%
Others	3619	581	37	16	1	1	4255	33.20%
Total	8025	3299	767	550	136	25	12802	100%
Rate	62.70%	25.80%	6.00%	4.30%	1.10%	0.20%	100%	

Source: Department of Capture Fisheries and Resources Protection of Khanh Hoa (DECAFIREP) (2009).

In order to increase the catch, the fishermen use a variety of fishing gears, including the gill net, long line, trawl, seine net, set net and hook. Among them, the number of purse seiners using lights was the biggest, with 3322 vessels or approximately 25% of the total fishing boats in Khanh Hoa, followed by the number of trawlers, accounting for 13.2% in total; the lift net (3.2%) appears at the end of the list. Besides, Table 2.2 shows that the vessels with an engine capacity of less than 20 hp are the most popular, with 8025 vessels (62.7%); approximately 89% of the total mechanized vessels have less than 50 HP, and 95% have less than 90 HP. In general, the fisheries in Khanh Hoa are mostly small scale in nature, which is the same situation as for Vietnamese fisheries. Thus, fishing activities are concentrated in coastal areas and this has resulted in heavy pressure on near-shore resources.

Coastal resources are becoming exhausted, while the size of vessels, the capacity of engines and the fishing pressure are still increasing. This has led to the catch per vessel (in tonnes/vessel) and the catch per unit of engine power (in tonnes/hp) having almost declined during the period of time 2001–2009. The average annual decrease rate was 9.4% of catch per vessel and 12% of catch per hp during this period. In 2009, the catch per vessel and catch per hp decreased to 5.65 tonnes and 0.195 tonnes, respectively (Duy, 2010).

In summary, coastal waters are very important to fisheries in Vietnam in general and Khanh Hoa specifically. They produce 82% of the total marine catch and comprise the fishing grounds of small fishing vessels that constitute 84% of the total mechanized fishing vessels. Coastal waters also serve as the source of living for poor fishers, whose population constitutes 88% of the total capture fisheries labour force. However, the coastal resources have been overexploited, and there is an imbalance between the fishing capacity (in terms of the quantity of fishing vessels) and the potential coastal stock abundance (FAO, 2005a). In order to maintain and develop the fisheries in a sustainable way, it is necessary to adopt appropriate management policies to reduce the fishing pressure on coastal waters. Therefore, assessing the economic performance of inshore fisheries in Khanh Hoa province is necessary to provide information and insights for the policy-making process in fisheries development.

2.3. Khanh Hoa Purse Seine Fisheries Industry

Purse seine fishing plays an important role in the fisheries in Khanh Hoa province. It uses one of the selective kinds of fishing gears that has high productivity and is also very popular in fishing countries all over the world. In Vietnam, there are two main fishing methods for purse seine fishing: fishing with light and fish aggregation devices, and the searching method. The method of using light and fish aggregation devices is very popular in many fishery provinces. For this method, the average size of the net is about 250–500 metres in length and 45–70 metres in depth (Luong, 2009). At present, in Khanh Hoa this practice is supplemented with additional features, including the use of lighting and echo sounders to attract and search for fish. The lighting method gathers schools of fish under light sources and the net is set to encircle them (Thanh Thuy el al, 2008). The searching method usually specializes in catching high-speed pelagic fishes. The skipper uses an echo sounder as well as his own eyes to observe the sea while the vessel moves at a moderate speed. When fish schools are found, the skipper has to assess the direction of their movement, as well as their abundance, in order to approach and encircle them (Thanh Thuy el al, 2008). For this method, the nets are larger: the average net size is 500–1200 metres in length and 70–120 metres in depth. This fleet is also characterized by modern fishing equipment, mechanical implements and fish finders (Luong, 2009).

In recent years, the number of purse seine vessels and the total fleet engine power have developed quickly in Khanh Hoa. In 2010, the total number of purse seine vessels with an engine capacity of more than 20 hp was 1389 units (DECAFIREP, 2010), of which about 77.2% were boats with an engine of less than 50 hp and almost 91% boats with an engine of less than 90 hp (see Table 2.3). Most of these groups are allocated to the Van Ninh district and Nha Trang and Cam Ranh city.

Nha Trang city had 415 units in total of 1389 purse seine vessels. Among them, the number of purse seine vessels with an engine of less than 50 hp was 257 vessels (accounting for nearly 62%) and 327 vessels with an engine of less than 90 hp (making up about 79%). Most purse seine vessels with an engine of more than 90 hp were concentrated in this city. In Nha Trang, the purse seiners are mostly anchovy vessels. For anchovy purse seiners, the target species are seasonal pelagic fish, mainly anchovy (Stolephorus spp.) but also other species like mackerel (Scomberomorus spp.), skipjack tuna (Katsuwonus pelamis) and scad (Decaterus spp.). Of these, the anchovy yields the highest revenue. The average annual operating time for an anchovy purse seiner is about 9 months. The high season for the anchovy purse seine fishery stretches from March to August or September. The remaining months are called the low season (Thanh Thuy et al, 2008).

Table 2.3: The distribution of purse seine vessels by location and engine size in Khanh Hoa, 2010

Range of engine power	Districts in Khanh Hoa					Total	Rate
	Nha Trang	Cam Ranh	Ninh Hoa	Van Ninh	Cam Lam		
20-<50	257	223	124	428	40	1072	77.2
50-<90	70	45	33	39	6	193	13.9
90-<250	78	11	10	15	0	114	8.2
250-<400	8	0	0	0	0	8	0.6
400-<500	2	0	0	0	0	2	0.1
Total	415	279	167	482	46	1389	100%
Rate	29.9	20.1	12.0	34.7	3.3	100%	

Source: DECAFIREP of Khanh Hoa (2010).

The fishing ground for Nha Trang purse seine vessels is in and around Nha Trang Bay and the fishing ground for Cam Ranh purse seiners is in and around Cam Ranh Bay. Anchovy purse seiners cannot operate in fishing grounds far away because of strong water currents and the propulsive forces of the net, which has a small mesh size (2 mm) (Thanh Thuy el al, 2008). The length of each fishing trip is 1 day and purse seiners only catch inshore.

For pelagic fish purse seiners, the main species targeted are also seasonal fish such as scad (Decaterus spp.), mackerel (Scomberomorus spp.) and skipjack tuna (Katsuwonus pelamis). Anchovy are rarely caught. The average annual operating time is 6.8 months, stretches from

February to July or August. In March and April, these vessels move to the fishing ground in Ninh Thuan province, South of Khanh Hoa, to catch mackerel. The fishing grounds stretch from Khanh Hoa to the Ninh Thuan Sea. Therefore, the length of each fishing trip is often longer, varying from 1 to 3 days. The mesh sizes are comparatively bigger than those of anchovy purse seiners, varying from 8 to 12 mm. Well-equipped pelagic fish purse seiners can catch either inshore or offshore (Thanh Thuy el al, 2008).

In short, the purse seine fishery in Khanh Hoa remains open access and largely small scale. In recent years, Vietnam's Government has adopted national offshore fisheries development to reduce the fishing efforts in coastal waters. However, most coastal fishing communities are poor and lack capital. In addition, their education level is low; therefore, their ability to acquire and operate modern equipment and machines is very limited. As a result, the offshore fishing programme has not perfectly obtained its goals and the fishing activities are still concentrated in coastal areas. This has led to conditions of excessive exploitation. Hence, the top priorities for fisheries are the establishment of an effective system for aquatic resource management and a vessel registration system to achieve sustainable fisheries.

Chapter 3

LITERATURE REVIEW

Fisheries management has many objectives, such as increase yields, maximize resource rent, rebuild overfished stocks, or maintain biodiversity. Governments increasingly demand that fisheries managers associate each objective to measurable performance indicators supported by scientific data in order to evaluate the success of management strategies and objectives (Cochrane, 2002). Besides, the assessment of economic performance is a key element in furthering understanding of the economic incentives that exist in the fishery (Pascoe, Robinson and Coglan, 1996). Hence, economic surveys of fisheries have been carried out in many nations for many years as a means of assessing the economic performance of their fisheries (Duy, 2010). In the European Union, concerted action on the economic assessment of EU fisheries has produced indicators on economic performance of selected European fishing fleets since 1998. The summary document on the "Economic Performance of Selected EU fishing fleets" had been prepared by the European Commission. The economic performance indicators were based on revenue, cost, profit, employment and landings composition. This document showed economic results of 16 national fleets for 2005. It consisted useful economic information on value added indicators. It also provided comprehensive annual economic information on the economic situation of all EU fishing fleets for fisheries managers and stakeholders, as well as for people not directly involed in the fisheries sector (European Commission, 2007).

In Norway, Flaaten et al. (1995) studied the profitability for the Norwegian purse seine fishery, with costs and earning data of 1983 and 1984. This is performed by comparing the profitability of purse seine vessels which received their licenses for free, with the profitability of vessels which had to purchase the license. The study concluded that, vessels that received free licenses had a significantly higher profitabilty than the other vessels. This was due to the owners who bought licenses had the highest capital costs (Flaaten et al., 1995).

Another research of Floc'h et al. (2008) investigated the capital value and the economic performance of the commercial fishing fleet of the French region of Brittany. Based on two data sources (bookkeeping or field surveys), measures of economic performance could be produced for the short term using gross surplus; and for the long term including the cost of capital and then the differences between them were then discussed (Floc'h et al., 2008).

In the United Kingdom (UK), the costs and earnings surveys were carried out in the English Channel fishery in 1994-1995. The results were used to assess the financial and economic performance of boats in the fisheries. It was estimated that most operators covered their cash costs during the 1994-1995 financial year. However, the level of cash profits varied greatly between boats depending on size class and main fishing activity. On average, the economic profit in the fishery was negligible. This indicated that the English Channel fishery had not managed to its full potential in 1994-1995 (Pascoe, Robinson and Coglan, 1996).

Whitmarsh et al. (2000) studied the profitability of marine commercial fisheries in the UK. In this study, the authors suggested that the need of separating the measures of economic and financial performance. The financial performance indicators were based on the concept of income and the explicit costs. Meanwhile, economic performance indicators were based on the concept of efficiency. They were assessed by relating the value of output to the real cost of the inputs needed to produce it. The study also showed that the role of costs and earnings surveys in assessing not only the current state of fisheries but also the indicators of the profit-earning potential under alternative fisheries management systems. Hence, the bioeconomic modelling was also required (Whitmarsh et al.,2000).

In Australia, Roger Rose et al. (2000) researched the economic performance of three commonwealth fisheries the northern prawn fishery; the offshore trawl sector of the south east fishery; and the east coast tuna and billfish fishery. The framework was based on a measure of the net returns to the fisheries. The results of this study showed that the importance of integrating economic and biological indicators in assessing the performance of fisheries management. By examining the full range of indicators and their interactions, this could lead to improve the management of fisheries (Rose et al., 2000).

In the United States (U.S.), Agar et al. (2005) investigated the costs and earnings study of fish trap fishery in U.S. Caribbean in 2003. The main socio-economic characteristics of the trap fishery were described in the contexts of the Commonwealth of Puerto Rico and Territory of the U.S. Virgin Islands. The study indicated that higher gross revenues were always not likely to translate into higher net revenues. It also showed that the various economic surpluses generated because of the heterogeneity of the trap fishery in U.S. Caribbean and the presence of negative economic earnings were imputed as evidence of the overinvestment of the trap fisheries (Agar et al., 2005).

Adeogun O. A et.al. (2011) evaluated the economic performance of small-scale crab fishery in Nigeria during the 2009-2010 fishing season in five lagoon systems in Lagos state. The objectives of the study were to identify economic viability of the crab fishing activity and to find out factors affecting the cost structure. The results showed that small-scale crab fishing had a positive net profit and fully recover their costs. The net cash flow, economic and financial performance of the crab fishers considered to be a good result. The study also concluded that improving efficiency of crab fishing is a key element to reducing cost.

In 1987, a study on the profitability for the Thai trawl fishery was performed in the Gulf of Thailand by Panayotou and Jentanavanich through four surveys in 1969, 1974, 1977 and 1982. In this study, some economic indicators were presented, such as revenues, costs, gross profits, net profits, pure profits, and rate of return on capital as well as catch per unit effort. The study concluded that an effective strategy for the solution of Thailand's fisheries would involve the construction of new trawlers, the licensing and control of the activities of existing vessels (Panayotou and Jentanavanich, 1987).

On a global scale, FAO Fisheries Department began collecting empirical information on the economic of fishing operations in 1995 in close cooperation with fisheries research institutions and national fisheries administrations in selected nations in Asia, Africa, Latin America and Europe. According to reports in FAO Fisheries Technical Papers 377, 421 and 482, studies of costs and earnings carried out by FAO in 1995-1997, 1999-2000, and 2002-2003 (FAO 1999; FAO 2001, FAO 2005b).

In 2005, FAO presented the findings of country level studies on the economic and financial performance of marine capture fisheries. The studies were carried out in 13 South American, Caribbean, European, African and Asian countries during 2002 and 2003 with the 94 most important fishing fleets in these countries operating covered. The results showed that all 94 types of fishing vessels had a positive gross cash flow and fully recovered their operating costs, 88 of the 94 types of vessels (accounted for 94%) showed a net profit after deducting operating costs and capital costs. The studies also presented that there were significant improvements in financial and economic performance of fishing fleets in the Republic of Korea, Germany and Argentina in comparison with in both 1999-2000 and in 2002-2003, partially due to reduction and limitation of fleet capacity. In the other nations, the overall picture remained similar, with some fleets improving their performance and others achieving less favourable results.

Beside that, many authors presented the economic performance through the measurement of technical efficiency and economic efficiency of fishing fleets. This is performed by using Stochastic Production Frontiers (SPF) and Data Envelopment Analysis (DEA). The performance of firms relative to this frontiers can then be assessed and aggregated to determine the overall efficiency of an entire sector or fishing fleet (Coelli et al. 2005). Data envelopment analysis (DEA) involves the use of mathematical linear programming techniques to construct a non-parametric surface (or frontier) over the data, so that efficiencies of sampled firms can be calculated relative to this surface. Oppositely, SPF involves the use of econometric estimation techniques to estimate a parametric frontier. The first authors to estimate a production frontier were Aigner and Chu (1968). Their production function incorporated a non-negative asymmetric error term, which showed a distance from the frontier for a given firm (Coelli et al. 2005).

In Vietnam, most studies focused on developing economic indicators for the offshore fisheries in Khanh Hoa Province as well as finding main factors influencing the vessel performance represented by gross revenue and (or) income (Kim Anh et al. (2006), Kim Anh et al. (2007), Thanh Thuy et al. (2008) and Long et al. (2008)). Some of the research projects concentrated on analyzing efficiency for the fisheries (Ngoc et al. (2009), Truong et al. (2011)). These authors contributed useful insights for fishery managers to improve and develop fisheries sector in Vietnam. For Kim Anh et al. (2006), the authors conducted the study of costs and earnings of gillnet vessels in Nha Trang, Vietnam in 2004 and 2005. The empirical results found that tuna-mackerel gillnet fishery was one of the offshore fisheries with relatively high economic efficiency. The return on equity ratio (ROE) in 2004 and 2005 were 10.9 % and 17.9% respectively. The main reasons for that were all presumably abundant in fish stock and increasing in market demands for Tuna and Mackerel.

Both studies of Long et al. (2008) and Thanh Thuy et al. (2008) had the same characteristics of methodology since economic performance indicators were based on gross revenue, gross value added, gross cash flow, net profit and profit margin. When calculating net profit, both these studies did not include opportunity cost of capital. The results of Long et al. (2008) showed that the average annual crew remuneration was 93% of labour earnings in the most productive sectors in Khanh Hoa and the owner of an average longline performer got a profit margin of 12.1%. In addition, the regression analysis of gross revenue and income indicated that if other factors hold constant, a vessel of hull length 15.9 and 15.1m would maximize gross revenue and income respectively. This implied that overinvestment in vessels could lead to inefficiency in Khanh Hoa's longliners. For Thanh Thuy et al. (2008), the authors carried out the study of costs and earnings of small-scale purse seiners in two fishing communities (Nha Trang and Cam Ranh) in Khanh Hoa province in 2005. The results demonstrated that an average small-scale purse seiner was able to cover its all costs including depreciation and interest payment, and earned a profit margin of 24% and a return on investment of 30%. The income of crew members was higher than that in the local seafood processing companies in the province.

Ngoc, et al. (2009) used SPF to evaluate efficiency of trawlers that affected by a marine protected area in Nha Trang Bay, Vietnam. The study showed that efficiency varried with the fishing grounds. The vessels fishing in the vicinity of the Nha Trang Bay Marine Protect Area (NTB-MPA) was higher level of efficient than those in an unprotected area. In addition, the authors also concluded that an MBA did not seem to be sufficient to obtain improved management. It was very important to deal with the link between poverty and resource management to ensure the success of an MBA.

Chapter 4

THEORETICAL FRAMEWORK

4.1. Fisheries theory

4.1.1. Open access bioeconomic model of the fishery

The traditional bioeconomic model of a fishery has been provided by Gordon, 1954. This model was built based on the important assumptions that the vessel fleets in a perfectly competitive market are homogeneous with an identical cost structure. Hence, all vessels have the same of cost per unit of effort, or, marginal cost and average cost are identical and constant. Market prices are assumed not to be affected by the quantity of fish landed from this one fishery. For simplicity, total costs may be supposed to increase linearly with efforts, and the vertical distance between total revenue and total cost will define the economic profit from the fishery (Gordon.,1954).

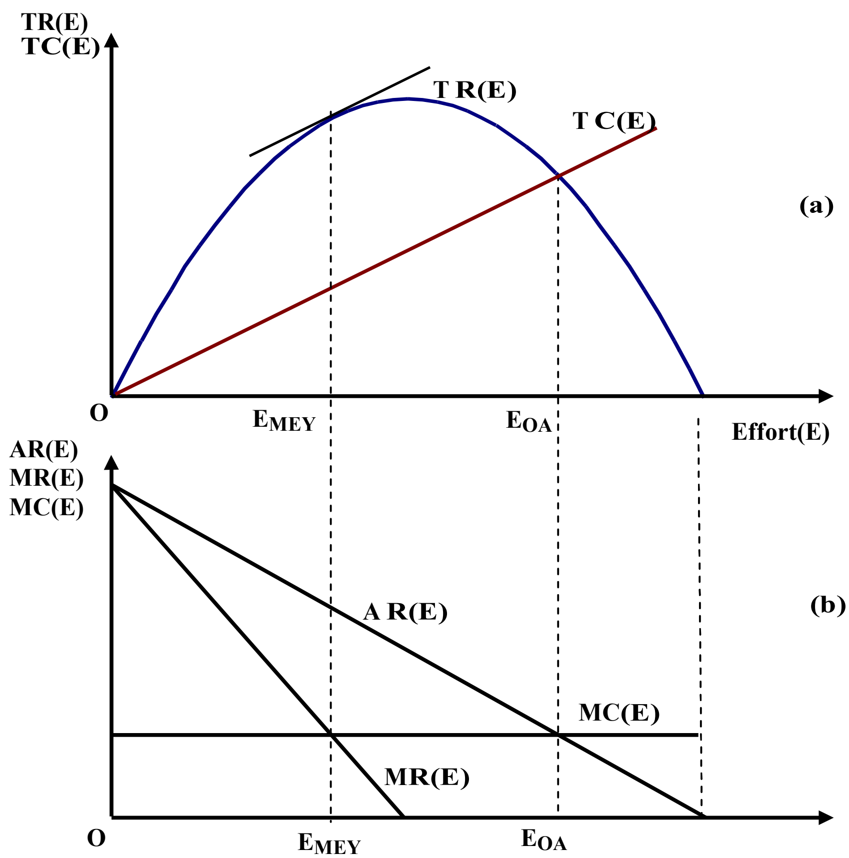

Figure 4.1: The traditional bioeconomic model. Source: Flaaten, (2011, p. 26).

The total revenue curve will simply have the same shape as the sustainable yield curve, scaled up or down depending on the actual price and price of fish is constant over time (Flaaten., 2011). Under an open-access regime, vessels will enter the fishery if average revenue per unit of effort is greater than average cost per unit, and will exit the sector if the average cost per unit is higher than average revenue per unit. When average revenue of effort, AR(E), equals marginal cost of effort, MC(E), there will be an economic equilibrium with neither an incentive to leave nor an incentive to enter the fishery. In other words, profit at this effort level is zero (Flaaten, 2011). In Figure 4.1, the level of effort under open access equilibrium is denoted as E_{OA}. When the vessels operate at lower levels of open-access effort, individuals will be making economic profits (resource rent). The existence of this positive profits (or called in term of super normal profits) will attract new entrants into the fishery, and lead to reducing the fisheries average revenue until individuals earning zero profits (called in terms of normal profits) (Coglan and Pascoe, 1999; Flaaten, 2011). As a result, the resource rent will be dissipated under open access condition (Gordon, 1954; Scott, 1955; Coglan and Pascoe, 1999; Flaaten, 2011). This is a consequence of the "Tragedy of the Commons" problem discussed in Hardin (1968).

4.1.2. Optimal economic management

In the case of maximum economic yield, the level of effort, $E_{\mathbf{MEY}}$, is determined at a point where MC(E) = MR(E). The economic profit generated at this effort level will be $TR_{\mathbf{MEY}}$ – $TC_{\mathbf{MEY}}$ (Flaaten, 2011). These profits are called resource rent. The existence of the resource rent is as a result of the fisheries management regimes. The figure 4.1 shows that $E_{\mathbf{MEY}}$ is significantly lower than $E_{\mathbf{MSY}}$. The reduction of effort compared with the open access effort level saves costs and/or enlarges fishery revenues and maintains a large stock (Flaaten, 2011).

As mentioned above, the potential resource rent is wasted under open access equilibrium. It occurs in the state of uncontrolled or unmanaged exploitation of a common property resource. In addition, there are few incentives for each fisher to save fish in the sea to let it grow and to let it spawn new recruits for later periods of fishing because there is no assurance that the fish they save would not be caught, either now or in the future, by competing fishermen (Scott, 1955; Flaaten, 2011). This has led to conditions of excessive exploitation and ecological degradation. Thus, unrestricted access to a fishery leads to inefficiency and overfishing. Therefore, public regulation of marine fisheries appears necessary to overcome the incentives to overfish and its consequences. The economists'early discussions about regulations to achieve objectives, such as increase yields, maximize resource rent, or maintain biodiversity. But they focused on normative issues such as: how can regulations be designed in order to move an open access fishery closer to a rent maximizing ideal? (Homans and Wilen, 1995).

To achieve the above objectives, fisheries managers have used traditional methods such as managing fishing capacity and effort. Examples of management instruments for capacity and effort reductions include vessel and fisher licences, effort quotas, length and weight limits for hull and fitted vessels, as well as engine power limitations. Such regulations are called input regulations. Output regulations related to the harvest of fish by setting a total allowable catch (TAC) which is then sub-divided into individual quotas such as harvest quotas per enterprise, vessel or fisher. In addition, input and output regulations may be combined with technical regulations, which include minimum mesh size of gear, minimum size of fish, and closed areas and seasons. Some of the regulatory instruments may be transformed into market instruments, such as tradeable licences and quotas. Indirect management instruments include taxes, fees and subsidies (Flaaten, 2011). Given the different ecological and socioeconomic consequences of a common property resource, a number of fisheries managers' efforts have sought to improve management in the hope of moving towards sustainable marine fisheries (Pauly et al., 2002).

4.1.3. Fishing vessel economics

In this section, the author will apply microeconomic theory to the operation of fish harvesting firms in order to study on the economic adaptation of fishing vessels (Flaaten, 2011). This includes the economic objectives of fishing activities, the costs structure, the size and the availability of natural resources, and the fish stock. A fishing effort measures the activity level of a vessel. The vessels can be different in effort levels due to the differences in the total number inputs needed to generate fishing efforts (Flaaten, 2011).

In the previous section we assumed that vessels are homogenous with respect to cost and catchability implying that cost per unit of effort, a, is constant and equal for all vessels (Flaaten, 2011). In actual fisheries vessels usually differ with respect to efficiency and costs. For example, a fishing fleet is characterized with the differences in size, age, engine power, or the difference in the skill of the skipper and crew (Coglan and Pascoe, 1999; Flaaten, 2011). Thus, the fishing vessels are heterogeneous in cost structure and variations in the efficiency of efforts. This lead to the existence of heterogeneous efforts in the fish harvesting industry.

Before analyzing the vessel's economic adaptation of fishing effort, there are some assumptions need to be showed. It is firstly assumed that each vessel is not able to impact on market price of fish in the competitive market due to the catch of a vessel is small in relation to the total landings of fish in this market. This is reasonable to consider that the price of fish is the same for all vessels. It is secondly assumed that the activity of the vessel has not effect on stock biomass, and fish stock is considered as constant in the short-run (Flaaten, 2011). In a given period of time the vessel's harvest function is a function of its effort. For simplicity, we assume that the vessel harvest function is the Schaefer harvest function:

(4.1) $h(e,X) = qeX$

where e is effort of one fishing vessel, given the stock level, X, and the catchability coefficiency, q.

The total cost of effort is $tc(e) = tvc(e) + f$, where $tvc(e)$ is total variable cost of effort and f is the fixed cost. The average cost is calculated by total cost divided by the effort, $ac(e) = tc(e)/e$ and marginal cost of vessel effort is the addition to total cost due to the addition of one unit to effort, $mc(e) = dtc(e)/de$.

According to the theory of the firm, marginal cost may decline with output at low level, reaches a minimum, and rises thereafter, due to the form of the production function. In the case of fisheries, effort is considered as the (intermediate) product of the production process and this (intermediate) product is produced by regular inputs according to a regular production function (Flaaten, 2011).

Using the Schaefer harvest function, the profit of the vessel is:

$\pi (e;X) = p\, h(e,X) – tc(e)$

or

(4.2) $\pi (e;X) = p\, qeX – tc(e)$

Assuming that the objective of the vessel is to maximize its profit given in equation (4.2), the first order condition for this is

(4.3) $\Pi'(e,X) = pqX – mc(e) = 0$

Equation (4.3) implies the following criterion for the vessel's adaptation of its effort is that

(4.4) $mc(e) = pqX$

This equation (4.4) shows that the marginal cost of vessel effort is equal to the marginal revenue of effort. The latter equals the product of fish price, catchability coefficient and stock level. The result represents the revenue earned by the adding one unit of effort. In the traditional theory of production or theory of the firm, the right hand side of the equation corresponding to (4.4) would include only p, whereas in this case both q and X are included in addition to the price. For a given set of p, q and X the vessel's optimal effort is implicitly given by equation (4.4) (Flaaten, 2011).

In the production theory, we can measure product along the horizontal axis whereas in this case we have used fishing effort as the fisher's decision variable. An ordinary firm can control its total production process, including all inputs needed and the costs incurred. A fish-harvesting firm, however, does not control it's the most important input, especially the fish stock. Fish stock is not the same as fuel and bait that can be purchased in the input market. Thus cost per unit of harvest will depend on both input costs and on the stock level and its catchability (Flaaten, 2011).

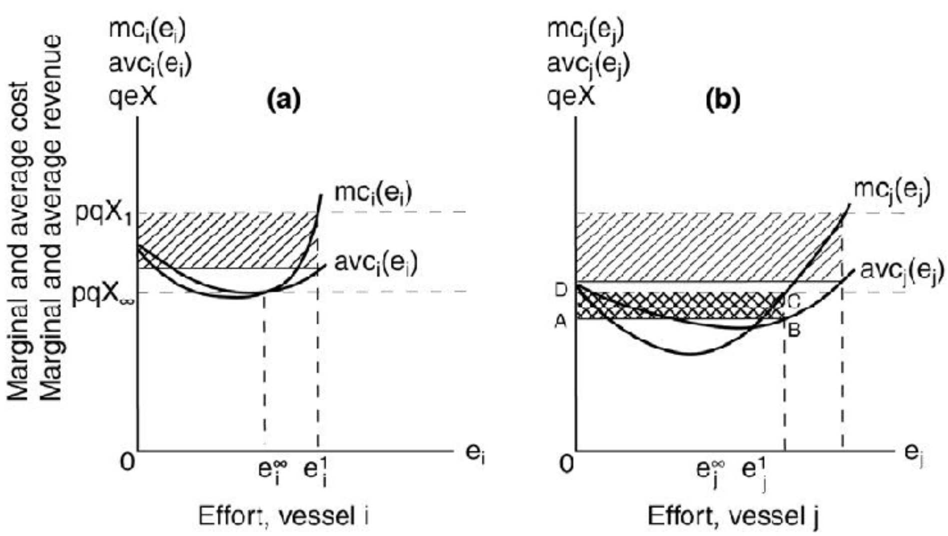

Figure 4.2. Two fishing vessels: short-run adaptation of effort for given cost structure, price of fish, catchability and stock level. Source: Ola Flaaten, (2011, p.93).

We will compare the adaptation of optimal effort for two profit maximising vessels, vessel i and vessel j (shown in figure 4.2)

Panel (a) of this figure shows the marginal revenue of effort, *pqX*, for two levels of the fish stock, namely X_∞ and X_1. The optimal effort of vessel *i* is e_i^∞ for stock level X_∞. This effort is according to the optimality criterion in equation (4.4), that is, marginal cost of effort equals marginal revenue of effort. In this case, vessel *i* does not make any profit, just remains break-even, since the marginal revenue of effort, pqX_∞, equals average variable cost.

If the stock level is lower than X_∞, it will be optimal for this vessel to stop fishing because marginal revenue will be below the minimum average cost at any effort level. In this case, the lost of vessel will be more than fixed cost, it is better for the vessel to be idle with zero revenue and zero cost, than to operate with a negative result. The vessel *i* is called as a marginal vessel.

Figure 4.2 panel (b) shows that vessel *j* achieves its maximal profit for effort e_j^∞ at stock level X_∞ and that profit equals the area ABCD in this case. This profit is called producer's surplus or quasi rent in the theory of the firm and intra-marginal rent in fisheries economic theory[1]. The latter refers to rent earned by those vessels that are more cost efficient than the marginal vessel. In figure 4.2 vessel i is a marginal vessel at stock level X_∞ whereas vessel j is intra-marginal at this level (Flaaten, 2011).

If the stock level is X_1, the vessel *i* and *j* will maximise its profit at effort level e_i^1 and e_j^1, respectively. In this case, the profit for each of these two vessels will equal the single-shaded areas of panel (a) and (b). From this, we can see that higher stock level means higher marginal revenue of effort, thus encouraging each vessel to increase its effort. The increase of vessel effort depends on the steepness of the marginal cost curve. If the marginal cost curve is very steep the optimal effort will hardly be expanded if stock increases (Flaaten, 2011).

[1] Sometimes intra-marginal rent refers to rent related to the average total cost curve. However, the main point is that intra-marginal rent is a surplus that accrues to those vessels that are more cost efficient than the marginal one.

Figure 4.3 shows behavior of the individual fishing vessel for its adaptation in short run and long run. In the short-run, the vessel suffices to cover operation cost (variable cost) whereas in the long-run it has to cover both fixed and variable cost. (Flaaten, 2011).

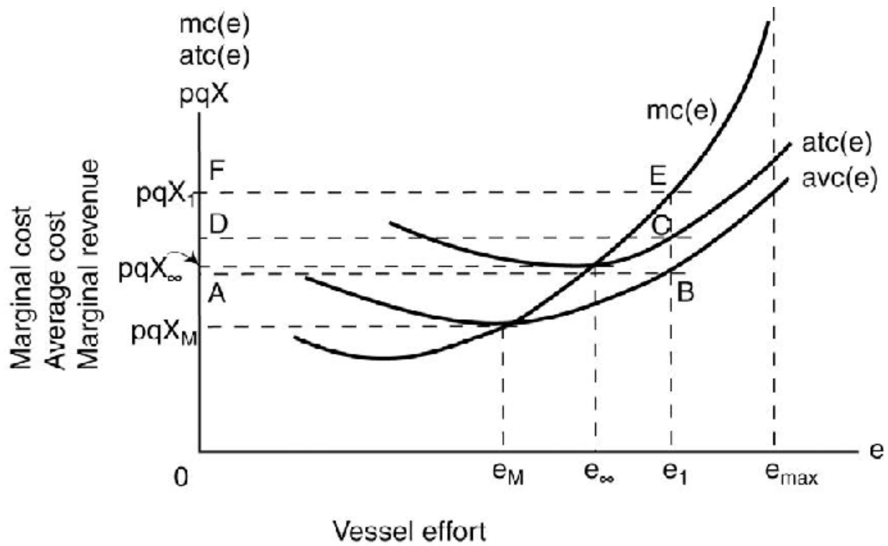

Figure 4.3. Short-run and long-run adaptation of fishing effort may vary due to fixed costs. Source: Ola Flaaten, (2011, p.95).

Note that the average variable cost curve, avc(e), is below the average total cost curve, atc(e), at any effort level, however, the difference between average total cost and average variable cost narrows when effort expands since this allows the fixed cost to be divided by more units of effort. The marginal cost curve intersects the avc(e) and atc(e) curves at their minimum points (Flaaten, 2011).

In the short-run a vessel will operate if stock level above X_M or marginal revenue of effort is above pqX_M, which is equal to the minimum of its average variable cost. In the long-run, a vessel will also have to cover fixed costs, it means that the stock level has to be at or above X_∞ or the marginal revenue of effort is equal or greater than $pq X_\infty$ for the vessel to be able to cover its capital cost. The X_∞ indicates that the stock level at which the marginal vessel breaks even under open-access fishing regime (Flaaten, 2011). The marginal vessel, producing effort e_∞, will be able to cover all its costs, and earning normal profit. However, if effective management measures have been taken, the stock level is kept at X_1 , the vessels will earn the gross profit is area of ABEF which include the super profit DCEF shown in figure 4.3. The super profit in this case is the vessel's share of resource rent (Flaaten, 2011).

4.1.4. Intra-marginal rent for the most efficient vessels

In section 4.1.1 we assumed that vessels are homogeneous from a cost and efficiency point of view. From this section we also see that the potential resource rent is wasted in an open-access fishery, but that sole ownership or other management measures can mitigate this and create resource rent. In actual fisheries vessels usually vary with respect to size, engine power, gear-type, costs and other technical and economic characteristics. Therefore, the fishing vessels are heterogeneous in cost structure and different in efficiency of effort, and resulting in the existence of heterogeneous effort in the fishery (Flaaten, 2011).

Figure 4.4 illustrates relationship between the standardized effort and the cost efficiency of the effort of 12 heterogeneous vessels. For each of the 12 vessels, the standardized effort is along the horizontal axis and the average cost per unit standardized effort is with the vertical axis. The standardized fishing effort of each vessel is measured by the width of the bar whereas the height of the bar measures cost per unit effort. The vessels are arranged from the left to the right according to their cost efficiency, with vessel number 1 as the most cost efficient one and vessel number 12 as the least cost efficient. Since the cost bars in Figure 4.4 are substituted by a curve enveloping the bars, this curve is called the marginal cost of effort curve, MC(E), and is shown in figure 4.5 panel (b) (Flaaten, 2011).

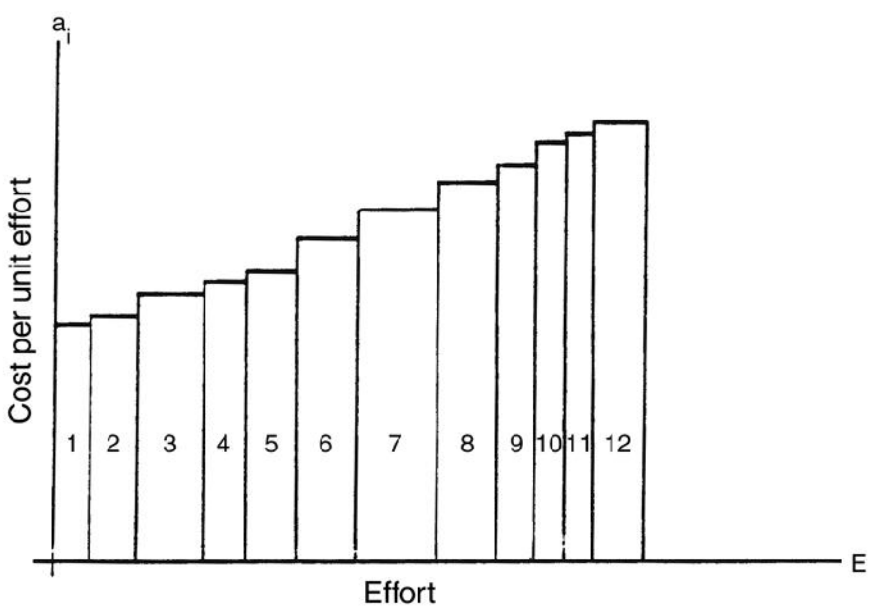

Figure 4.4. Relationship between the standardized fishing effort and the cost efficiency of the effort in heterogeneous vessels. Source: Flaaten (2011, p.108)

In figure 4.4 panel (b), the marginal cost of effort curve is increasing with respect to the increase of fishing effort of the fishery. Based on the above fundamental principle of the traditional bioeconomic model, under open access, vessels will enter the fishery if the average revenue per unit effort is greater than the marginal cost of effort, and exit the fishery if revenue is less than cost. So, open-access equilibrium is found where *MC(E) = AR(E)*, for effort level X_{∞}. For the effort level E_{∞} the total revenue equals the square $AGOE_{\infty}$ and the total cost equals the area of $ADOE_{\infty}$ .This implies that there is an economic surplus in the fishery, equivalent to the area *AGD*, or the line segment *R* in figure 4.5 panel (a) since $AGOE_{\infty} > ADOE_{\infty}$. This surplus is called intra-marginal rent or producer's surplus[2]. This rent accrues to those vessels that have lower costs than the marginal vessels at E_{∞}. In this case, with a progressively increasing TC(E) curve, the equilibrium point is to the left of the intersection between the TR(E) and the TC(E) curves, the difference between them being the intra-marginal rent (Flaaten, 2011).

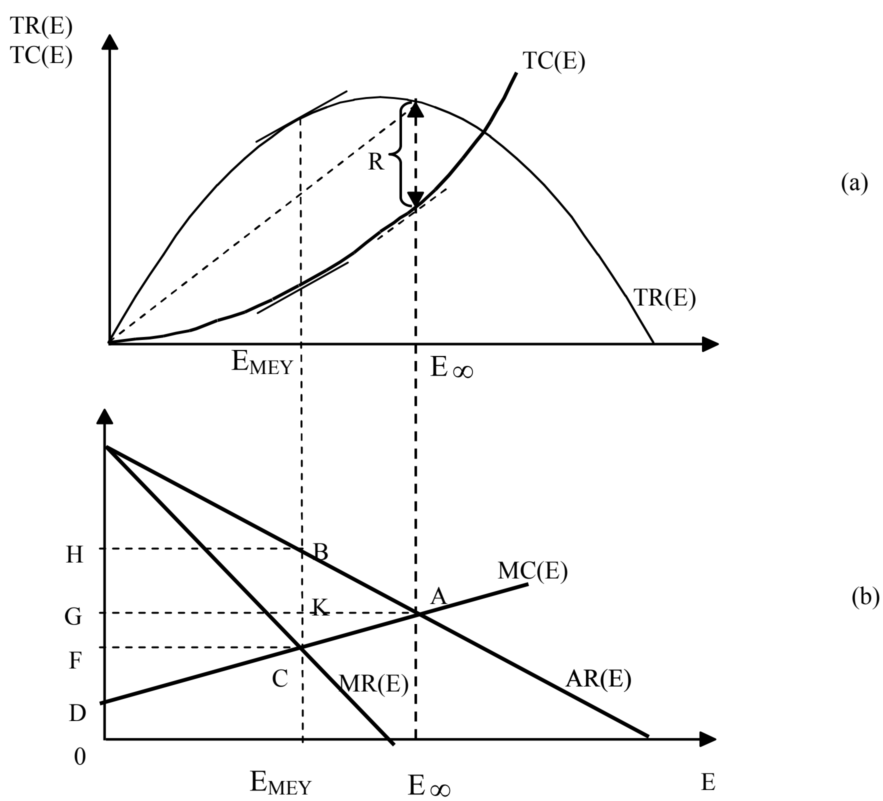

Figure 4.5. Equilibrium fishing effort, resource rent and intra-marginal rent under open-access and under maximum economic yield management in the case of heterogeneous effort. Source: Flaaten (2011, p.109)

[2] Producer's surplus in fisheries was discussed first in Copes (1972).

Overall, the intra-marginal rent is generated from the existence of heterogeneous vessels, of which the most cost efficient vessels make above normal profits (Coglan and Pascoe, 1999; Flaaten, 2011). This is in contrast to the case of homogeneous vessels in which rent equals zero. Thus, this can indicate that the profits still generated even under open access regime.

4.2. The concepts of costs and earnings

As mentioned in the previous chapter, the assessment of economic performance is a key element in furthering the understanding of the economic incentives that exist in the fishery. In this study, we develope economic performance indicators based on costs and earnings of purse seine vessels in Nha Trang, Vietnam in 2011. The concepts of costs and earnings are based on those of profitability analyses of fishing vessels in industrialized countries (Flaaten et al., 1995).

The calculation of economic performance indicators is presented as follows:

Gross Revenue
- *Variable costs* (except labour cost)

= *Income*
- *Fixed cost*

= *Gross value added*
- *Labour cost*

= *Gross cash flow*
- *Depreciation*
- *Interest payment on loans*

= *Profit*
- *Calculated interest on owner's capital*

= *Net profit (rent)*

Gross revenue is defined as landing value of the vessel in year of fishing operations. It is the result of the average revenue of each trip multiplied by the number of fishing trips in the year 2011.

Variable costs are total expenses for all fishing trips in year, except labor costs. They include costs for fuel, lubricant, ice, provisions, minor repair in one fishing year. They are the result of the average vessel variable cost per fishing trip times the number of fishing trips in the year 2011.

Income is defined as the difference between gross revenue and variable costs, except labor cost

Fixed cost is the total of annual repair and maintenance costs of boat, engine, fishing gear, and other equipments on the vessel, and insurance for vessels and all crew members and registration fee. Fixed cost does not change with the number of fishing trips taken in the fishing year 2011.

Gross value added (GVA) is referred to as the difference between the annual gross revenue minus the total of annual variable costs and fixed cost, excluding labor costs. In other words, GVA is the total of labor cost, depreciation, interest payments, calculated interest on owner's capital and net profit.

Gross cash flow is an important indicator of economic performance. It is specified by gross value added less labor cost or it refers to as the gross revenue minus all expenses, except depreciation, loan interests and calculated interest on owner's capital.

Profit is the remaining value after deducting depreciation and interest payment on loans (except the calculated interest on owner's capital) from gross cash flow.

Net profit is calculated as the gross revenue less all expenses, including the calculated interest on owner's capital. Thus, it is considered as an actual net reward after all factors of production have received their compensation.

Depreciation is calculated as the actual loss in the value of the assets over time, that is not offset by repairs and maintenance over the period due to wear and tear (Pascoe, Robinson and Coglan, 1996). In this study, the author use straight-line depreciation because of limited information in the data set. The depreciation is calculated basing on the fixed capital value which is to be valued at current prices. This means that assets acquired in earlier period (historic prices) have to be revalued in order to convert them into 2011 prices (OECD, 2001). In this case, the depreciation rate[3] is estimated basing information on the age, current value and current replacement cost of each item (Elizabeth Clark et al., 2006/07).

---

[3]An allowance for depreciation of a capital item was estimated using the formula (R-C)/A where R = replacement cost of the item, C = current value of the item and A = age of the item in years.

Interest payment on loans is costs for payment of loan interest in year. The rate of interest on loans has differences among the vessel owners because of a non-perfect capital market as Vietnam.

There are various loan sources for fishermen with the unfair price. These sources can come from their relatives, midle-men, or Vietnam's commercial banks. Thus, the loan interest should be deducted before the profit (Duy, 2010).

The calculated interest on owner's capital is referred to as the opportunity cost of the owner's capital in the year of the profitability analysis (2011). Whitmarsh et al. (2000) showed that "*the opportunity cost of capital is based on what the capital invested in the vessel would have earned in the next best alternative investment*". In this study, the calculated interest on owner's capital is counted as the vessel owner's capital multiplied by the annual bank deposit interest rate. For this fishing year, the interest rate is 14% per annum [4]. The vessel owner's capital is defined as the asset value at the time of the calculation minus the loans in the year 2011.

Profit margin is referred to as ratio of profit (before the opportunity cost of owner's capital but after depreciation and interest payment on loans) to gross revenue. This ratio expresses what is left as compensation to the vessel owner's capital in relation to gross revenue as percentage of gross revenue.

The return on investment (ROI) is defined is defined as ratio of profit to owner's capital of the vessel. This ratio shows what is left to the vessel owner as compensation to the opportunity cost of owner's capital in relation to owner's capital of the vessel as percentage of owner's capital of the vessel.

4.3. Econometrical model

4.3.1. Model of annual vessel production

In this study, annual vessel production is chosen for further analysis. The author want to investigate "what are the main determinants of annual vessel production". In this case, the output is a physical measure of volume. However, Vietnamese fisheries are characterised by mixed outputs due to different species in the catch. Hence, the value of catch is a common

[4] This information is available from the annual reports of the State Bank of Vietnam

proxy for output when multi-species fisheries are examined. (Ngoc et al, 2009; Pascoe and Mardle, 2003). Cunningham and Whitmarsh (1980) also stated that "Catch is measured in monetary terms it often gives a better fit to the data" even though for biological objectives. The authors explained that skippers, in fact, were more concerned about revenue than biomass and therefore, value of catch correlated better with inputs than weight of caught (Cunningham and Whitmarsh, 1980). Thus, the analysis of annual production is implemented by performing regression analysis of the proxy, annual gross revenue.

The production function of each vessel adopted by the Cobb-Douglas production function. It was used validly in many studies of the fisheries sector, such as the studies of Comitini and Huang (1967), Hannesson (1983), Taylor and Prochaska (1985), Campbell (1991), Padilla and Trinidad (1995) (Duy., 2010). The main inputs used in the production process often are capital, capital utilisation, labour utilisation and fish stock (Kirkleyet al., 1995; Sharma and Leung, 1999; Grafton et al., 2000; Pascoe and Coglan, 2002) (Ngoc et al., 2009). This is broadly in keeping with traditional economic production theory, where output is assumed to be a function of land (i.e. stock), labour and capital (Pascoe and Mardle., 2003). The level of capital employed in the fishery can be measured in terms of monetary investments or in terms of physical inputs (boat size, engine power) (Pascoe and Mardle., 2003; Ngoc et al.,2009). Capital utilisation can be measured in terms of either days fished or fuel use (Pascoe and Mardle, 2003). Pascoe et al. (2003) found that economic measures of capital were also subject to measurement errors. They emphasised that physical measures were generally more robust (in terms of measurement), and are often more readily available.

In this study, by using a log linear function. The returns to the inputs also can be measured by output elasticities (FAO.,2003). The functional form of the model can be given by:

$$\text{Ln}(\text{Revenue}_i) = \beta_0 + \beta_1 \ln(\text{HP}_i) + \beta_2 \ln(\text{Crewsize}_i) + \beta_3 \ln(\text{days}_i) + \beta_4 D_{\textbf{location}} + \varepsilon$$

Where the output is annual vessel gross revenue. The physical inputs – horsepower and number of fishing days are used as proxy measures of capital invested and capital utilisation in the fisheries. The crew size is the number of crew members employed per vessel for a fishing trip, including the captain. It is included in the model as a variable input. In addition, a dummy variable is used to distinguish how the characteristic of locations can affect revenue, with 1 for island and 0 for mainland. ε is random error term.

Initially, other inputs that are skipper'experience and gear-length were also considered as factors affecting gross revenue. However, they were excluded from the final model because they neither individually nor jointly provided any evidence to support their statistically significant effects on gross revenue of the vessel. As a result, engine power, number of crews, number of fishing days and dummy variable for location are identified as the main factors affecting the gross revenue of the vessel. In this model, the magnitudes of these beta coefficients allow us to compare the contribution of each explanatory variable in the prediction of the gross revenue. It is expected that the signs of all estimated parameters are positive. They are explained by some reasons below.

Engine power is correlated to the gross revenue due to the higher engine capacities, the more quickly vessels can travel between the fishing ports and fishing grounds, thus, have more time for fishing. Besides, the highest possible speed is desired to prevent the active fish school from escaping, and to reduce the influence of wind drift and water current on the operation. In addition, the increase in engine power of fishing vessel is relevant to the expansion of the average size of vessel length. In fact, vessels with higher length may carry larger volume. This lead to enhance the probability of catching more fish (Parente, 2004). So, it is expected that engine power has a positive effects on gross revenue of the vessel.

Average crew size is the next operational characteristic that impact on gross revenue. In many econometric models of fisheries production function and frontiers include crew numbers as a variable input (e.g. Squires, 1987; Kirkley, Squires and Strand, 1995, 1998) (Pascoe and Mardle, 2003), on the basis that bigger crews result in greater output levels due to more crew enable the catch to be removed and processed more quickly, allowing more hauls to take place over a given period of time. Hence, it is expected that crew size has a positive effects on gross revenue of the vessel.

Fishing days is calculated as actual fishing time of each vessel. This would involve the time spent on searching for fish, looking for fishing grounds, preparing the fishing gear, and harvesting. When the fishing time increases, the total catch in year will increase accordingly. The total amount of catch is highly correlated to the actual fishing time (FAO, 2003a). So, it is expected that fishing days has a positive relationship with gross revenue.

A dummy variable for location helps to distinguish how the characteristics of locations can affect revenue, with 1 for the island and 0 for the mainland areas

4.3.2. Model of of standardised fishing effort

In the fisheries, effort is an abstract concept that is defined as the combined effect of the inputs used in fishing, including fixed components of vessel and variable components. It includes many factors such as length of vessel, horse power, fishing time, a number of gears or a number of boats, the skill of skippers and crew, etc (FAO, 2003). Cunningham and Whitmarsh (1980) found that there are two terms of fishing effort: the first is nominal fishing effort (i.e. total time spent fishing) referred to as the volume of resource devoted to fishing, quantified in monetary or physical units, the second is effective fishing effort (in terms of fishing power of the vessel) defined as the biomass of fish extracted by fishing expressed as a proportion of the mean population size or in other words, effective fishing effort can be considered as fishing mortality (Cunningham and Whitmarsh.,1980). FAO (2003) also showed that the fixed input stocks which make up the capacity base (capital base) whereas the variable inputs such as days fished or days at sea, which represents the combination of inputs applied to the capacity base to generate catch. In short term, the vessel's main characteristics such as weight, length, engine power are fixed, while effort measured in days and hour of fishing (nominal fishing effort) is flexible. However, this nominal effort may depend on the vessel's technical characteristics that are built before, which all they generate total fishing effort (Flaaten, 2011)

Obviously thus it is very difficult to know the exact formulation to measure a fishing effort because we need base on biological and economic characteristics of the fishery (Padilla at al., 1995). In all fisheries, there are fishing vessels of many different shapes and sizes, using different kinds of equipment and fishing gear. To obtain a meaningfull expression of fishing effort, the effort of various kinds of boats must be standadized (OECD., 2006).

In this study, the standardized fishing effort for vessels will be estimated by fishing effort the production function approach to effort. From the Schaefer harvest function in equation (4.1) we can rewrite:

(4.5) $h\ (e,X) = qe^{\beta_1} X^{\beta_1}$ (with $\beta_1 = \beta_2 = 1$)

where h is the produced catch, e is effort of each fishing vessel, given the stock level, X, and the catchability coefficiency, q is a constant.

The product of fish harvesting firms, is a function of effort and stock and this can be expressed in the general form of the production function is:

(4.6) $h = f\ (e, X)$

With cross-sectional data for one year, we assume that stock level is constant. This assumption implies that the production function is separable. Hence, the production function can be expressed by:

(4.7) $h = f(g(x), X)$

Where e = g(x) and x is a vector of inputs. The separability generating the form of equation (4.7) is shown in the studies of Squires (1987), Campbell (1991), and Padilla and Trinidad (1995) (Duy., 2010). Hence, the effort function of each vessel, g(x), can be given by the form of Cobb-Douglas function:

(4.8) $EFFORT = g(x_1, x_2, ..., x_n) = A\, x_1^{\alpha_1} x_2^{\alpha_2} ... x_n^{\alpha_n}$

Where $EFFORT_i$ is the standardized fishing effort of vessel i, x_i is factor i of the vessel and A is a constant.

As you can see, this production function is similar in the theory of the firm. However, the great difference is that effort is not a final product to be sold, like the products of most firms, but an intermediate good produced to encounter the fish stock (Flaaten, 2011).

Based on the characteristics of the fishery, this study uses engine capacity (measured in horsepower) and the number of fishing days in a year as proxies for capital invested and capital utilisation, the crew size as the proxy for variable input. All this explanatory variables are identified as key factors affecting fishing effort of the vessel. From equation 4.8, the log-linear effort model for vessel i can be written as follows:

$$\ln EFFORT_i = \alpha_0 + \alpha_1 \ln(HP_i) + \alpha_2 \ln(Crewsize_i) + \alpha_3 \ln(Days_i) + u_i \qquad (4.9)$$

Where HP is horse power of vessel, the Crew size is the number of crew employed per vessel and Days is number of fishing days of vessel, u_i is the random error term and subscript shows vessel i.

In the fisheries, fish caught per unit of time is often used as a measure of effective fishing effort (Cunningham and Whitmarsh,1980; Duy, 2010). However, by assuming that the prices of fish are fixed and the same for all vessels and months within one year, annual gross revenue is considered to be a proxy for fishing effort due to lack of catch volume data for each vessel. In model (4.9), the returns to the variable inputs also can be measured by output elasticities (FAO, 2003b). We expect that $\alpha_1 + \alpha_2 < 1$, $\alpha_3 < 0$. With this log linear function, the elasticities can be estimated by using an Ordinary Least Squares (OLS) regression. The econometric package EVIEWS version 5.1 is used.

This fishing effort measure is often standardised to represent differences in relative fishing power, because vessels often vary with engine capacity, hull length and, fishing days. Such standardized measures of the relative performance of different boats compensate for heterogeneity in the fleet (FAO, 2003b). Hence, in this study, the relative standardised effort will be used instead of the fishing effort for all vessels.

Adapting the definition of relative fishing power by Beverton and Holt (1957), the relative standardized fishing effort of vessel i can be given by:

$$e_i = EFFORT_i / \overline{EFFORT}$$

where e_i is the relative standardized fishing effort of vessel i ; $\overline{EFFORT}$ is an average standardized effort of all vessels (Duy., 2010)

Calculating the relative standardized effort also gives us the indices of the relative fishing power (RFP) (Duy., 2010). The difference in relative standardised effort can be expressed as the difference in the relative fishing power efficiency of the vessels. The ratio of cost to relative standardized effort reflects the cost efficiency of the vessel. From this ratios, we can find out what vessel group have the most cost efficiency by using Salter diagram software.

Chapter 5
DATA AND DESCRIPTIVE STATISTICS

5.1. Data Collection

Data for this study was collected from a survey of cost and earnings as well as the technical and operational characteristics of purse seine fishery in Nha Trang city, Khanh Hoa province in 2011. The sample was collected randomly with a sample size of 62 anchovy purse seiners, representing about 46 % of such vessels in Nha Trang (see table 5.2). The author collected data for this year, the questionnaire is designed by Prof. Ola Flaaten, Dr. Khanh Ngoc Thi Quach, PhD student Thanh Thuy Thi Pham and MSc. Duy Ngoc Nguyen. This questionnaire was applied for some previous studies on the economic performance indicators of the fisheries in Khanh Hoa (see Thanh Thuy et al., 2008 and Luong., 2009). The standardised questionnaire form is attached in the appendix A.

All surveys were conducted during mid - November to December in 2011 through face to face interviews with vessel owner and/or his wife. In this period, the fishermen stopped fishing to repair boats and nets for the new season. The high season for the anchovy purse seine fishery stretches from March to August or September. The data consists of detailed information on various aspects of purse seine fishery such as vessel technical characteristics, number of trips per month and number of operating months in year, crew size, variable costs per trip and fixed costs, gross revenue and other information.

In this study, the sample representativeness was tested because representative sample is a key factor to determine the quality of the study. Hull length was selected to test since it is available in the database of DECAFIREP of Khanh Hoa and the data set of 62 purse seine vessels. Unfortunately, we have only the 2010 database of Khanh Hoa purse seiners. Therefore, assuming that the population of Khanh Hoa inshore purse seiners in 2011 is the same as in 2010, the 2010 population of Khanh Hoa's purse seine fleets is employed to test for the representativeness of the 2011 sample. The test results in Table 5.1

Table 5.1: Sample representativeness tests

Variable	Sample[a]			Mean of the population[b]	T-Test statistic
	N	Mean	S.D		
Hull length	62	14.29	1.15	14.07	1.51

Sources: [a]own data and calculations, [b]DECAFIREP of Khanh Hoa (2010)

In Table 5.1, an application of T-Test statistic for sample representativeness tests is performed. Selecting the level of significance of the test is α = 5%, then the critical values of t distribution for this two-tail test are 2.5 percentile $t_{(0.975,\ 61)}$= 1.9996. This results show that the sample size of 62 anchovy purse seiners is considered representative for Nha Trang's anchovy purse seine vessels. Hence, the sample in this study can be used as the reliable proxy to represent for the whole population.

Table 5.2: The distribution of the anchovy purse-seine vessels in the sample by location

Ward	Population[b]	Sample[c]	Rate of sample to population[c]
Vung Ngan Island	50	32	64.00%
Vinh Truong	29	10	34.48%
Vinh Nguyen	31	13	41.94%
Hon Ro	8	7	87.50%
Other[a]	16	0	0%
Total	134	62	46.27%

Notes: [a]other wards include Vinh Tho, Vinh Phuoc, Xuong Huan, Van Thanh and Ngoc Hiep; [b]source from DECAFIREP of Khanh Hoa (2010); [c]source from own data and calculations.

5.2. Descriptive statistics of variables

Table 5.3 presents a summary of economic and technical data for 62 surveyed purse seiners in 2011. The sample vessels are quite heterogeneous in terms of technical and operational characteristics. Engine capacity ranged from 22 to 550 HP, with a mean of about 161.31 HP. Hull length varied from 11.60 m to 15.90 m, with an average length of 14.29 m. The number of fishing days of the vessels in the year also ranged from 160 days to 215 days, with an average about 198.65 days. The average crew size was 13.15 persons, with a range from 8 to 15 persons.

Table 5.3: Descriptive statistics of 62 anchovy purse seiners in 2011

Criteria	Mean	S.D.	Min	Max
Engine Power (HP)	161.31	127.34	22.00	550.00
Hull length (m)	14.29	1.15	11.60	15.90
Number of fishing days (days)	198.65	13.18	160.00	215.00
Number of crew size (person)	13.15	1.76	8.00	15.00
Gross revenue	1762.26	519.34	800.00	2800.00
Variable costs	718.93	157.99	392.00	1042.75
Maintenance and repair costs	75.90	11.93	49.44	98.32
Insurance and registration fee	2.15	2.13	0.50	6.54
Labor cost	481.74	144.93	216.00	675.00
Drepreciation	139.08	50.31	33.33	215.00
Loan interest payment	35.19	17.67	3.70	55.50
Owner’s capital	732.65	200.53	300.00	1120.00
Calculated interest on owner’s capital	102.57	28.07	42.00	156.80

Unit of measurement: million VND. Source: Own data and calculations

Furthermore, table 5.3 also shows the important economic performance indicator of an average purse seiner that is gross revenue and its costs including variable costs, maintain and repair costs, insurance and registration costs, labor cost, and capital cost. Annual gross revenue of the vessel varied from 800 million to 2,800 million VND, with an average of 1762.26 million VND. In the same year, although gross revenue increased, but the costs were also very high corresponding due to the fuel price increse. The annual average variable costs was of about 718.93 million VND with a wide range from 392.00 to 1042.75 million VND. The labor cost also varied from 216 million to 675 million VND, with an average amount of 481.74 million VND.

In addition, an average depreciation of vessel in one year was 139.08 million VND, with a range from 33.33 million to 215.00 million VND. These costs are determined by the information on the age, current value and current replacement cost of vessels. The average maintenance and repair costs was 75.90 million VND, with a range from 49.44 million to 98.32 million VND. The average loan interest payment was 35.19 million, with a range from 3.70 million to 55.50 million VND. Finally, owner's capital and calculated interest on owner's capital for an average vessel were 732.65 million VND (with a range from 300.00 million to 1120.00 million VND) and 102.57 million VND (from 42.00 million to 156.80 million VND) respectively. In this study, the vessel owner's capital is defined as the asset value at the time of the calculation minus the loans. The calculated interest on owner's capital is counted as the vessel owner's capital multiplied by the annual bank deposit interest rate, which is at 14% in 2011 (The State Bank of Vietnam (SBV), 2011).

Table 5.4 presents a comparison of the economic and technical data between vessel groups of the anchovy purse seiners, which are categorized based on engine capacity. These three vessel groups are quite heterogeneous in terms of technical and operational characteristics. Almost figures show that larger mean values in the groups with greater engine capacities. For the vessel group with the engine capacity of less than 90 HP, the average length of this vessel group was 13.12 m; the average fishing days of 192 days per year and the average crew size was 11.70 persons. For the vessel group with the engine capacity from 90 to 250 HP was higher than those of the vessel group with the engine capacity of less than 90 HP. The last vessel group with engine capacity greater than 250 HP had a mean vessel length of 15.27m; the number of fishing days of 205.67 days and the average crew size of 14.25 persons.

Table 5.3 also describes the average economic variables for each of the three vessel groups. The gross revenues of these three vessel groups, ranging from the smallest to the largest engine capacity, were 1185.50 million, 1855.00 million and 2491.67 million VND respectively. The average costs (including variable costs, maintain and repair costs, insurance and registration costs, labor cost and capital cost) also increased with engine sizes. The vessel groups with higher engines had the average costs higher than those of vessel groups with smaller engines.

Table 5.4: Descriptive statistics of three vessel groups in 2011

Criteria	Range of engine power					
	HP<90 (n=20)		90<=HP<=250 (n=30)		HP>250 (n=12)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Engine Power (HP)	53.60	15.54	144.33	49.11	383.25	86.82
Hull length (m)	13.12	0.91	14.69	0.77	15.27	0.57
Number of fishing days (days)	192.00	16.21	200.27	10.33	205.67	9.34
Number of crew size (person)	11.70	1.69	13.67	1.37	14.25	1.22
Gross revenue	1185.50	189.31	1855.00	236.48	2491.67	278.66
Variable costs	553.05	88.72	752.92	83.78	910.41	114.64
Maintenance and repair costs	62.67	6.87	79.21	6.71	89.65	5.90
Insurance and registration fee	1.65	1.88	1.79	1.75	3.86	2.64
Labor cost	318.95	69.14	530.20	101.87	631.88	41.08
Drepreciation	81.52	24.73	153.87	30.09	198.04	13.51
Loan interest payment	16.29	10.26	30.24	16.87	48.29	8.13
Owner's capital	497.50	112.41	822.47	104.88	900.00	138.15
Calculated interest on owner's capital	69.65	15.74	115.15	14.68	126.00	19.34

Unit of measurement: million VND

Source: Own data and calculations

Chapter 6 EMPIRICAL RESULTS

6.1. Economic performance indicators

Table 6.1 presents the most important economic performance indicators for an average purse seiner in 2011 including gross revenue, income, gross value added, gross cash flow profit and net profit. The results show that these indicators are positive for an average vessel. The average income of the vessel after deducting all variable costs (not including labour cost) was estimated at 1043.33 million VND, with a wide range from 406.25 million to 1757.25 million VND. The average annual gross value added of the vessels was largely varied from 349.03 million to 1664.02 million VND, with a mean of 965.29 million VND. The next is an indicator of gross cash flow. This indicator is considered as a good short-term indicator in fisheries. In this case, the annual gross cash flow of the vessels, on average, was 483.55 million VND with a wide range from 47.45 million to 989.08 million VND. This result means that the vessel owners were able to pay for all their operational costs. In addition to the results, the average annual vessel profit was estimated at 330.85 million VND, with a range from -23.88 to 723.58 million VND and the average vessel net profit after deducting the opportunity cost of owner's capital was 228.28 million VND. This indicator varied greatly from -65.88 to 583.58 million VND. Consequently, the vessel owner of an average anchovy purse seiner was able to cover all of the costs and had a significant reward for the operating year.

The ratios of the most of the important indicators are also shown in Table 6.1, the averages of vessels'profit margin and return on investment were 17.41% and 42.45% respectively, with wide ranges for both indicators. These ratios are higher than the annual bank deposit interest rate, which is at 14% in 2011 (The State Bank of Vietnam (SBV), 2011). Consequently, the purse seine fishery may continue expanding as well as attracting additional vessels to this fishery in the near future. For fishermen's income, this table also presents the labor cost was, on average, about 481.74 million VND. The crew size was 13.15 persons for an average purse seiner. Thus, the average annual crew share of about 36.63 million VND and the average crew share per month was about 3.05 million VND, the average annual income per crew member was about 36.63 million VND, which is about 2% more than that of other people in Khanh Hoa province (GSO of Khanh Hoa, 2011) and about 26.86 % higher than the 2011 national average income per capita (GSO, 2012).As mentioned above, the crew remuneration also included all crews, skipper in the income share system.

Table 6.1: Economic performance indicators of 62 anchovy purse seiners in 2011

Criteria	Minimum	Maximum	Mean	S.D.
Gross revenue	**800.00**	**2800.00**	**1762.26**	**519.34**
Variable costs	392.00	1042.75	718.93	157.99
Income	**406.25**	**1757.25**	**1043.33**	**376.34**
Fixed costs	50.43	102.16	78.04	12.69
Gross value added	**349.03**	**1664.02**	**965.29**	**365.27**
Labour cost	216.00	675.00	481.74	144.93
Gross cash flow	**47.45**	**989.08**	**483.55**	**254.03**
Depreciation	33.33	215.00	139.08	50.31
Interest payment on loans	3.70	55.50	35.19	17.67
Profit	**-23.88**	**723.58**	**330.85**	**196.65**
Calculated interest on owner's capital	42.00	156.80	102.57	28.07
Net profit	**-65.88**	**583.58**	**228.28**	**176.43**
Profit margin	-2.49%	28.05%	17.41%	6.59%
Return on investment (ROI)	-7.96%	86.47%	42.45%	19.14%

Unit of measurement: million VND

Source: Own data and calculations

In addition, table 6.2 presents a comparison of some important economic performance indicators between vessel groups of the anchovy purse seiners, which are categorized according to engine capacity. In general, the results show that most annual performance indicators tend to increase following the increasing of engine power. We can see that the vessel group with engine capacity of less than 90 HP had an average gross cash flow of 249.18 million VND, translating into a profit of 161.96 million VND, the net profit after deducting the opportunity cost of owner's capital of 92.31 million VND, a profit margin of 13.24%, and return on investment of 30.95%. For the vessel group with the engine capacity from 90 to 250 HP was higher than those of the vessel group with the engine capacity of less than 90 HP. For the last vessel group with engine capacity greater than 250 HP, an average gross cash flow, profit and net profit were 855.86 million VND, 609.54 million VND and 483.54 million VND respectively, the profit margin was 24.23% and return on investment was 67.78%.

Table 6.2: Economic performance indicators among vessel groups in 2011

Criteria	Range of engine power					
	HP<90 (n=20)		90<=HP<=250 (n=30)		HP>250 (n=12)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Gross revenue	**1185.50**	**189.31**	**1855.00**	**236.48**	**2491.67**	**278.66**
Variable costs	553.05	88.72	752.92	83.78	910.41	114.64
Income	**632.45**	**125.17**	**1102.08**	**190.24**	**1581.26**	**175.83**
Fixed costs	64.32	7.03	81.00	7.23	93.51	6.52
Gross value added	**568.13**	**122.92**	**1021.08**	**186.27**	**1487.75**	**171.05**
Labour cost	318.95	69.14	530.20	101.87	631.88	41.08
Gross cash flow	**249.18**	**96.94**	**490.88**	**165.16**	**855.86**	**135.88**
Depreciation	81.52	24.73	153.87	30.09	198.04	13.51
Interest payment on loans	16.29	10.26	30.24	16.87	48.29	8.13
Profit	**161.96**	**81.70**	**331.97**	**139.37**	**609.54**	**122.94**
Calculated interest on owner's capital	69.65	15.74	115.15	14.68	126.00	19.34
Net profit	**92.31**	**69.96**	**216.83**	**133.60**	**483.54**	**109.83**
Profit margin	13.24%	5.75%	17.46%	5.97%	24.23%	2.79%
Return on investment (ROI)	30.95%	13.40%	39.99%	15.69%	67.78%	10.76%

Unit of measurement: million VND

Source: Own data and calculations

In summary, as shown in Table 6.2, the results revealed that, on average, most vessels had positive income, gross value added, gross cash flow, profit and net profit. The vessels groups with higher engine powers had the economic performance indicators far better than those of vessel groups with smaller engines in 2011. These positive results are very interesting in terms of an open-access characteristics of this fishery. This may be explained by the theory of the fishing vessel economics in an open access fishery. In the case of heterogeneous vessels, we have seen that the most cost-efficient vessels make above-normal profits, called intra-marginal rent. Therefore, these vessels may create net benefits for society (this explanation will be demonstrated in the section 6.4).

6.2. Results of Econometrical model

6.2.1. Results of annual vessel production function

In this section, we present the results of the regression analysis of annual gross revenue for Nha Trang's anchovy purse seiners in 2011. This is performed by regression analysis of the vessel's gross revenue by means of some technical and operational characteristics of the vessel, such as horse power (HP), crew size (Crewsize), the number of fishing days (Days) and a dummy variable for location ($D_{location}$). The econometric package Eviews version 5.1 was used. Table 6.3 shows the results of the ordinary least square (OLS) estimation

Table 6.3: Parameter estimate and test statistics of gross revenue function

	Estimated coefficient	T-value	P-value
Constant	2.2417	2.9098	0.0051[a]
ln(HP)	0.3105	18.8611	0.0000[a]
ln(Crewsize)	0.3107	3.9177	0.0002[a]
ln(Days)	0.5401	3.7092	0.0005[a]
$D_{location}$	0.0858	4.8709	0.0000[a]
R^2	0.9543		
F	297.5370		0.0000[a]

[a]Statistically significant at the level of 1%. Source: own data.

As shown in Table 6.3, the results indicate that the signs of all estimated coefficients are positive as we expect and these coefficients are statistically different from zero at the level of significance $\alpha = 0.01$ or better. This means that horse power, crew size, fishing days and the location of Nha Trang's anchovy purse seiners have statistically significant effects on annual gross revenue. Furthermore, an application of the F- test for testing the overall significance of the model. Since F-value =297.5370 with P- value = 0.0000, then at least one of the parameters is not zero at the level of significance α = 0.01 or better. Thus, the estimated model is significant at the 1% level. In addition, R^2 = 0.9543 indicating that 95.43 % of the variation in gross revenue is explained by the variation in horse power, by the variation in crew size, by the variation in the number of days at sea and by location, in our sample, 4.57% of the variation in revenue is left unexplained and is due to variation in the error term. In this case, the estimated model fits the data well.

In this model, the returns to the inputs also can be measured by output elasticities. The input that makes the largest contribution to the value of the output is the number of days at sea. The coefficient of fishing days is about 0.5401, so an increase of 1% in the number of days at sea then the revenue will increase by 0.5401% while other variables are held constant. The coefficients of horse power and crew size are 0.3105 and 0.3107 respectively. Thus, horse power makes the smallest contribution to the gross revenue. The positive sign of area dummy variable implies that the anchovy purse seiners around the island can get more gross revenue than those in the mainland areas

However, a good regression model should not violate the least square assumptions. Some various tests for errors are performed in this case. Jarque-Bera test for the normality of errors, Lagrange Multiplier test for autocorrelation and White test for the heteroskedasticity of the errors (see table 6.4).

Table 6.4: Residual analysis

Some tests	Test statistics	P-value
1. Test for Normality (Jarque –Bera test)	3.9931	0.1358[a]
2. Test for Heteroskedasticity (White test)	10.8576	0.6227[a]
3. Test for Autocorrelation (Lagrange Multiplier(LM) test)	0.1382	0.7101[a]

[a]Statistically significant at the level of 5%. Source: own data.

As can be revealed in the table 6.4, the Jarque –Bera (JB) test is performed to test the normality. We can see that JB-value is equal to 3.9931, with P- value = 0.1358. This probability is larger than 0.05. Thus we can conclude that the errors are normally distributed at the 5% level of significance. The test for heteroskedasticity is performed by using the

White test, with the test statistic of 10.8576 and P-value of 0.6227. This probability is much larger than 0.05. Therefore, we accept the hypothesis that error variances are homogenous. Finally, the Lagrange Multiplier (LM) test is performed to test autocorrelation. The results shown that LM-value is 0.1382, with P- value = 0.7101. This probability is much larger than 0.05. Thus, we reject the null hypothesis of autocorrelation and conclude that the errors are uncorrelated at the 5% level of significance.

Table 6.5 represents the correlations between the explanatory variables. The pair correlations of horse power (HP) with crew size, number of fishing days and location are 0.5210, 0.3945 and 0.1539 respectively. The correlations of crew size with fishing days and location are 0.2759 and 0.1357 respectively.

Table 6.5: The correlations between the explanatory variables.

	HP	Crewsize	Days	$D_{location}$
HP	1.0000	0.5210	0.3945	0.1539
Crewsize	0.5210	1.0000	0.2759	0.1357
Days	0.3945	0.2759	1.0000	0.1441
$D_{location}$	0.1539	0.1357	0.1441	1.0000

Source: own data

In table 6.5, the results revealed that the correlation of horse power and crew size is the highest. This may indicate the nearly collinear relationship between them. However, when the model is estimated, the results indicate that all estimated coefficients are statistically different from zero at the 1% level of significance or better. They have the expected signs and magnitudes. Furthermore, an application of the F- test for testing the overall significance of the model. The results show that at least one of the parameters is not zero at the level of significance $\alpha = 0.01$ or better. In addition, when we estimate the auxiliary regression, the left-hand-side variable is the crew size and the right-hand-side variables are all the remaining explanatory variables. R^2 from the auxiliary regression is not high (R^2=0.4296), then the variation in crew size is not explained by the other explanatory variables. In this case, we may reject the multicollinarity in this study (Hill et al.,2008). In general, these tests indicate that the estimated model is well specified.

6.2.2. Results of standardised fishing effort function

Initially, many factors were considered to be inputs to generate fishing effort. However, some of them were excluded from the final model because they neither individually nor jointly provided any evidence to support their statistically significant effects on fishing effort of the vessel.Consequently, the physical inputs – horsepower and number of fishing days are used as proxy measures of capital invested and capital utilisation in the fisheries, and the crew size is the number of crew members employed per vessel for a fishing trip, as the proxy for variable input. These variables were identified as the main factors affecting the fishing effort of the vessel. The estimated results are presented in Table 6.6

Table 6.6: Parameter estimate and test statistics of standardised fishing effort function

	Estimated coefficient	T-value	P-value
Constant	1.9427	2.1443	0.0362
ln(HP)	0.3151	16.256	0.0000[a]
ln(Crewsize)	0.3193	3.4137	0.0012[a]
ln(Days)	0.5966	3.4838	0.0009[a]
R^2	0.9353		
F	279.3504		0.0000[a]

[a]Statistically significant at the level of 1%. Source: own data.

As shown in Table 6.3, the results indicate that the signs of all estimated coefficients are positive and the coefficients of horse power, crew size and fishing days are statistically different from zero at the 1% level of significance or better. This means that horse power, crew size and fishing days have statistically significant effects on fishing effort. Furthermore, the F-test is performed to test the overall significance of the model. Since F-value = 279.3504 with P- value = 0.0000, then at least one of the parameters is not zero at the level of significance $\alpha = 0.01$ or better. Thus, the estimated model is significant at the 1% level. In addition, $R^2 = 0.9353$ indicating that 95.43 % of the variation in the fishing effort is explained by the variation in horse power, by the variation in crew size and by the variation in the number of days at sea. In this case, the estimated model fits the data well.

In this model, the returns to the inputs also can be measured by output elasticities. The elasticities and return to scale analysis has shown that the elasticities for the horse power and crew size on the output revenue were smaller than 1 and the elasticity for the number of days at sea was also smaller than 1. These results may seem reasonable while resources are considered as overexploited.

As mentioned above, a good regression model should not violate the least square assumptions. Therefore, some various tests for errors are also performed for this model. Overall, these tests show that this estimated model is well specified. The tests include the Jarque-Bera test for the normality of errors, Lagrange Multiplier test for autocorrelation and White test for the heteroskedasticity of the errors (see table 6.7)

Table 6.7: Residual analysis

Some tests	Test statistics	P-value
1. Test for Normality (Jarque –Bera test)	1.7319	0.4206[a]
2. Test for Heteroskedasticity (White test)	9.4886	0.3934[a]
3. Test for Autocorrelation (Lagrange Multiplier(LM) test)	3.7091	0.0591[a]

[a]Statistically significant at the level of 5%. Source: own data.

As can be shown in the table 6.7, the Jarque –Bera (JB) test is performed to test the normality. We can see that JB-value is equal to 1.7319, with P- value = 0.4206. This probability is larger much than 0.05. Thus we can conclude that the errors are normally distributed at the 5% level of significance. The test for heteroskedasticity is performed by using the White test, with the test statistic of 9.4886 and P-value of 0.3934. This probability is much larger than 0.05. Therefore, we accept the hypothesis that error variances are homogenous. Finally, the Lagrange Multiplier (LM) test is performed to test autocorrelation. The results revealed that LM-value is 3.7091, with P- value = 0.0591. This probability is larger than 0.05. Thus, we reject the null hypothesis of the existence of autocorrelation and conclude that the errors are uncorrelated at the 5% level of significance.

Table 6.8 represents the correlations between the explanatory variables. The pair correlations of horse power (HP) with crew size and number of fishing days and location are 0.5210, 0.3945 respectively. The correlations of crew size with fishing days is 0.2759

Table 6.8: The correlations between the explanatory variables.

	HP	Crewsize	Days
HP	1.0000	0.5210	0.3945
Crewsize	0.5210	1.0000	0.2759
Days	0.3945	0.2759	1.0000

Source: own data

In table 6.8, the results presented that the correlation of horse power and crew size is the highest. This may indicate the nearly collinear relationship between them. However, when the model is estimated, the results revealed that the signs of all estimated coefficients were positive and showed their impacts on the fishing effort at the 1% level of significance or better. Furthermore, an application of the F- test for testing the overall significance of the model. The results show that the estimated relationship is a significant one at the level of significance $\alpha = 0.01$ or better. In addition, when we estimate the auxiliary regression, the left-hand-side variable is the crew size and the right-hand-side variables are all the remaining explanatory variables. R^2 from the auxiliary regression is not high (R^2=0.4294), then the variation in crew size is not explained by the other explanatory variables. In this case, we may reject the multicollinarity in this study (Hill et al.,2008). Overall, these tests show that this estimated model is well specified.

After estimating the standardised fishing effort function. The equation used to standardise fishing effort for each vessel is:

$$e_i = exp\ (1.9427)^*\ HP_i^{0.3151} Crew_i^{0.3193} Days_i^{0.5966} \qquad \text{(Eq.1)}$$

where *HP* is horsepower, $Crew_i$ is the number of crew members and *Days* is the number of fishing days in 2011.

The results estimated from Eq. 1 show that vessel number 31 has the lowest standardised effort of 782.09, whereas the highest standardised effort of 2882.92 is for vessel number 48. The average standardised fishing effort is 1,043.18 (units of effort) (see Figure 6.1)

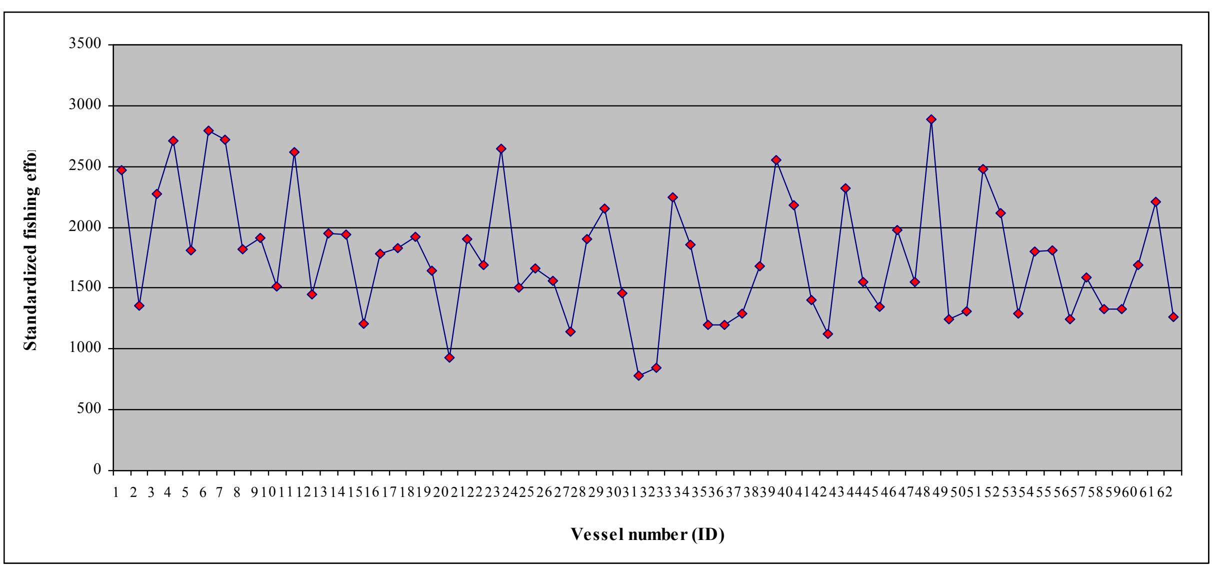

Figure 6.1: The standardised fishing effort of the 62 anchovy purse seiners. Source: Own data.

Relative standardised fishing effort

To compare the fishing effort and the costs among vessels the relative standardised effort is calculated for each vessel. Figure 6.2 shows that the minimum and maximum values of relative standardised effort are 0.44 and 1.64 respectively, with corresponding vessel numbers 31 and 48. An average value of relative standardised effort is 1.00. There were 30 vessels with a relative standardised effort of greater than 1.0, whereas 32 vessels had a relative standardised effort of less than 1.0. The majority of vessels with the relative standardised effort of bigger than 1.0 had engines capacity of greater than 120 HP (see Appendix C)

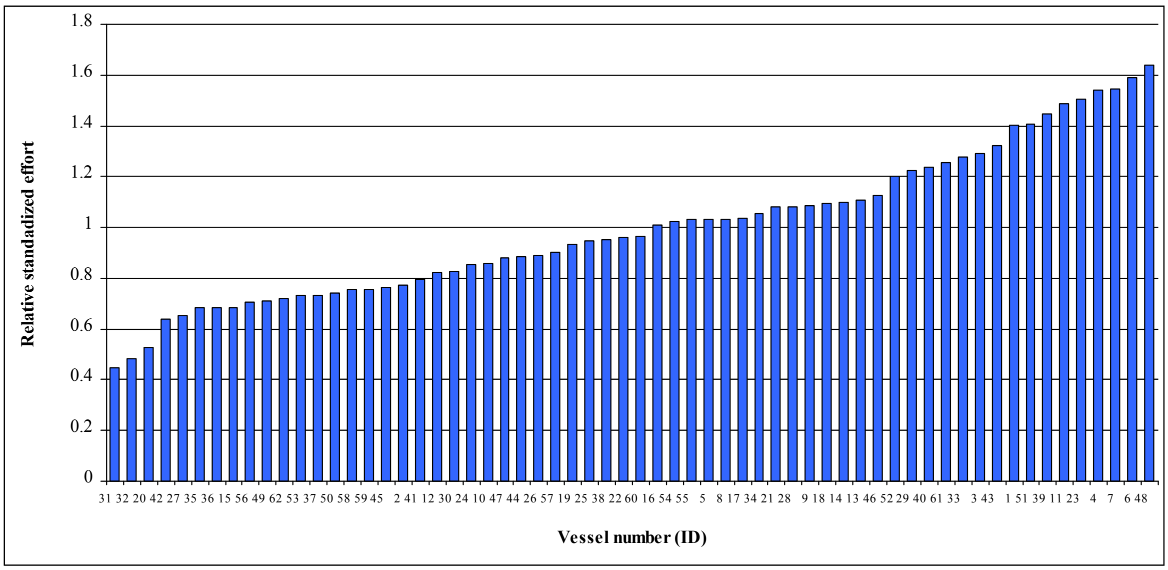

Figure 6.2: Relative standardised fishing effort of the 62 anchovy purse seiners. Source: Own data.

6.3. The cost efficient vessels

In this section, we will examine which vessel is the most cost-efficient. This is derived from dividing the total cost of each vessel by its relative standardised effort. After that, we show the Salter diagram with the relative standardised effort is along the horizontal axis and the average cost per unit of relative standardised effort is along the vertical axis. In this study, the total costs consist of variable cost, fixed cost, labour cost, depreciation and interest payment on loans.

Figure 6.3 presents the cost-efficiency of 62 heterogeneous vessels. The standardised fishing effort of each vessel is measured by the width of the bar whereas the height of the bar measures the average cost per unit of relative standardised effort. The vessels are arranged from the left to the right according to their cost efficiency, with vessel number 38 as the most cost efficient one and vessel number 32 as the least cost efficient. We notice that for example, vessel number 23 produces 2.2 times as much effort as the vessel number 49 but this vessel is less cost-efficiency than the latter. Figure 6.3 also shows that 21 of the 32 vessels with a relative standardised effort above 1.0 are among the most cost-efficient vessels. Thus, 11 vessels that are among the most-efficient in effort terms are not among the most cost-efficient vessels, when comparing the average costs.

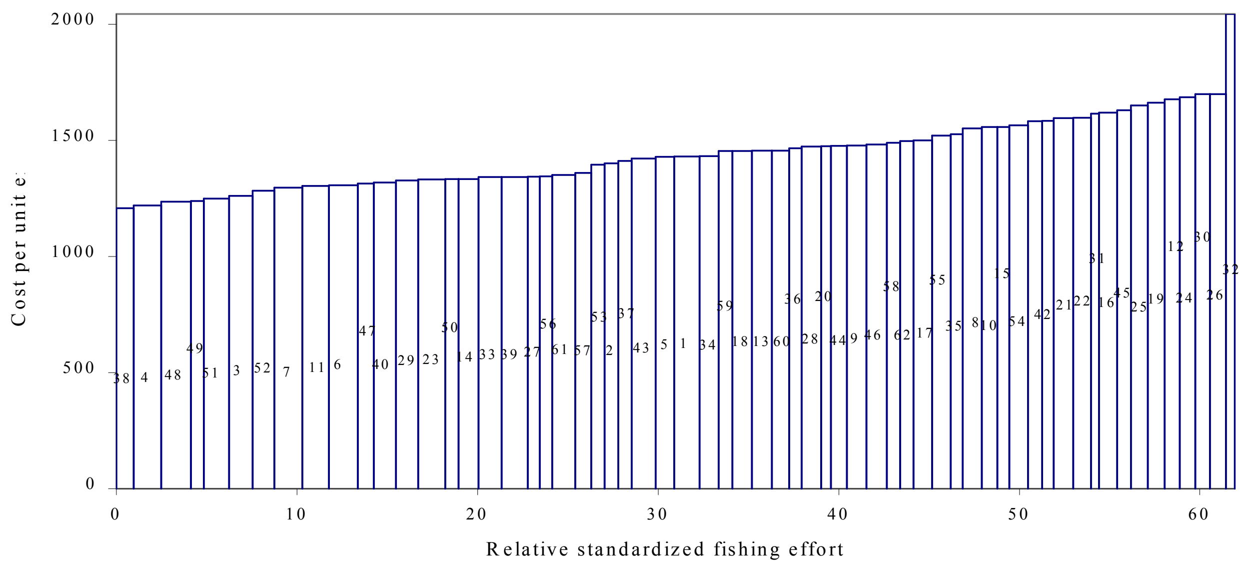

Figure 6.3: The cost-efficiency among 62 anchovy purse seiners in 2011. Source: Own data

6.4. The profit under open access regime

A combination between the average revenue per unit of relative standardised effort[5] and the average cost per relative standardised effort of each vessel will help us to explain more clearly why profits are still generated even under an open-access regime (see figure 6.4). Figure 6.4 represents the level of rent generated among the vessels. We can see that any vessel has the average revenue above the average cost, they can get the profit and vice versa. This surplus is called intra-marginal rent. This rent accrues to those vessels that have lower costs than the marginal vessel.

---

[5]The average revenue per unit of relative standardised effort, is AR(E) =[$\sum_{i=1}^{62}$Total revenue of vessel i]/ [$\sum_{i=1}^{62}$ Relative standardised effort vessel i]

In this study, the profit of the fishery in 2011 is generated by the most vessels excluding vessel number 32 that made economic loss. This is based on the estimated cost and revenue in figure 6.3, but was this also the case when using the account data that we collected for vessel 32. However, by using the accounting method we can know exactly the amount of money that vessel number 32 lost. The estimated ranking results for this and the other vessels will generally be somewhat different from the account figures.

Overall, the intra-marginal rent is generated from the existence of heterogeneous vessels, of which the most cost efficient vessels make above normal profits, called intra-marginal rent (Coglan and Pascoe, 1999; Flaaten, 2011). This is in contrast to the case of homogeneous vessels in which the rent equals to zero. Thus, this can indicate that the profits still generated even under open access regime.

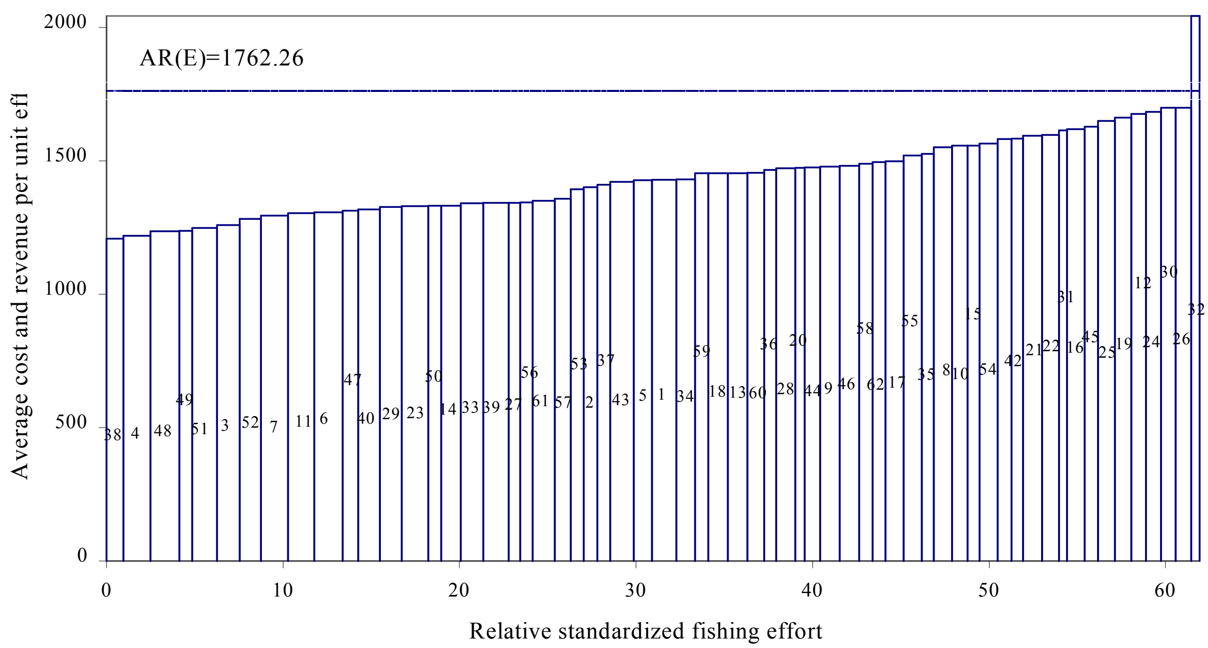

Figure 6.4: The estimated average revenue AR(E), average cost (bar heights) and profit of 62 anchovy purse seine vessels in 2011. Source: Own data

Chapter 7

DISCUSSION

7.1. Economic performance

In 2011, the inshore purse seine vessels in the sample of this study, on average, had positive income, gross value added, gross cash flow and profit. The vessels earned a profit margin of 17.4 %. This implies that the owner of an average purse seiner vessel was not only capable of covering all of the costs (including variable cost, fixed cost, labour cost, depreciation and loan interest payment costs), but also turned a profit for the operating year. As shown in Table 6.2, the results also revealed that larger engine vessels had a better annual economic performance than those with smaller engine. This may be explained by two reasons. First, the larger engine vessels have higher gross revenue due to the higher fishing efficiency and higher catches. The anchovy purse seiners in Nha Trang follow the searching method so vessels which have higher engine power which allows them to travel to other fishing grounds in a short time to find fish. For these high-powered vessels, 2 to 4 hauls can be performed in one night instead of 1 haul for smaller vessels. Second, they are on average more cost-efficient than smaller vessels. The majority of vessels with the relative standardised effort of bigger than 1.0 had engine capacities of greater than 120 HP. These vessels are among the most cost-efficient vessels. Besides, the average annual profit and crew income increase with engine power, there may be incentives for owner-operators to adopt technologies that expand their fishing efficiency.

In the same year, the average annual income per crew member was about 36.6 million VND, which is about 2% more than that of other people in the Khanh Hoa province (GSO of Khanh Hoa, 2011) and about 26.7 % higher than the 2011 national average income per capita (GSO, 2012). This demonstrates that crew members may have earned their opportunity cost of labour, or above, in the fishing season of 2011. The income of crew members was based on the share system between the crew and the owner. The crew members receive 40% or 50% after deduction of all operating expenses. Therefore, the share system offers more incentives for the crew to work hard and helps the vessel owners to use labour more efficiently (Ngoc et al., 2009). However, without further investigation it is not possible to tell if lower crew remuneration would still provide sufficient manpower for this fishery.

In general, of all the coastal fisheries, the anchovy purse seine fishery is now considered the most attractive one because of its high return ratio in comparison with the annual bank deposit interest rates, which is at 14% in 2011 (The State Bank of Vietnam (SBV), 2011). Consequently, the purse seine fishery may continue expanding as well as attracting additional vessels to this fishery in the near future.

Capital investment and operating expenses are relatively great in this fishery. The risk of damaging vessels and fishing gear, and losing workers is high. The risk of damage is quite large for this fishery because the anchovies live in the coral reefs. Therefore, the nets are often torn when they are caught in these coral reefs. These risk factors are, of course, also valid for vessels and crew and, especially in bad weather, they may result in serious outcomes. In principle, risk- induced private costs, such as insurance, maintenance and repair costs of fishing gear and vessels, are included in the costs of this study.

7.2. Results from the model of annual vessel production.

In the model of annual vessel production, we want to investigate the main factors affecting vessel production. In this model, the results indicate that engine power, crew size, and fishing days of Nha Trang's anchovy purse seiners have a positive impact on gross revenue. These results may seem reasonable. As mentioned above, the greater engine vessels have higher gross revenue due to higher catches and higher fishing efficiency. The highest possible speed is desired to prevent the active fish school from escaping, and to reduce the influence of wind drift and water current on the operation. Besides, greater engine power also helps vessels to access other fishing grounds in a short time in order to find fish. With regard to the impact of crew size, more crew enable the catch to be removed and processed more quickly, allowing more hauls to take place over a given period of time. Hence, crew size has a positive effect on gross revenue of the vessel. The results also show that the gross revenue varies with respect to locations. The dummy variable for location helps to distinguish how the characteristics of locations can affect revenue, with 1 for the island and 0 for the mainland areas. The positive sign of area dummy variable implies that the anchovy purse seiners around the island can get more gross revenue than those in the mainland areas. The explanation for this is that the fishermen live on the island having the traditional fisheries. The fishing experiences are passed down from generation to generation. Therefore, they can catch more efficiently. In addition, these fishers live nearer the fishing ground than other people, so they can access it more quickly and, thus, have more time for fishing.

7.3. Results from the model of standardised fishing effort

Fishing effort is considered as an intermediate output which transfers from the factors of production to harvesting quantity (Flaaten, 2011). Initially, many factors were considered to be inputs to generate fishing effort. However, some of them were excluded from the final model because they neither individually nor jointly provided any evidence to support their statistically significant effects on fishing effort of the vessel. Consequently, engine power effect, number of crew size and number of fishing days are identified as the main factors affecting the fishing effort of the vessel. The crew size is chosen as an important independent variable here in the purse seine fishery due to the fact that a fishing trip cannot be performed if it is not enough crew members. Besides, the number of fishing days is referred to as the volume of resource devoted to fishing and the physical input – horsepower is used as proxy measures of capital invested, are also considered as the factors generating fishing effort.

As shown in Table 6.3, the results indicate that the signs of all estimated coefficients were positive and showed their impacts on the fishing effort. In this model, the returns to the inputs also can be measured by output elasticities. The elasticities and return to scale analysis has shown that the elasticities for the horse power and crew size on the output revenue were smaller than 1 and the elasticity for the number of days at sea was also smaller than 1. These results may seem reasonable while resources are considered as overexploited.

7.4. Cost-efficient vessels and intra-marginal rent

To compare fishing effort and costs among vessels, the relative standardised effort is calculated for each vessel. The relative fishing power differed among the vessels. Vessels equipped with high engine power, a large number of crew members and a large number of fishing days have the greater relative standardised effort. The results showed that a large number of vessels with high relative standardised effort (more than one) were the most efficient vessels, both from a fishing efficiency and from a cost efficiency point of view. As a result, intra-marginal rent is mostly generated by these vessels. From these results, the purse seine fishery may continue expanding, as well as attract fishing investors to this fishery in the near future. Either investments in engine capacity and fishing gear or an additional increase in fishing time may continue this growth. This seems to reflect somewhat the situation of Khanh Hoa’s fisheries since the total engine power of the fishing fleet continued to increase in 2011.

Overall, intra-marginal rent is generated from the existence of heterogeneous vessels, of which the most cost efficient vessels make above-normal profits, called intra-marginal rent (Coglan and Pascoe, 1999; Flaaten, 2011). This could imply that even in an open-access fishery, some vessels may improve their economic performance by the introduction of cost saving practices. It is important to note that even under an open-access regime many vessels may create benefits for society.

Chapter 8

CONCLUSION

The economic performance of inshore purse seine vessels in an open-access fishery have been investigated in this study, based on a 2011 survey of costs and earning data of a sample of 62 anchovy purse seiners in Nha Trang, Vietnam. The presented economic analysis shows that an average purse seiner was able to cover all costs and earned a profit margin of 17.4% and crew members earned their opportunity cost of labour or above. This is close to what was expected, based on discussion of the theory of open-access fisheries. These results indicate that the purse seine fishery may continue expanding as well as attracting fishing investors to this fishery in the near future.

This study also investigated factors affecting annual vessel production. In this analysis, engine power, number of crew, number of fishing days and dummy variable for location are identified as the main factors affecting the gross revenue of the vessel. Thus, these are the factors that best produce indicators of vessel efficiency. The elasticities and return to scale analysis have shown that the input that makes the largest contribution to the value of the gross revenue is the number of days at sea.

To compare the fishing effort and the costs among vessels the relative standardised effort is calculated for each vessel. The results showed that a large number of vessels with high relative standardised effort (more than one) were the most efficient vessels, both from a fishing efficiency and from a cost efficiency point of view. These vessels earned most of the intra-marginal rent generated. This could imply that even in an open-access fishery with heterogeneous vessels, some vessels may improve their economic performance by the introduction of cost saving practices. Therefore, these vessels may create the most benefits for society.

The empirical findings of positive vessel profit and good crew earnings in the purse seine fishery is a sign of possible further expansion of the capacity and effort of the fleet in this open-access fishery, unless resource depletion comes first. From a resource conservation objective point of view the results we have found indicate that policies aiming to reduce the overall fishing effort should be instigated. A reduction in the number of vessels or the number of days at sea of the fishermen could be a way forward. Policies should aim at such reductions without reducing revenue and catch of the remaining vessels. Furthermore, the programs that help to create alternative income by development of other sectors such as aquaculture, agriculture and to improve education of fishermen could be implemented to mitigate over-exploitation of the resources (Ngoc et al., 2009).

REFERENCES

Adeogun O. A., B. B. Solarin1, H. K. Ogunbadejo1, E. E. Ambrose1, O. R. Akinnigbagbe1, A. A. Ajulo1, Bolaji D. A., O. A. Olusola and M. O. Adeogun, 2011. Economic performance of crab fishery in Lagos lagoon, Nigeria.

Agar J.J., Shivlani M., Waters J.R., Valdés-Pizzini M., Murray T., Kirkley J. and Suman D., 2005. U.S. Caribbean Fish Trap Fishery Costs and Earnings Study. NOAA (National Oceanic And Atmospheric Administration) Technical Memorandum NMFS-SEFSC- 534, 127 p.

Bell, F. W.1978. Food from the sea: The economics and politics ofocean fisheries. Westview Press, Boulder, Colo., 380 p.

Cheung, S. N. S. 1970. The structure ofa contract and the theory ofa non-exclusive resource. J. Law Econ. 13:49-70.

Cochrane, K. 2002. The use of scientific information in the design of management strategies.

FAO Fish. Tech. Papers 424: 95–130

Coelli T.J., Prasada Rao D.S., O'Donnell C.J., and Battese G.E., 2005. 2nd Edition. An Introduction to Efficiency and Productivity Analysis. Springer Science, 2005.

Coglan L. and Pascoe S., 1999. Separating Resource Rents From Intra-Marginal Rents In Fisheries' Economic Survey Data. Agriculture and Resource Economics Review. 28 (2), 219-228.

Cunningham S. and Whitmarsh D., 1980. Fishing effort and fisheries policy. Marine Policy. 4(4):309-316.

DECAFIREP of Khanh Hoa, 2010. The Annual Report of the number of vessels and engine power registered in 2010 (In Vietnamese). Department of Capture Fisheries and Resources Protection of Khanh Hoa.

DECAFIREP of Khanh Hoa, 2009. The Annual Report of the number of vessels and engine power registered in 2008 and 2009 (In Vietnamese). Department of Capture Fisheries and Resources Protection of Khanh Hoa.

Decision 289/QD-TTg by Prime Minister on March 18, 2008, on issuing some policy supporting for ethnic minority people, poor people and fishermen. Available at (in Vietnamese): http://www.cpv.org.vn/cpv/Modules/News/NewsDetail.aspx?co_id=30340&cn_id=29300# [assessed March 10th, 2012].

Decision 123/2006/ND-CP of Prime Minister of Vietnam of October 27, 2006, on management of aquatic resource exploitation by Vietnamese Organizations and Individuals in sea areas. Available at: http://faolex.fao.org/docs/pdf/vie69865.pdf [assessed April 6th, 2012].

Duc N M, 2011. Value chain analysis in Vietnam. Nong Lam University, Vietnam.

Duy N.N, Flaaten O, Kim Anh N.T, Khanh Ngoc Q.T, 2012. Open-access Fishing Rent and Efficiency – The Case of Gillnet Vessels in Nha Trang, Vietnam (in press).

Duy N.N, Flaaten O, Kim Anh N.T, Khanh Ngoc Q.T, 2010. On the economic performance and efficiency of gillnet vessels in Nha Trang, Vietnam.

EconSearch, 2008. Economic Indicators for the Commercial Fisheries of South Australia. Summary Report 2006/2007. Prepared by EconSearch. September, 2008.

European Commission. Economic Performance of Selected European Fishing Fleets. Annual Report 2007. Concerted Action 'Economic Assessment of European Fisheries'. December, 2007.

FAO, 2009. Fisheries and Aquaculture Country Profiles – Vietnam. Food and Agricultural Organization of the United Nations. Available at: http://www.fao.org/fishery/countrysector/FI-CP_VN/en [assessed 6th March 2012].

FAO, 2005a Report of the conference on the national strategy for marine fisheries management and development in Vietnam. FAO/FishCode Review No.16, Food and Agricultural Organization of United Nations, Rome, Italy.

FAO, 2005b. Economic performance and fishing efficiency of marine capture fisheries. By Tietze, U.; Thiele, W.; Lasch, R.; Thomsen, B; Rihan, D. FAO Fisheries Technical Paper. No. 482. Rome, FAO. 2005. 68p.

FAO, 2004. Report of the national conference on responsible fisheries in Vietnam. FAO/FishCode Review No. 9, Food and Agricultural Organization of the United Nations, Rome, Italy, 2004

FAO, 2003a. Measuring capacity in fisheries. FAO Fisheries Technical paper 445, Food and Agricultural Organization of the United Nations, Rome, Italy.

FAO, 2003b. Measuring and assessing capacity in fisheries. FAO Fisheries Technical paper 433/2, Food and Agricultural Organization of the United Nations, Rome, Italy.

FAO, 2001. Techno-economic performance of marine capture fisheries, by U. Tietze, J. Prado, J.-M. Lery, R. Lasch. FAO Fisheries Technical Paper. No.421. Rome.

FAO, 1999. Economic viability of marine capture fisheries. Findings of global study and an interregional workshop, by Lery, J-M., Prado, J., Tietze, U. FAO Fisheries Technical Paper. No. 377. Rome.

Flaaten, O. Fisheries Economics and Management. 2011. University of Tromso, Norway.

Flaaten O., Heen K., and Salvanes K.G., 1995. The Invisible Resource Rent in Limited Entry and Quota Managed Fisheries: The Case of Norwegian Purse Seine Fisheries. Marine Resource Economics. Volume 10, pp. 341-356.

Floc'h, P.L., Daurès, F., Brigaudeua, C., Bihel, J., 2008. A comparison of economic performance in the fisheries sector: A short- and long-term perspective. Marine Policy 32: 421–431.

Gordon S. H., 1954. The economic theory of a common property resources: the fisheries. Journal of Political Economy, 62, 124-142.

Hardin G. 1968. The Tragedy of the Commons. Science. Vol. 162: 1243-1248.

Hien T.T, Flaaten O, Reithe S, Khanh Ngoc Q.T, 2011. Measuring capacity and capacity utilization in small-scale fisheries in Nha Trang, Vietnam.

Hong Nga C.T, Flaaten O, Kim Anh N.T, 2010. A study on the economic efficiency of the offshore long line fishery in Khanh Hoa province, Vietnam.

IFEP, RIMF, 2005. Fisheries profile: Khanh Hoa province. In: Assessment of Living Marine Resources in Vietnam. Institute of Fisheries Economics and Planning (IFEP) and Research Institute for Marine Fisheries (RIMF), Hanoi, Vietnam.

Khanh Ngoc Q.T., Flaaten O. and Kim Anh N.T., 2009. "Chapter 15: Efficiency of Fishing Vessels Affected by a Marine Protected Area – The Case of Small-Scale Trawlers and the Marine Protected Area in Nha Trang Bay, Vietnam". In *Integrated Coastal Zone Management*/ Edited by Einar Dahl, Erland Moksness and Josianne Stottrup. Blackwell Publishing. 2009. p.189-206.

Kim Anh N.T., Flaaten O., Tam Ngoc D.T., Dung P.T., and Tram Anh N.T., 2007. Costs and earnings from offshore tuna long line fishery in Nha Trang, Vietnam. Fish for the People –SEAFDEC journal, Volume 5, Number 1: 2007, 33-41.

Kim Anh NT, Flaaten O, Tuan N, Dung PT, and Tram Anh NT. A study on costs and earnings of gillnet vessels in Nha Trang, Vietnam. The International Institute of Fisheries Economics and Trade (IIFET) 2006 Portsmouth Proceedings, UK; 2006.

Long L K, Flaaten O, Kim Anh NT. Economic performance of open access offshore fisheries - The case of Vietnamese longliners in the South China Sea. Fisheries Research 93 (2008): 296–304.

Long, N. 2003. A preliminary analysis on the socioeconomic situation of coastal fishing communities in Vietnam. In: Silvestre, G., Garces, L., Munro, P., Christensen, V., Pauly, D., editors. Assessment, management and future directions for coastal fisheries in Asian countries. WorldFish Center conference proceedings, vol.67. Penang, Malaysia: WorldFish Center.

Long N., 2002. Small-scale fisheries management in Vietnam. In: Asia-Pacific Fishery commission. Interactive mechanisms for small-scale fisheries management – report of the regional consultation. RAP publication 2002/10. Bangkok, Thailand: FAO Regional Office for Asia and the Pacific; 2002. [assessed 6th March 2012]. Available at http://www.fao.org/docrep/005/AC467E/ac467e07.htm#bm07.8.

Luong, N.T., Reithe, S., Larsen, T.A., Kim Anh, N.T. 2009. Economic performance indicators for coastal fisheries: The case of pure-seining in Khanh Hoa, Vietnam. Library of Tromso University, Norway. http://www.ub.uit.no/munin/bitstream/10037/1977/2/thesis.pdf.

MOFI, 2005. Programs and projects. Vietnam Fisheries and Aquaculture Sector Study. Ministry of Fisheries (MOFI). Hanoi, Vietnam.

MPI, 2010. The Fisheries Sector in Vietnam: A Strategic Economic Analysis. Phase 2 - DANIDA Project. Central Institute for Economic Management, Ministry of Planning and Investment of Vietnam (MPI). Hanoi, Vietnam.

OECD – Organisation for Economic Co-operation and Development, 2001. Measuring Capital OECD manual. Measurement of Capital Stocks, Consumption of Fixed Capital and Capital Services. 2001. 134pp. [cited 8th April, 2012]. Available from http://www.oecd.org/dataoecd/61/57/1876369.pdf

Padilla, J,E., Trinidad, A.C., 1995. An application of production theory to fishing effort standardization in the small-pelagics fishery in central Philippines. Fisheries Research 22:137-153

Panayotou T. and Jentanavanich S., 1987. The Economics and Management of Thai Marine Fisheries. ICLARM Studies and Reviews 14, 82 p. International Center for Living Aquatic Resources Management, Manila, Philippines and Winrock International Institute for Agricultural Development, Arkansas, USA.

Parente, J., 2004. Predictors of CPUE and standardization of fishing effort for the Portuguese coastal seine fleet. Fisheries Research 69: 381-387

Pascoe, S. and Mardle, S. (eds) (2003) Efficiency analysis in EU fisheries: stochastic production frontiers and data envelopment analysis. CEMARE Report 60, CEMARE, University of Portsmouth, UK.

Pascoe S., Robison C., Coglan L., 1996. Economic and financial performance of the UK English Channel fleet. CEMARE Research Report No. 44. University of Portsmouth, Centre for the Economics and Management of Aquatic Resources (CEMARE). United Kingdom, 1996. 55p.

Paul A.M. van Z., Wim L.T. van D., Thi. D.V., 2002. Improving the usage of fisheries statistics in Vietnam for production planning, fisheries management and nature conservation. Marine Policy 26 (2002) 13-14.

Pomeroy R., Kim Anh N.T., Thong H.X., 2009. Small-scale fisheries policy in Vietnam, Marine Policy, 33, 419-428.

Raakjaer, J., Son, D.M., Staehr, K., Hovgard, H., Thuy, N.T.D., Ellegaard, K., Riget, F., Thi, D.V., Hai, P.G., 2007. Adaptive fisheriesmanagement in Vietnam: the use of indi-cators and the introduction of a multi-disciplinary Marine Fisheries Specialist Team to support implementation. Marine Policy 31 (2), 143–152.

RIMF (Research Institute for Marine Fisheries), 2001. Final summary report: Assessment of the Living Marine Resources in Vietnam in 1996-2000.

Rose R., Stubbs M., Gooday P. and Cox A., 2000. Economic Performance Indicators for fisheries. International Institute of Fisheries Economics and Trade 2000 Conference, Oregon State University, Corvallis, Oregon, 1-14 July 2000.

Scott, A. 1955. The fishery: The objectives of sole ownership. J. Polit. Econ. 63: 116-124.

State bank of Vietnam (SBV). On the base interest rate in Vietnamese Dong. Available at: http://www.sbv.gov.vn [assessed March 16th, 2012].

Thanh Thuy T.P., Kim Anh N.T., Flaaten O., 2008. Economic Performance Indicators for Coastal Fisheries – the case of Purse Seining in South-Central Vietnam. IIFET 2008 Vietnam Proceedings.

Thao, T.N., 2002. Fisheries Economic (in Vietnamese). Nha Trang University, Vietnam.

Vieira S. Schirmer J. and Loxton E., 2009. Social and economic avaluation methods for fisheries: a review of the literature. Presented for the Department of Fisheries, Government of Western Australia and the Western Australian Marine Science Institution (WAMSI), 94p. Fisheries Research Contract Report No. 21, 2009.

Vietnam Business Forum (VCCI), 2010. Fisheries Sector Asserting Foremost Position in Khanh Hoa Province. Available at: http://www.vccinews.com/news_detail.asp?news_id=19373 [assessed 12th March 2012].

Whitmarsh D., James C., Pickering H., Neiland A.E., 2000. The Profitability of Marine Commercial Fisheries: A Review of Economic Information Needs with Particular Reference to the UK. Marine Policy 24 (2000): 257–263.

APPENDICES

APPENDIX A: Questionnaire

ANNUAL SURVEY ON ON INSHORE PURE SEINE VESSELS

IN NHA TRANG CITY, VIETNAM

I. General information:

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

II. Information about vessel and owner

1. Registered vessel number ………………………………………………………….
2. Vessel owner' name...
3. Address ……………………. ………………..Phone number: …………………
4. Hull length (m):…………………………………………………………………….
5. Year of building vessel ……If vessel owner does not know, please tick here…………
6. Engine power (HP):………………………………………………………...

III. Information about labor

Skipper	Crew (including skipper)
1. Skipper information a. Does skipper have a license? Yes/ No b. Skipper educational level....................... c. Skipper age .... d. Skipper experience (years).................... e. Skipper vocational training time............ f. Does skipper come from traditional fishing household?........................Yes/ No	2.Average crew size (persons)…………………. 3. Income/person (1000 VND) a. Average income/month in main season:.............. b. Average income/ month in sub-season :……….... 4. Total income of household in year (million VND) a. From fishing operation:.............. b. From other activities:………....

IV. Information about harvested quantity, season, fishing grounds and weather

Items	Main season	Sub season
1.Number of trips in year		
2. Average quantities of catch 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 (months)		
5. Fishing grounds		
6. Special weather? (Storms)		

V. Capital Items

Items	Year of purchase	Physical units	Value per unit (1000 VND)			Asset status (new/old)	Estimated Lifespan
			Purchase value	Current estimated value	Current value of a similar new one		
The value of the vessel While:							
1.Hull							
2. Engine							
3. Auxiliary engine (generator)							
4. Mechanic equipment							
a. Winch							
b. Normal lighting system (battery and lamps)							
c. Lighting system for fishing							
d. Other mechanic equipment 1							
e. Other mechanic equipment 2							
4. Electronic equipment							
a. GPS							
b. Compass							
c. Short-range radio							
d. Long-range radio							
e. Radar							
f. Others							
5. Fishing gear							
a. Fishing net							
b. Subgear 1							
c. Subgear 2							
d. Other							
6. Storage equipment							
7. Other equipments							

VI Annual Repair and Maintenance

Items	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

Items	Costs (1000 VND)
1. Insurance	
a. Vessel	
b. Crews	
2. Annual registration fee	
5. Other	

IX. Loan

	Debt at the end of year (1000 VND)	Interest payment	
		Interest payment per year (1000VND)	Interest rate per month (%)
1.Bank			
2. Private loan			
3. Project/ program			

X. Average variable costs/trip

	Main season		Other season	
Items	Quantity	Value (1000 VND)	Quantity	Value (1000 VND)
1.Fuel				
a. Oil (diesel) (liter)				
b. Lubricant (unit)				
2.Ice				
3. Provisions				
4.Minor repairs				
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 deducting operating costs		
4.Crew share in % after deducting for total costs		
5. Average annual price (VND/kg)	-	
a. Main species 1		
b. Main species 2		
c. Main species 3		
d. Main species 4		
e. Other		

XIII. Other information and comments from interviewer

………

………

………

………

APPENDIX B:

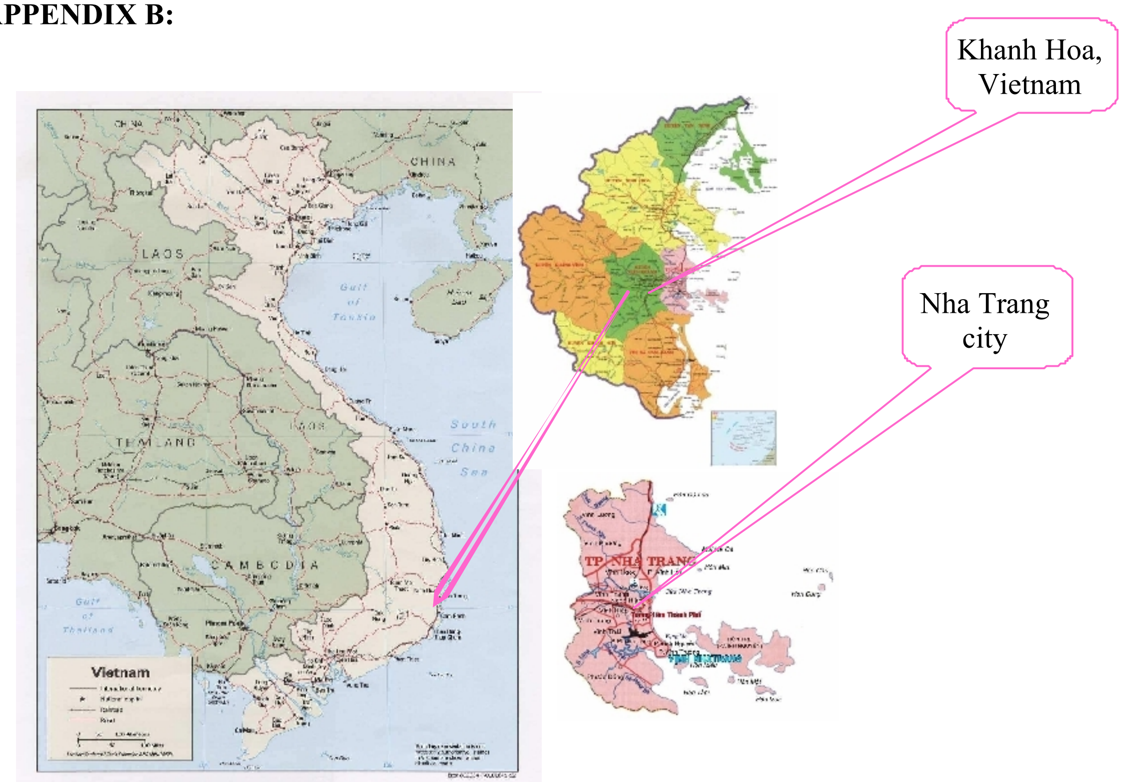

Figure B: The map of Nha Trang city, Khanh Hoa Province, Vietnam

APPENDIX C:

Table C: The Standardised effort, Relative standardised effort and Average cost per standardised effort of the 62 purse seine vessels

No.	Engine Power	Total cost	Standardised fishing effort	Relative standardized effort-	Average cost per standardised fishing effort
1	350	2006.84	2469.19	1.40	1429.87
2	60	1080.79	1356.68	0.77	1401.54
3	250	1627.86	2272.63	1.29	1260.16
4	550	1876.42	2708.04	1.54	1219.03
5	140	1472.52	1813.79	1.03	1428.28
6	450	2077.98	2797.63	1.59	1306.74
7	450	2002.68	2719.25	1.55	1295.69
8	120	1603.22	1818.93	1.03	1550.66
9	140	1604.38	1909.46	1.09	1478.21
10	80	1338.15	1511.76	0.86	1557.26
11	380	1938.16	2615.51	1.49	1303.68
12	90	1378.80	1447.08	0.82	1676.28
13	160	1610.95	1948.12	1.11	1454.80
14	140	1466.70	1936.46	1.10	1332.52
15	56	1066.87	1204.83	0.68	1557.85
16	120	1637.55	1779.30	1.01	1619.14
17	140	1556.63	1826.88	1.04	1499.04
18	190	1587.95	1921.57	1.09	1453.85
19	100	1551.98	1643.10	0.93	1661.73
20	30	779.87	930.48	0.53	1474.54
21	160	1727.26	1905.38	1.08	1594.83
22	120	1536.92	1692.87	0.96	1597.23
23	384	2002.73	2646.45	1.50	1331.37
24	90	1439.08	1502.67	0.85	1684.85
25	120	1559.76	1662.53	0.95	1650.54
26	90	1506.98	1560.20	0.89	1699.29
27	56	875.32	1146.45	0.65	1343.23
28	160	1594.93	1905.38	1.08	1472.64
29	240	1627.38	2156.52	1.23	1327.62
30	90	1407.33	1457.38	0.83	1698.88
31	22	717.74	782.09	0.44	1614.55
32	22	983.88	846.94	0.48	2043.75
33	270	1713.40	2246.92	1.28	1341.56

34	140	1509.11	1854.68	1.05	1431.50
35	45	1042.61	1201.76	0.68	1526.31
36	45	1001.24	1201.76	0.68	1465.75
37	50	1036.56	1291.94	0.73	1411.53
38	120	1151.22	1676.17	0.95	1208.31
39	350	1944.70	2548.60	1.45	1342.42
40	240	1634.19	2180.23	1.24	1318.68
41	90	1257.76	1399.12	0.80	1581.55
42	50	1009.11	1121.27	0.64	1583.32
43	250	1877.91	2324.63	1.32	1421.22
44	90	1304.07	1554.82	0.88	1475.57
45	60	1247.69	1347.29	0.77	1629.23
46	180	1665.05	1977.43	1.12	1481.38
47	80	1158.40	1550.90	0.88	1314.06
48	495	2025.59	2882.92	1.64	1236.11
49	50	878.73	1248.61	0.71	1238.13
50	66	988.72	1305.55	0.74	1332.35
51	320	1758.36	2477.64	1.41	1248.56
52	280	1543.44	2116.51	1.20	1282.94
53	60	1022.46	1290.04	0.73	1394.38
54	140	1600.11	1798.78	1.02	1564.98
55	180	1566.94	1813.12	1.03	1520.42
56	60	950.18	1243.52	0.71	1344.29
57	120	1224.72	1585.62	0.90	1358.87
58	60	1120.83	1324.20	0.75	1489.11
59	60	1093.93	1324.20	0.75	1453.37
60	120	1401.55	1693.84	0.96	1455.71
61	320	1695.24	2207.47	1.25	1351.06
62	60	1077.68	1266.92	0.72	1496.50