unuftp.is Final Project 2009

ECONOMIC EFFICIENCY OF THE DEEP SEA FISHING FLEET OF SRI LANKA

Lalith Amaralal Kariyawasam Hewamanage
Socio-economic and marketing research division (SED)
National Aquatic Resources Research and Development Agency (NARA)
Colombo 15, Sri Lanka
l_amaralal@hotmail.com, lalith@nara.ac.lk

Supervisors:

Ögmundur Knútsson
University of Akureyri
ogmundur@unak.is

Helgi Gestsson
University of Akureyri
helgig@unak.is

ABSTRACT

The aim of the study was to estimate the economic efficiency of vessels operating in the deep sea fisheries in Sri Lanka, in relation to the length of these vessels. The results can then be used as a management tool for the improvement of the deep sea fisheries. Multi-day deep sea operating vessels (MDOVs) vary in length from 28-60 ft. According to a questionnaire survey conducted, all MDOVs´ had average trip duration of 9-22 days and 5-10 fishing days. Labour, fuel, food, ice and water contributed to about 41, 39, 12, 7 and 1 per cent of the total operational cost of the vessels respectively. The average net profit showed that all size classes operated with profit. The highest calculated yearly return of the capital investment of 66% was earned by the 35-39 ft group, followed 28-34 ft MDOV that earned 51%. The lowest, 9%, was earned by the > 44 ft MDOVs. Nearly one fourth of the captains surveyed had problems with foreign vessels arriving into Sri Lankan waters and about one fifth of them with fish price instability at the markets. About 13, 12 and 7% of the captains respectively named the insufficient harbour services, the constantly increasing input prices and the danger of being taken into custody by neighbouring countries when crossing EEZ country boarders as a problem. Collaboration of all actors in the industry will be the most suitable solution for the development of the industry. The possibility of vertical integration should be promoted for the development of deep sea fisheries in Sri Lanka.

This paper should be cited as:
Hewamanage, L. A. K. 2010. *Economic efficiency of the deep sea fishing fleet of Sri Lanka.* United Nations University Fisheries Training Programme, Iceland [final project].
http://www.unuftp.is/static/fellows/document/lalith09prf.pdf

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

Sri Lanka is an island nation located in the Indian Ocean between lat 5° and 10°N, long 79° and 81°E. Sri Lanka is a highly populated country with about 21.3 million people and has a total land area of 65,625 km². Sri Lanka is a multi-racial and multi-religious country and about 75 per cent of the total population is Sinhalese. Tamil, Moor, Burger and Malay make up the rest. Majority is Buddhists and the official languages are Sinhalese, Tamil and English (CIA n.d).

Sri Lanka has a coastline of 1,777 km, which consists of bays, lagoons, estuaries and coastal wetlands (NARA 2008). Since the declaration of 200 miles Exclusive Economic Zone (EEZ) in 1978, Sri Lanka has sovereign right over 517,000 km² of the ocean (NARA 2008). There is approximately 200,000 hectare of fresh water bodies. Fisheries have a long history and can be divided into marine and inland water fisheries. Although, the present contribution of the fisheries to the Gross Domestic Production (GDP) of the country is relatively small or about 1.2 per cent, it provides about 160,000 direct and about 400,000 indirect employments (NARA 2008). Fisheries play an important role in the society in terms of protein supply and foreign currency earnings. About 60 per cent of animal protein intake of the people comes from fish (Amaralal 2004). In the last two decades, export of fish and fishery products has developed rapidly bringing a substantial amount of foreign exchange earnings to the country. In 2007, about 2.2 per cent of country's total export earnings came from fish and fishery products (NARA 2008).

Total fish production of the country in 2008 was 319,000 t (NARA 2008). Marine fisheries constitute 87 per cent of the total fish production while inland water fisheries contributed the rest (NARA 2008). Of marine fisheries production, about 109,000 t or 40 per cent came from deep sea fisheries that year. About 18,000 fishermen are employed and about 3,600 vessels were registered in deep sea fisheries in the same year.

Deep sea fisheries target medium and large pelagic species mainly tuna and tuna like fish (Maldeniya and Amarasooriya 1998). Deep sea fisheries of Sri Lanka can be divided into a gill net fishery and a long- line fishery and extend from the edge of the continental shelf to the outer limits and beyond the EEZ of the country.

Since 1980 the number of vessels operating in deep sea fisheries has increased by about 3,600 with the introduction of inboard-engine multi-day vessels to the deep sea fisheries in the late 1980s. Fish landings of deep sea fisheries have increased from about 8,000 t in 1989 to about 109,000 t in 2008. The types of multi-day deep sea operating vessels (MDOV) vary profoundly in length and the degree of having sophisticated technological equipment.

Deep sea fisheries are characterised by open access resulting in the increase in the number of vessels year by year. The uncontrolled new entries are often attributed to the absence of proper management measures and policies. This situation can lead to decrease profitability of fishing operations in the future. This situation can thus limit the incomes of thousands of fishermen and other employees as well as the profitability of investments. Generally, investors make their decisions primarily based on income expectations and subject to maximization of net benefit from the operations (Lane 1988). For investors to be able to make sound investment decisions the availability of reliable and real-time scientific information related to economic aspects of the deep sea fisheries are critically important. These aspects are presently given to little concern. In the recent past, investors have claimed that their investments have been faced with great risk because of the reduction of operational profits due to increased operational costs as well as low levels of catch of the fishing trips.

The government of Sri Lanka, under its present fisheries policy objectives, has planned to increase the number of employments and food security of the people by developing the deep sea fisheries further through introducing large sized vessels with sophisticated technology therefore it is important to study the economic efficiency of multi-day deep sea fishing operations in the hope of evaluating the profitability of the present deep sea fishing operations.

It is also important to undertake a benchmarking study of similar fishing operations in order to address the causes of poor productivity of the deep sea fishing operations of Sri Lanka and in the future find ways of improving the deep sea operations. An attempt has been made here to achieve this through benchmarking with a part of the Icelandic fisheries.

The aim of the study was to estimate economic efficiency in relation to the length of the vessels operating in the deep sea fisheries in Sri Lanka, which can be used as a management tool for the improvement of these fisheries. More precisely, the objectives of the study were:

- To estimate operational income of vessels operating in deep sea fisheries in Sri Lanka.
- To estimate operational cost of vessels operating in deep sea fisheries in Sri Lanka.
- To examine critical operational factors of vessels operating in deep sea fisheries in Sri Lanka.
- To find ways to make improvements of operational factors of vessels through benchmarking with Icelandic fisheries.

This study will provide some preliminary answers to the questions related to the economic aspects and management of the deep sea fisheries. On that basis it is hoped that policies and management measures may be derived for the Sri Lankan deep sea fisheries.

2 CONCEPTUAL FRAMEWORK AND LITTERATURE REVIEW

Economic efficiency is, in general, measured as profitability in any business company or industry that generates revenues and costs. Generally, it is also reasonable to consider that current profitability is related to past investment and that current investment is related to future profitability (Richardson *et al*. 2005). In this context it is important to be able to measure profitability of the deep sea vessels operating in deep sea fisheries in Sri Lanka. If that is made possible it can lead to better fisheries policies, sounder management decisions and also increase the probability of sustainability of the industry. For analysing the industrial environment and for calculating profitability of deep sea fishing vessels, industrial analysis was partly conducted and both cost analysis and strategic cost management theories were considered.

2.1 Industrial analysis

A systematic way of analysing industries is important. Management decision making is complex in a dynamic environment and needs a rational knowledge to make sound strategic decisions to face rivalry actions in the industry. With the present increased pressure of new entries into deep sea fisheries in Sri Lanka it is important to identify the state of the industry, its driving forces which can completely change the industry's profitability and the key factors of success for the industry. Thompson and Strickland (2010) in their textbook on strategy use a holistic model of industrial analysis. In their model they put forward seven questions that provide a holistic understanding of the economic and competitive factors of an industry. The questions asked are:

1. What are the industries' dominant economic features?
2. What kind of competitive forces are industry members facing?
3. What forces are driving industry changes and what impacts will they have?
4. What market positions do rivals occupy- who is strongly positioned and who is not?
5. What strategic moves are rivals likely to make next?
6. What are the key factors for future competitive success?
7. Does the outlook for the industry offer companies' good opportunity to earn attractive profits?

Industrial analysis is by nature a single company specific view of the industry. The lack of reliable data on number and the size of boats operating in the deep sea industry in Sri Lanka as well as on revenue and costs also limit the use of this holistic model. For the purpose of this study it is used here to give an overview of the industry and its profitability and is only used as a guideline for the analysis that follows leaving out the company specific aspects of the questions. This means that for guidance for the industrial analysis the author focuses on questions 1, 2, 3 and 6. This coupled with the results from the questionnaire survey conducted will hopefully add meaningful understanding of the industry and be used as a first step for future management decisions for these fisheries.

2.1.1 Cost volume profit relationship (CVP)

Cost volume profit analysis examines the behaviour of total revenues, total cost and operating profit as changes occur in the output level, selling price, variable cost or fixed cost. This analysis is used to answer questions that have a "what if" theme (Bhimani *et al.* 2008). This method was used to calculate the main economic criterion related to the deep sea fisheries in Sri Lanka. Revenues are received by harvesters (fishermen) from assemblers (buyers) in exchange for the catch of fish at the markets (landing centres). Selling price of fish, the volume of fish harvested and operational cost affect revenues of deep sea fishing. The quality of the fish is an important part of the price. Changes in a cost factor in turn cause a change in both the total cost and the net revenue of the operation. The main operational cost factors of deep sea fisheries in Sri Lanka have in earlier research been identified as fuel, ice, water, food and labour (Amarasinghe 2001).

2.1.2 CVP terminology

In the context of Sri Lankan deep sea fisheries it is assumed here that total costs are made up of only two categories: Operational cost, as a synonym for variable cost, and fixed cost. Therefore, Total Cost = Operational Cost + Fixed Cost.

Operational cost includes all variable cost related to fishing operations at the sea such as drinking water, ice, fuel, wages and food expenses. Similarly, fixed cost includes all fixed costs related to the capital investments such as on the vessel, fishing gears and communication and navigation equipment. Other fixed costs related to the operations are not calculated here. The main equipment associated with deep sea fishing vessels are radio communication equipment and satellite navigators.

Cost of the capital is assumed to be the depreciation cost of vessel, engine, gear and equipment. These were calculated on the basis of a straight forward depreciation method. The following life-times were used in calculating of depreciation costs:

- Hull = 16 Years
- Engine = 8 Years
- Equipment = 12 Years
- Gear = 4 Years

These life values of fixed assets are in accordance with a technical report of Bay of Bengal Programme (BOBP), on exploratory fishing for large pelagic species in Sri Lanka by Maldeniya and Suraweera (1991). Both operational and fixed costs were estimated using the authors´ questionnaire survey results.

Operating profit or Gross profit in the deep sea fisheries is found as the total revenues from fishing operations minus the total operational costs of the operations or as follows:

Operating profit (Gross profit) = Total Revenues - Total Operational Costs

Net profit is then found as the Operating profit (Gross profit) minus fixed costs. Thus, net profit was calculated as follows:

Net Profit= Operating Profit - Fixed Cost

Return on the fixed capital investment was calculated as a ratio by dividing net profit by the total fixed capital investment. The ratio as such does only show the return for the period, which the net profit is calculated. The result was then expressed as a percentage of the total value of the fixed capital investment:

Return on the capital investment = (Net profit/Fixed Capital Investments)*100

Due to the lack of reliable financial data no attempt was made to find the return on investment over a lifetime of the investment taking into account the time value of money and the expected return for the investment.

2.2 Review of previous research conducted on deep sea fisheries in Sri Lanka

Only a handful of studies have been conducted addressing issues related to the economic and social aspects of the deep sea multi day fisheries in Sri Lanka. In the BOBP proceedings Madeniya and Suraweera (1991) studied operational income and cost of deep sea operations and later Gulbrandsen (1998) in his FAO technical paper evaluated those data under the techno-economic valuation of offshore boats. His conclusions were that those operations were not economically viable, showing that 34 ft deep sea vessels owners had earned only 3 per cent return on their investment. Amarasinghe (2001) studied economic and social implications of multi-day fishing in Sri Lanka and concluded that annual revenues did not increase in proportion to the length of the vessels and that the capital cost of vessels increased with length. He found that hull, engine and gear accounted for 38, 29 and 33 per cent of the total cost of the vessels respectively. Of operational cost 50 per cent went to labour and 20 per cent for fuel. It should be noted that in his study he categorized vessels into groups differently from the categorization of this study.

Kumara (2001) examined issues related to deep sea fishermen and their families due to their detention in foreign countries and concluded that fishermen wives and family members, more than others, were faced with difficulties in managing their daily activities, due to the absence of their husbands. Thordarson (2008) studied the value chain of yellow fin tuna in Sri Lanka and concluded that the arrival of foreign vessels into Sri Lankan waters was both criticised and protested by fishermen. He further found that the new entry, substitute products, buyers and inputs suppliers bargaining power and rivalry among existing companies of deep sea fisheries had made negative effects to the industry and may have an effect to reduce the profitability of the industry in future.

3 DEEP SEA FISHERIES IN SRI LANKA

The administrative and policymaking organization for fisheries in Sri Lanka is the Ministry of Fisheries. It was set up in 1970. The functions of the Ministry are to promote the development of the fishing industry, regulate fisheries activities and look after the welfare of those who engage in fishing. The deep sea multi-day fisheries of the country are still managed as an open access fishery. At present the department of fisheries handles a scheme to issue licenses for deep sea vessels for fishing operations under the fisheries act. It is generally considered that the management of deep sea fisheries is a difficult task due to the increase of unregistered vessels entering the deep sea fisheries over the last few years.

3.1 The historical development of deep sea fisheries

With the high rate of population growth in Sri Lanka fish foods demand increases too. To cater to this increased demand, higher rates of exploitation of fish beyond the existing levels have become necessary. In order to face this challenge the state decided to expand fish production by introducing multi-day fishing vessels in the late 1980s to develop offshore fisheries.

After experiments conducting the late 1950s by the state using one-day operating crafts (ODOC) with inboard engine for deep sea fisheries for facilitating fishing up to 40 km from the coastline that type of fishing became popular among fisher folk. However, these types of boats were not equipped with facilities to chill or freeze the fish and therefore they had to confine their fisheries only one day. By the late 1980s as a solution to mitigate this problem the fishers started introducing an ice compartment to their existing one-day crafts. These became very popular as tank boats or tanki boattu. These tank boats were later replaced by multi-day deep sea operating vessels (MDOV), which were longer, and with more sophisticated equipment, an ice hold and a cabin for the crewmembers (Amarasinghe 2001).

The over 28 ft long MDOVs are mainly engaged in deep sea fisheries using large-mesh gill nets and long lines. The main areas and seasons of operation of the MDOVs´ within and outside the Sri Lanka's EEZ are shown in Figure 1.

Deep sea fisheries in Sri Lanka operate mostly in 3 areas depending on both oceanographic conditions and fisheries. Oceanographic conditions around Sri Lanka are driven by bimodal pattern of monsoonal winds. These monsoons give rise to two periods of fishing operations, the North-East one from December to February and the South-West one from May to September. However, fishing is conducted in the South throughout the year.

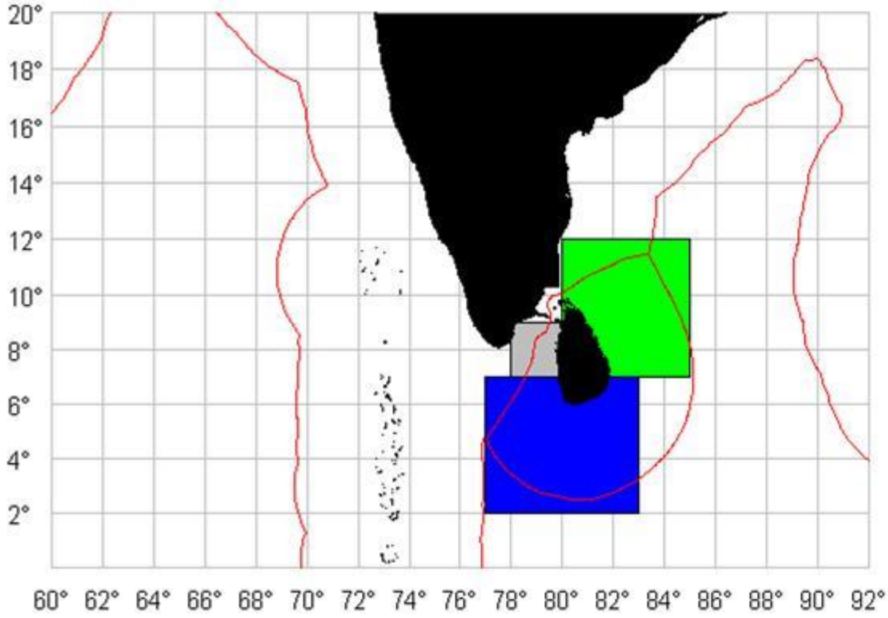

Figure 1: Areas and seasons of operation of MDOVs in Sri Lanka.

In the south, south-east and the east gillnets are used alone but in the west and the south-west gillnets are used together with long lines (Maldeniya and Amarasooriya 1998).

3.2 Types of deep sea vessels in operation

The types of the MDOVs´ presently operating in the deep sea fisheries are made of fibreglass but vary in length and the degree of having sophisticated technological equipment. A general appearance of the modern MDOVs can be seen in Figure 2.

Figure 2: General appearances of the MDOVs in Sri Lanka.

The lengths of these vessels generally vary from 28 to 60 ft and inboard-engines power them. Most of the MDOVs in operation today are 28 to 40 ft powered by 45 to 110 hp engines. These MDOVs are often equipped with navigation and communication equipment. To enable the MDOVs to engage in longer fishing trips a water tank, two fuel tanks, an ice hold, a fish hold and a cabin facilitate them for crewmembers. With the increase in the length of the vessels, the size of its fuel tanks, water tank, ice holding and fish holding capacities have also increased, making longer trips possible and more efficient. Generally 3 crew members and the captain are employed of the vessels from 28 to 32 ft while 4 crew members and the captain are employed for the 32-45 ft. Most of the time vessels > 45 ft are employ 4 crew members and the captain but some of the bigger vessels employ 5 crew members and the captain for their fishing operations. Drift gill nets and lone line are used by all size categories of the vessels but the larger vessels over 39 ft often use mostly long line, targeting tuna for export markets. Smaller sized vessels, below 39 ft, mostly use drift gill nets for fishing rather than long line.

Gulbrandsen (1998) has indicated that the present day barge-like shape of the MDOVs´ may have adverse influence on the stability of the vessels. He also emphasised that many of the MDOVs´ operating in deep sea fisheries do not meet the international safety standards and are not equipped with onboard safety devices. Even at present, since facilities for freezing are not available in most MDOVs´, fish can´t be preserved for a long period. A few MDOVs, which are equipped with chill bathing facilities, practice fishing for a longer period at sea, sometimes longer than one month.

3.3 Number and age of operating vessels

Department of fisheries registers deep sea vessels and records are present in the vessels registry. This system was launched in 2006 with the financial and technical assistance of the Icelandic International Development Agency (ICEIDA). In 2007, the Sri Lankan department of fisheries launched an island wide census to register all MDOVs operating in deep sea fisheries. Shown in Figure 3 is the number of MDOVs according to the census of 2007 and from then on the annually registered new vessels into deep sea fisheries until the end of September 2009.

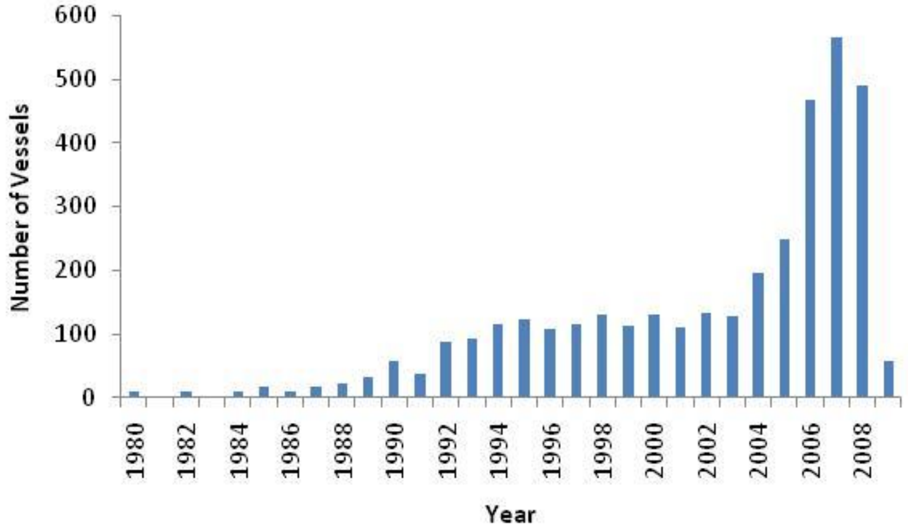

Figure 3: Registration year of vessels operating at the end of September 2009.

The figure indicates that the now operating multi-day deep sea vessels, registered from 1980 to 1984, were relatively few. The number of operating vessels, registered since then, has been increasing slightly over the years until 1990. The main reason for this increase was a subsidy scheme introduced in 1983 by the government, financed through the Abu Dhabi Trust Fund. Under this scheme 35 per cent of the capital expenditure of vessels was subsidized and a total number of 70 vessels entered the fisheries through this program (Gulbrandsen 1998).

For the vessels registered according to the census after 1992 the number of now operating vessels has shown a sharp increase up to 1995. The main reason for this increase was the subsidy scheme, which was introduced by the government in 1991. Under this scheme the government subsidized 35% the converting of the existing one day 3.5 t vessels into multi-day deep sea vessels. Although the records of actual numbers of converted vessels through this program are not available it is assumed that a large number of fishermen benefited and, because of the subsidies, entered the deep sea fisheries. For the vessels now operating it can be seen that after 1996 the number of vessels is more or less stable until 2003. At the beginning of 2005 the deep sea fisheries faced the diminishing in fish landings due to the reduction of operated vessels, which were destroyed or damaged by tsunami devastation at the late of 2004. It was estimated that 195 deep sea vessels were destroyed and 402 vessels were damaged due to the tsunami devastation (MFAR 2007).

In 2006 and 2007 a sharp increase in numbers of registered vessels can be seen. The main reason for this can be attributed to vessel donations by governmental and nongovernmental organizations under the programme of restoration of fisheries, which were affected by tsunami devastation. It was found that the registered number of MDOVs´ has increased by 66% in 2007 compared to the year 2004. Relevant information is not available for the estimation of the numbers of MDOVs that were entered into the deep see fisheries as a result of donations immediately after the tsunami (MFAR 2007). In the present study, MDOVs have been grouped into four categories according to lengths. Figure 4 presents the age of registered vessels of the 4 categories: 28-34, 35-39, 40-44 and >44 ft.

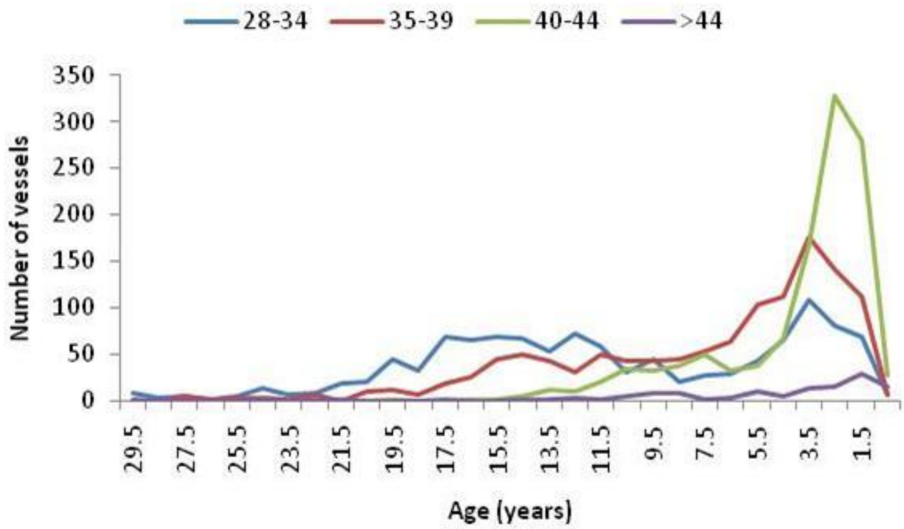

Figure 4: Present age composition of deep sea vessels by size groups (in feet).

Age 0.5 represents newly registered vessels of 2009 while 29.5 for year the vessel registered in 1980. A large proportion of vessels in all size categories are less than 10 years old but there is a clear trend for an increase in the size of vessels in the past 5 years. It is clear that after the tsunami the number of vessels in deep sea fisheries has increased sharply and a large proportion of the increase was in the 40-44 ft size category of vessels followed by the 35-39 ft.

3.3.1 Deep sea fish catch

Deep sea fisheries mainly target by medium and large tunas with skipjack (*Katsuwonus pelamis*) and yellow fin (*Thunus albacares*) dominating the catches while sailfish (*Istiophorus playtypterus*), swordfish (*Xiphias gladius*) and marlin are also common in the catch. Many species of sharks are also a part of the deep sea catches.

Catch estimates of Sri Lanka have often been criticised in the recent past. Many international governmental and nongovernmental organizations have pointed out that country's catch estimates were subjected to a high degree of uncertainty (IOTC 2009). This has to be taken into account when using Sri Lankan catch estimates. In Figure 5 below the annual total fish catch of the country and its trend are shown based on official catch statistics.

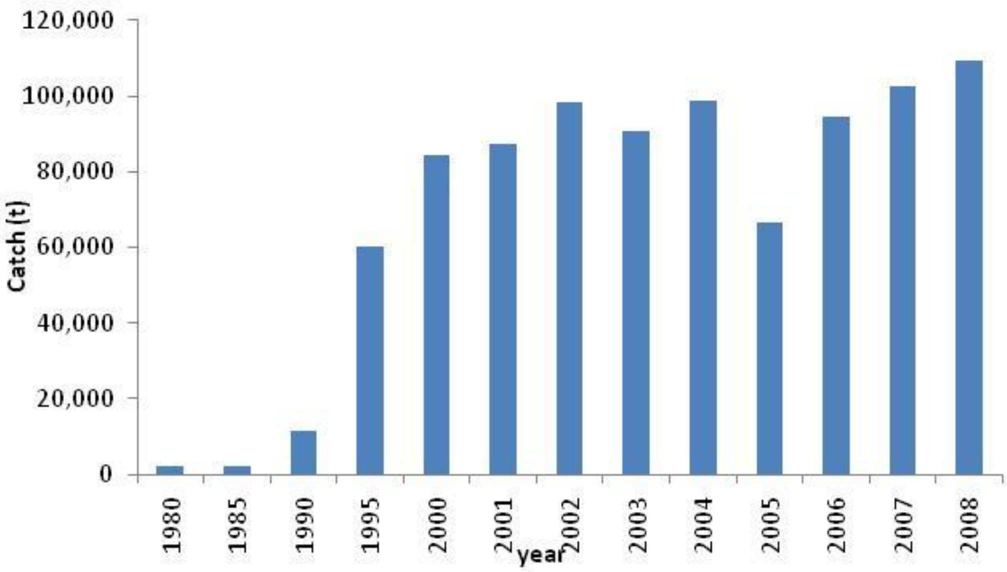

Figure 5: Annual deep sea fish catch (t) 1980-2008.

Annual deep sea fish catch from 1980 to 1990 was very low due to low numbers of vessels engaged in these fisheries in that period. During the period of 1990 to 1995 more than a 500% increase is seen in deep sea fish catch. This increase can be attributed to the increase in numbers of vessels operating in that period. Since then, fish production has been increasing up to 2004 although some fluctuations are noticed. In 2005 the deep sea catch dropped from 98,000 t in 2004 by about 32% to about only 66,000 t due to the tsunami devastation in 2004. Owing to rehabilitation programmes and donations of vessels and gear from international organizations the deep sea catch went in 2006 almost up to what it had been in 2003 and has been on the increase since then. When comparing the increase in the number of vessels entered into the fisheries from 2006 to 2008 (Figure 3), when 1,521 were added, the increase in the catch for the same years is relatively much less. The most likely explanation is that either vessels are not targeting the resource areas correctly or an over exploitation of the deep sea resources is taking place. This situation should be given more concern by the authorities governing the management of these fisheries. Most of the total catch is sold in local markets and the rest in export market. A large proportion was exported to the high value markets especially to the Shasimi market in Japan. Local market prices of deep sea fish, especially tuna, are high throughout the year relative to the buying power of the locals. Almost all the catch enters the local market without any processing. Minimum processing is done before exporting to the Japanese market but some filleting and packaging are done for markets in the EU.

Deep sea fisheries are increasingly using new technological equipment and technology for their operational activities, especially mobile phones, using them to communicate with assemblers and using the Internet for communication with foreign buyers. This has resulted in a cost reduction and an increase of the profitability of the companies. Producers for export markets now use safety standards in processing of fish for cater international market demand, where more concern is placed on the product quality and safety.

3.4 The Value chain of the deep sea fisheries

The value chain of deep sea fisheries of Sri Lanka is comprised of two parts, domestic market and exports (Figure 6).

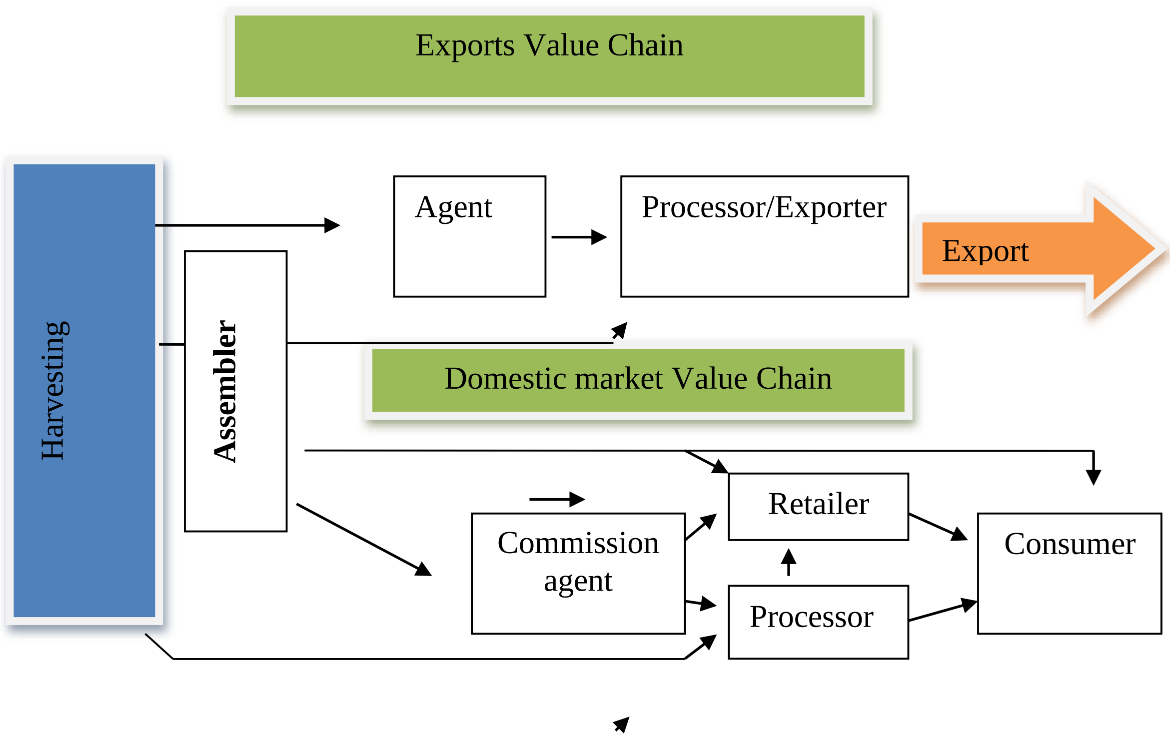

Figure 6: Value chain of the deep sea fisheries in Sri Lanka.

3.4.1 Domestic market value chain of deep sea fisheries

The domestic market value chain of the deep sea fisheries has three links connecting the harvester and consumer, namely assembler, commission agent and retailer (Amaralal 2004). The assembler, who is the first middleman, buys fish directly from vessels when they come ashore and sends it to the wholesale market in Colombo where the commission agents, the second middleman in the structure, take over. The commission agents sell the fish on behalf of assemblers for a commission. Generally they take 10 percent commission of the total revenue and send the balance to the assemblers. Commission agents do not bear any risk on price reduction in terms of quality deterioration of fish in between landing and the distribution of fish to the market. Retailers, the final intermediaries, buy fish from the commission agents and sell it to consumer with a mark-up.

3.4.2 The exports value chain of deep sea fisheries

Exports value chain of the deep sea fisheries comprises of two links, the assembler or the agent and the processor/exporter. The latter consists of few private companies, targeting export of yellow fin tuna to the Japanese Sashimi market and some considerable amount of yellow fin tuna and other tuna like skipjack and big eye to the EU and Asian markets. These companies purchase high quality fish offering a higher price than local market price through their direct and indirect agents. After minimal processing the fish is exported by air to the foreign markets.

4 METHODOLOGY

The methodology used in this study can be described by a list of chronological steps as follows:

1. Preliminary survey and study planning
2. Drafting of study questionnaire
3. Piloting of questionnaire
4. Minor modifications to the questionnaire
5. Administration of the questionnaire (Data collection)
6. Conducting benchmarking interviews in Iceland
7. Data entry and analysis
8. Report writing

4.1 Data

A Cross-sectional questionnaire survey data was collected through direct interviews with captains of deep sea vessels asking 7 questions on capital investment, operational cost, total catch, unit sale price of fish, total number of days at sea, number of fishing days and barriers they see to the deep sea fisheries. NARA officials from January to August 2009 interviewed 100 vessel captains. Some captains were unaware of the capital investment of the vessel so that information had to be gotten from the vessels owner. Data from the vessel registry from the Ministry of Fisheries was also used for information on the registered deep sea vessels in Sri Lanka. Data from Icelandic fish processing and marketing companies was collected through direct interviews. 6 semi-structured interviews with Icelandic company managers were conducted, asking 6 to 7 questions under 5 themes; quality aspects of the products, marketing of products and product development, marketing strategies, company competitive strategies and company key success factors. In both Reykjavík and Ísafjöður, two mangers from fish processing companies, were interviewed. Also in both Reykjavík and Ísafjörður author himself interviewed one executive from a fish marketing company in January 2010.

4.1.1 Sampling

A convenience sample of 100 MDOVs captains representing all types of vessels operating out of seven fishery harbours were selected for the study, namely out of; Beruwala, Negombo, Tangalle, Mirissa, Trincomalee, Hikkaduwa and Kalpitiya. During the data analysis it was found that in some cases the data was incomplete and those samples were omitted from analysis. The final samples used were 89 MDOVs captains. The sample frame of the study is shown in Table 1 below. The sample percentage of the first two groups (28% respectively) is only slightly lower than the percentage of total vessels operating in these groups (32 and 33% respectively). For the 40 to 44 ft group the sample percentage (35%) is only a bit higher than the total percentage (32%). If this was the variation of the total sample it would tolerably indicate that the sample represented the total boats operating.

Table 1: Sample frame of the study.

Type of the vessel	Total number of vessels in deep sea fisheries	Percentage of total vessels	Number of samples	Percentage of the sample	Percentage of total vessels
28 – 34 ft	1,151	32	25	28	2
35 – 39 ft	1,208	33	25	28	2
40 – 44 ft	1,144	32	31	35	3
> 44ft	126	03	8	09	6
Total	3,629	100	89	100	

Since the group >44 ft shows that the relative sample size (9%) is trice the total sample size (3%) it can't be said that the sample variation is a good indicator for the total of boats operating in the deep sea fisheries.

4.1.2 Data analysis

Data analysis of this study was done with SPSS (17) software package and some graph were developed using Microsoft Excel software package. All survey data was, before analysis, coded and tabulated according to the requirements of SPSS. In this study the interest lies in comparing the mean scores of four different vessel size groups, 28-34, 35-39, 40-44 and >44 and therefore an analysis of variance (ANOVA) was conducted. To identify which groups means differ the post-hoc tests were conducted. The study uses 4 vessel groups. Therefore, only one-way analysis of variance between groups was used. Because the sample sizes were fairly different in the study it was found doubtful that the population variances were equal. Therefore, the Games-Howell procedure was chosen since it offers the best performance under such conditions.

In the survey, data was collected for a trip. To convert the trip data into a yearly data for each vessel group, the trip data was multiplied by the corresponding total number of trips per year for each vessel group.

4.1.3 Categorization of MDOVs into groups

All vessels registered for deep sea fisheries were in the study categorized into 4 groups according to their lengths. This categorization was decided on after considering the available technical recommendations suggested by previous studies of the deep sea fisheries in Sri Lanka. Amarasinghe (2001) indicated that vessels over 34ft in length are technically well-suited for the deep sea fisheries in Sri Lanka even if boats as small as 28ft are taking part in the deep sea fishing. Pajot (1993) recommended that special safety regulations for vessels less than 12 m (39ft) in length used for deep sea fishing should be introduced. The safety measures needed thus only to be applied to boats up to 12 meters long (39.1 ft). Taking this into account it was decided that the second deep sea fishing group was to be made up of boats 35 to 39 ft long.Thordarson (2008) in his study recommended that vessels greater than 44 ft in length should be promoted for Sri Lankan deep sea fisheries if the country wanted to target the international market through enhancing the quality of fish. He emphasised that quality standards of fish in international markets cannot be achieved without having proper onboard handling and preservation facilities, and for this end to accommodate necessary facilities, the vessel need to be over 44 ft in length. Thus, considering all these facts and information the MDOVs were categorized into 4 groups as 28-34, 35-39, 40-44 and >44 ft respectively.

4.2 Limitation to the study

In Sri Lanka there are mainly to different operational strategies used in deep see fisheries; individual deep sea fishing where captains are independently landing their trips´ catch at the market, and the collecting of export quality catch, where bigger export companies send boats to collect the quality catch at sea for export purposes. For the collective fishing to work a number of boats have to work together and after few days or a week a boat collects the total catch and brings it to land for processing and export. This way the quality is better guarantied than with the individual fishing. In this study the boats of the sample are all using the individual fishing strategy. Hence collective fishing strategy is not represented in the study.

Survey data of this study was collected in the period from January to August 2009. The questions asked were for one trip. The answers were then used for calculating the annual results of this study by multiplying answers by the number of trips pr. year. This may have an effect on the results of the study. All study results were based on data that was given by the vessel captains and it has to be considered how reliable the data is. Study samples did not quite equally represent the population of the vessels operating in the deep sea fisheries in Sri Lanka. This may have some effect on the results of the study.

5 ANALYSIS OF THE QUESTIONNAIRE SURVEY

The basic characteristics of the sample are shown in Table 2. Here, according to the information given by the captains in the survey, the actual fishing days of the trip, total days at the sea per year, the ratio of fishing efficiency of size categories of vessels, number of fishing trips per year and the total number of days every year at sea are shown.

Table 2: Basic characteristics of the samples.

Vessel Group	Frequency	Total number of days per trip	Actual fishing days per trip	Ratio of fishing efficiency	Total number of trips per year	Total days at sea per year
28-34	25	9	5	55.5%	27	243
35-39	25	13	6	46.2%	21	273
40-44	31	19	9	47.4%	14	266
>44	8	22	10	45.5%	12	264

The highest number of days of a trip and actual fishing days of a trip are seen for the > 44ft group while the lowest to the 28-34 ft group. The highest number of trips a year is taken by the 28-34 ft group while the fewest trips are taken by the > 44 ft group. The ratio of fishing efficiency is found as the actual fishing days per trip to the total days per trip. The smallest group is most efficient and the biggest group least efficient.

Travelling distance and storage capacity of ice normally increases with the size of vessel and therefore the number of sea days is higher for the bigger vessels.

The average number of trips per year was found by multiplying the total number of sea days of a month per vessel group by 12. This was then divided by the total number of days per trip. The average number of trips per year for 28-34 ft was 27 followed by 21 for the 35-39 ft, 14 for the 40-44 ft and 12 for the >44 ft size categories respectively.

The distance to the fishing area, the numbers of days that the fish can maintain export quality on ice or in the chill baths govern the number of sea days and fishing days per trip. The bigger vessels, which have chill baths, can sail long distance making more sea days and fishing days.

Almost all vessels, irrespective of their size categories, use hooks and drift gill nets for fishing (Table 3). Vessels targeting the best quality tuna for export markets mostly use long line, while other vessels use both long line and drift gill nets. Generally all size categories of vessels deploy both nets and hooks and the how much so depends on oceanographic condition of the resource area.

Table 3: Average number of hooks and drift gill net used.

Vessel group	Average number of drift net pieces (equal to 91 meters) used	Average number of hooks used
28-34	46	267
35-39	51	311
40-44	48	354
>44	56	275

According to this the largest size category of vessels uses as low an amount of hooks as the smallest group does.

5.1 Operational revenue

Operational revenue of deep sea vessels is only made up of sale revenues. Therefore the operational revenue is highly sensitive to the market price of fish. Thordarson (2008) found that the unit price of grade 1 quality tuna collected for export and tuna collected for the local market is about 3 per cent higher at the landing centre. The market price of fish changes according to the supply of fish at the market. If the quality of fish is high the price will tend to be higher. If the quantity of fish supplied at the market is high the price of fish will be lower.

5.1.1 Catch

Catch of vessels is comprised of quantity of harvested fish of different varieties. Average catch for different groups of vessels are shown in Table 4 below.

Table 4: Annual catch of deep sea vessels (Kg)

					95% Confidence Interval for Mean	
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound
28-34	25	23785	14133	2827	17951	29619
35-39	25	28094	21777	4355	19104	37083
40-44	31	21777	13442	2414	16846	26707
>44	8	12930	2440	863	10890	14970
Total	89	23320	16220	1719	19903	26737

There was a statistically significant difference at the $p<.05$ level for the 4 groups [$F(3, 46.37) = 10.47$, $p= .00$]. Post-hoc comparisons using the Games-Howell test indicated that the average annual catch of vessels >44 varied significantly from any other groups. The reason for this is that the mean for that group is so low. This could indicate that the larger vessels are targeting different and more exploited fishing grounds than the other groups.

5.1.2 Catch composition of deep sea vessels (Kg)

The highest proportion of the catch in all vessel groups is tuna, up to 60% (Figure 7). For the > 44 group a relatively smaller proportion is tuna (47%) while the second highest proportion is shark. Skipjack is the second biggest catch for the other groups while proportions of marlin and other species of total catch are more or less similar in all vessels groups. The reason for this is tuna is the dominant variety in normal in deep sea catch. Larger vessels normally target sharks for fins due to their high prices at the export markets.

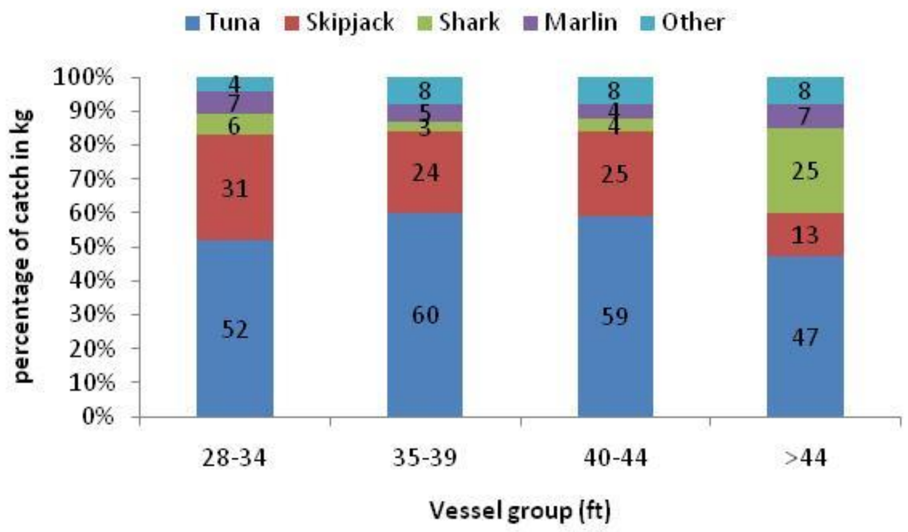

Figure 7: Catch composition (Kg)

5.1.3 Comparison of estimated catch with official catch data

About a 21,000 t difference is found when, using survey data, the estimated annual total catch of deep sea fisheries and the annual official total catch data from the Ministry of fisheries is compared (Table 5). From this could be assumed that the collected survey data did not represent the resource areas accurately or that captains might have given wrong information on catch data from their operations.

Table 5: Estimated annual catch data (Kg) - 2008.

Vessel group	Number of vessels	Average catch from sample	Estimated total catch according to sample average
28-34	1,151	23,785	27,376,535
35-39	1,208	28,094	33,937,552
40-44	1,144	21,777	24,912,888
>44	126	12,930	1,629,180
Total	3,629	23,320	87,856,155
Official catch			109,000,000

It can be seen that the estimated catch volume according to the survey data is about 21,000 Kg or 19% lower than official catch data. Reasons for this could be that either the survey data given by the vessel captains are unreliable or, that due to the small sample size of the study, the real catch of the deep sea fisheries was not represented by the sample.

5.1.4 Unit price of fish

The highest price is for tuna followed by marlin, shark, skipjack and other fish in sequence by all vessel groups (Figure 8).

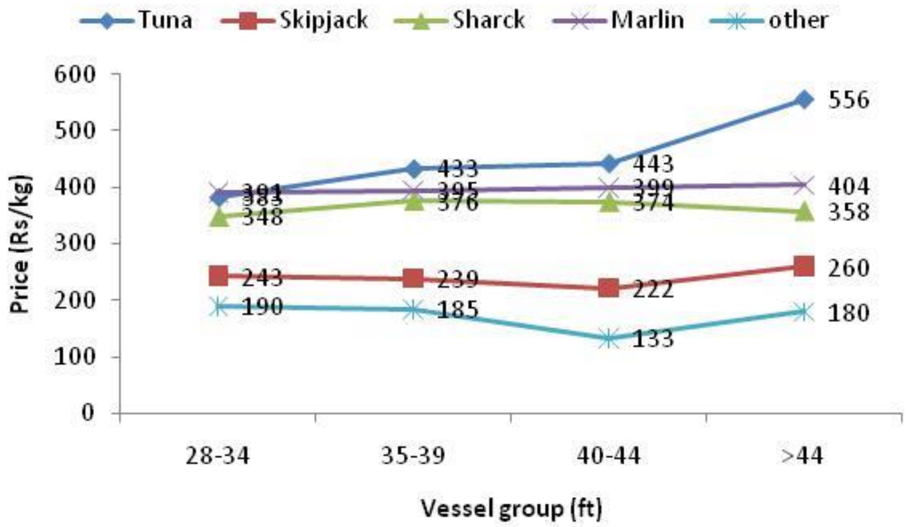

Figure 8: Price of fish (1Kg/Rs).

The largest vessels fetch noticeably higher prices for tuna than other size categories of vessels. This price could be assumed as export market price for high quality fish. The price for each group shows that for tuna and shark a small difference seems to be in prices between the smallest group and the next two but the same for the other species. The price of tuna is much higher for the >44 ft group than for the others and slightly higher for both shark and skipjack. This price difference can be attributed to high quality fish for export markets.

5.1.5 Revenue

The revenue of vessels is governed by their total catch and the unit sales price of different species of fish at the market. Normally the unit sale price of fish at the market is very sensitive to quality and quantity of fish and has direct influence on the revenue. This is in full accordance with the views of the Icelandic executives interviewed.

Annual revenue of deep sea vessels is outlined in Table 6 below.

Table 6: Annual revenue of deep sea vessels (Rs).

					95% Confidence Interval for Mean	
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound
28-34	25	7,680,717	4279159	855832	5914367	9447067
35-39	25	9,339,834	5632049	1126410	7015038	11664630
40-44	31	7,501,460	4722491	848184	5769236	9233683
>44	8	5,028,225	1679290	593719	3624303	6432147
Total	89	7,845,897	4783039	507001	6838339	8853455

There was a statistically significant difference at the p<.05 level for the 4 groups [F (3, 40.91) = 5.04, p= .00]. Post-hoc comparisons using the Games-Howell test indicated that the average annual revenue of vessels >44 ft was significantly varied from 35-39 ft vessels. The average revenue for vessels 28-34 ft did not vary that of any other size vessels from all groups. The reason for this was as said before the corresponding amount of catch of each group, the mix of species caught by each group and the corresponding unit price of fish.

5.2 Operational costs

Fuel, drinking water, ice, food and labour of the fishing trip are considered as operational cost. Yearly average operational costs of vessel groups are shown in Table 7 below.

Table 7: Annual operational cost (Rs).

					95% Confidence Interval for Mean	
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound
28-34	25	5,283,310	2566516	513303	4223904	6342716
35-39	25	6,479,400	3295707	659141	5118999	7839801
40-44	31	5,202,097	2710280	486781	4207959	6196236
>44	8	3,678,006	845850	299053	2970857	4385154
Total	89	5,446,706	2817065	298608	4853285	6040127

There was a statistically significant difference at the p<.05 level for the 4 groups [F (3, 43.13) = 6.75, p= .00]. Post-hoc comparisons using the Games-Howell test indicated that the annual average operational cost of vessels >44 significantly varied from 35-39 ft. The average cost for groups 28-34 and 40-44 ft did not vary from that of any other size vessels from all groups.
The highest operational cost is at the vessels group 35-39 ft while the lowest at the >44 ft vessel group. Operational cost of deep sea vessels was assumed to be governed by the value of material inputs and food consumed and the number of days of the trip. Further it can be predicted that these two variables have a linear relationship to each other. It can be further assumed that the cost of fuel consumption differs according to the distance travelled, the service speed and the weather condition at sea. The weather conditions are an uncontrollable factor and if the weather is rough it leads to lower service speed and an increase in fuel consumption and vice versa. If the number of sea days of the trip is high the ice usage and food consumption can be higher and vice versa. Fresh water is used for drinking and will be increased or decreased corresponding with the number of sea days of the trip.

5.2.1 Composition of operational cost of deep sea vessels (Rs)

The highest proportion of total operational cost goes to labour followed by fuel and foods while the lowest for water in all vessel groups (Figure 9). The highest fuel cost is about 41% and belongs to the group >44 ft followed by 40% both for the 35-39 and 40-44 ft groups and 37% for the 28-34 ft group respectively. These cost results differ from the previous research results of Amarasinghe (2001). The greatest difference lies in his estimate of labour cost where he states that labour cost is around 50% of the total variable cost.

Labour cost is a highly influential factor on operational costs which is totally governed by gross profit of the vessels since this is calculated as a percentage of the total gross profit, 50% for the crew and 5% for the captain. The vessel group 35-39 earned a higher average yearly gross profit than other groups resulting in increased labour cost and in turn increased operational cost. The vessel group 35-39 ft earned a higher average yearly gross profit than other groups resulting in increased labour cost and in turn increased operational cost.

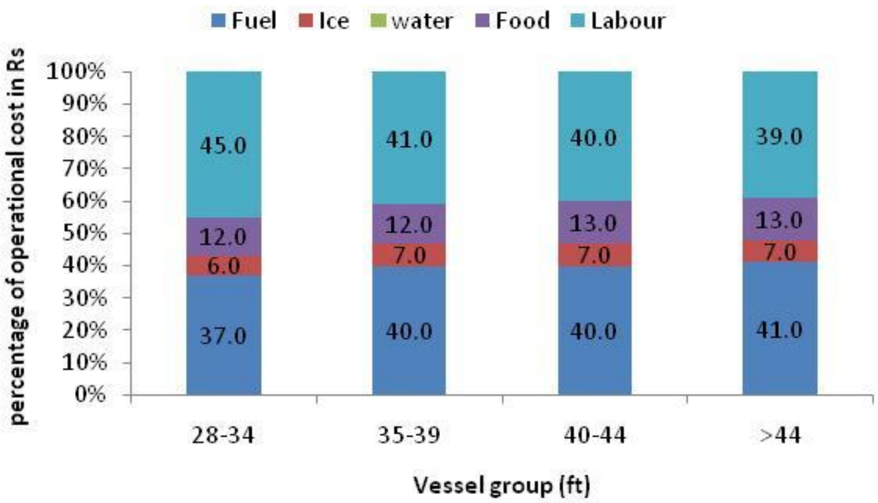

Figure 9: Operational cost of deep sea vessels (Rs).
* Cost related to water is not shown due to the small percentage.

The composition of operational costs of vessel groups shows a slight variation between the groups generally the labour and fuel costs are the major parts of the operational cost among all groups. These two cost factors collectively accounted for about 80 per cent to the total operational cost of the vessels. Food cost contributes about 13 per cent to the total operational cost. Ice cost only contributes about 7 per cent while the smallest cost; the cost of water, contributes less than 1 per cent to the operational cost.

5.3 Capital investment

Invested monetary values of vessel, engine, fishing gears and communication and navigation equipment are here assumed to be the total capital investment of the deep sea vessels. The average investment for each vessel group is shown in Table 8 below.

Table 8: Capital investment of deep sea vessels (Rs).

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
28-34	25	3,774,640	1761084	352217	3047700	4501580
35-39	25	4,454,320	1836446	367289	3696272	5212368
40-44	31	5,704,903	1519232	272862	5147644	6262162
>44	8	7,734,500	1540915	544796	6446263	9022737
Total	89	4,993,843	2026640	214823	4566926	5420759

There was a statistically significant difference at the $p<.05$ level for the 4 groups [$F(3, 28.71) = 14.48$, $p= .00$]. Post-hoc comparisons using the Games- Howell test indicated that the average capital investment of vessels 40-44 and >44 ft significantly varies from that of any other size vessels from all groups. The average value of capital investment for group 28-34 ft did not vary significantly from group 35-39 ft. The reason for this is the capital investment was assumed to be increased with the increase in size of the vessel.

5.3.1 Composition of capital investment of deep sea vessels (Rs)

The largest proportion of total investment goes to the vessels followed by the engine and gears while the lowest investment in all vessel groups is for the equipment (Figure 10).

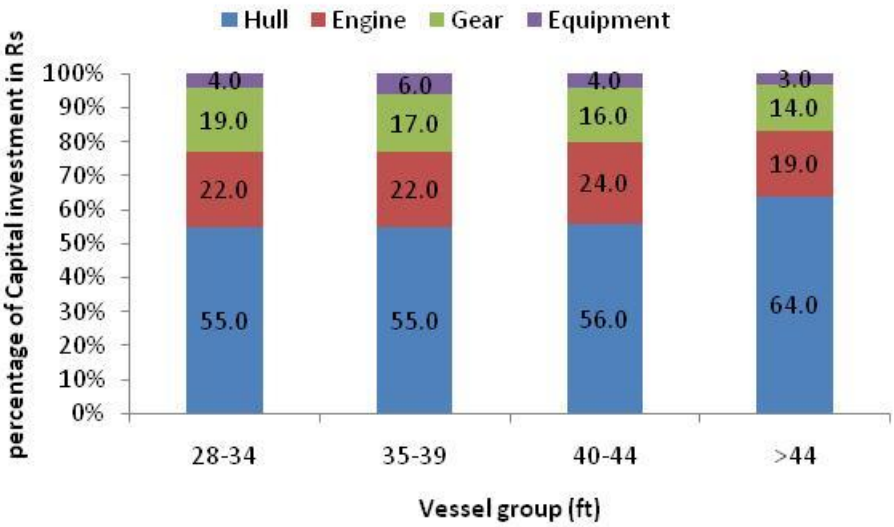

Figure 10: Capital investment of deep sea vessels (Rs).

5.4 Capital cost

The average yearly capital costs of vessel groups are shown in Table 9 below.

Table 9: Annual capital cost of deep sea vessels (Rs).

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
28-34	25	454,537	209342	41868	368124	540949
35-39	25	470,743	193399	38680	390912	550575
40-44	31	598,372	112118	20137	557247	639498
>44	8	765,245	109095	38571	674039	856450
Total	89	537,118	191382	20286	496803	577433

There was a statistically significant difference at the $p<.05$ level for the 4 groups [$F(3, 29.38) = 12.98$, $p= .00$]. Post-hoc comparisons using the Games- Howell test indicated that the annual average capital cost of 40-44 and >44 ft vessels significantly varies from that of any other size vessels from all groups. The average value for group 28-34 ft did not vary significantly from group 35-39. The reason for this differs is that if the capital investment is high the capital cost is also being higher.

5.4.1 Composition of capital cost of deep sea vessels (Rs)

A larger proportion of capital cost goes to vessels and gear among all groups of vessels whiles a very small proportion to equipment. The capital cost of engine shows more or less similar percentages in all groups (Figure 11).

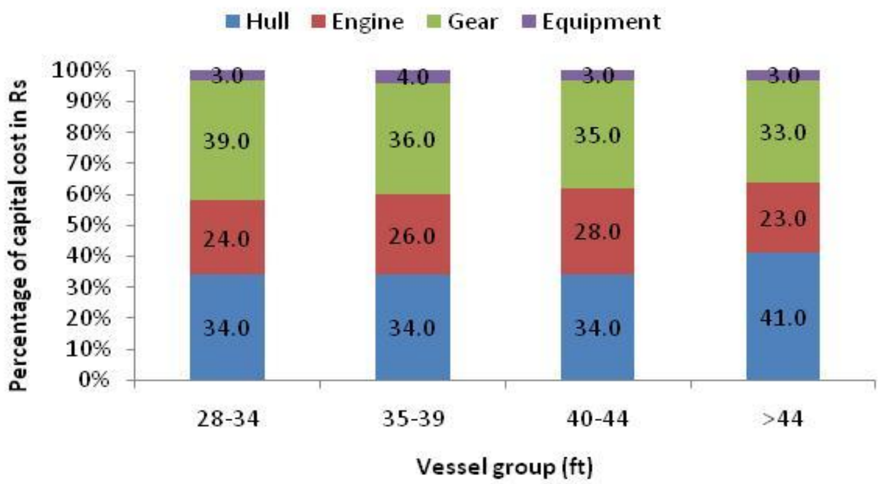

Figure 11: Capital cost of deep sea vessels (Rs).

5.5 Gross profit

Gross profit of the operation is governed by operational income and operational cost of deep sea operations. The average yearly gross profit of the vessel groups is shown in Table 10 below.

Table 10: Annual gross operational profit of deep sea vessels (Rs).

					95% Confidence Interval for Mean	
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound
28-34	25	2,397,407	1829698	365940	1642145	3152669
35-39	25	2,860,434	2495663	499133	1830275	3890593
40-44	31	2,299,363	2083661	374237	1535069	3063656
>44	8	1,350,220	1026713	362998	491866	2208573
Total	89	2,399,191	2083173	220816	1960366	2838016

There was not a statistically significant difference at the $p<.05$ level for the 4 groups [$F(3, 35.47) = 2.40$, $p= .08$]. The yearly average gross profit indicates that all 4 groups earned a positive gross profit indicating that their fishing operations were profitable. This is in accordance with Amarasinghe´s results (2001). The highest gross profit was earned by the 35-39 ft vessels group while the lowest by the >44 ft group. The reason for the lowest gross profit of > 44 group is the lower corresponding catches of this vessel category.

5.5.1 Net profit

Net profit of the vessel is totally governed by gross profit and capital cost of the vessel. The average yearly net profit of vessel groups is shown in Table 11 below.

Table 11: Annual net profit of deep sea vessels (Rs).

					95% Confidence Interval for Mean	
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound
28-34	25	1,942,870	1789224	357845	1204314	2681426
35-39	25	2,389,691	2486511	497302	1363309	3416072
40-44	31	1,700,990	2060379	370055	945237	2456743
>44	8	584,975	1067375	377374	-307373	1477323
Total	89	1,862,073	2082182	220711	1423457	2300690

There was a statistically significant difference at the $p<.05$ level for the 4 groups [$F(3, 34.69) = 3.44$, $p= .02$]. Post-hoc comparisons using the Games- Howell test indicated that the annual average net profit of vessels 35-39 ft was significantly varies from that of vessels size > 44 ft. As the capital cost of vessels gets higher the gross profit becomes lower. It was found, as could be expected, that the highest capital cost belongs to > 44 ft vessel group while the lowest for 28-34 ft. It is clear to assume that capital cost increase with the size of the vessel.

5.5.2 Return on capital investment (ROcI in Percent)

The average yearly return on the capital investment of the deep sea fisheries is shown in Table 12.

Table 12: Periodic return to capital investment of deep sea vessels (%).

					95% Confidence Interval for Mean	
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound
28-34	25	51	44	9	33	69
35-39	25	66	81	16	32	99
40-44	31	29	36	7	16	43
>44	8	9	14	5	-3	21
Total	89	44	56	6	32	56

There was a statistically significant difference at the $p<.05$ level for the 4 groups [F (3, 41.66) = 8.29, p= .00]. Post-hoc comparisons using the Games-Howell test indicated that periodic average return on capital investment vessels > 44 significantly varies from that of groups 28-34 and 35-39 but did not vary significantly from group 40-44. The average value of vessels 28-34 did not vary significantly from groups 35-39 and 40-44. Vessels 40-44 did not vary from that of any other size vessels from all groups.

Return on the capital investment is totally governed by the net profit and the amount of capital invested in fixed assets. It has to be mentioned, that the ratio used as such does only show the return for the period, which the net profit is calculated. The highest return on the capital investment was realised by the 35-39 ft group followed by the groups 28-34 and 40-44 ft while the lowest for >44 ft group. This was due to difference in net profit earned and different amount of invested capital by each group. The highest average capital investment was by far found by the > 44 ft group followed by 40-44, 35-39 and 28-34 ft groups.

5.6 Problems in deep sea fisheries

The captains were asked to offer their perceptions on the barriers they are facing in the deep sea fisheries. They were able to give more than one answer. The answers were then categorised into the five themes and the category of “no idea” as is shown in Table 13 below.

Table 13: Problems in deep sea fishing.

	Frequency	Percent	Valid Percent	Cumulative Percent
Lack of harbour services	11	12.4	12.4	12.4
Fluctuation of fish price at the market	18	20.2	20.2	32.6
Poaching of foreign vessels on EEZ in Sri Lanka	23	25.8	25.8	58.4
High operational cost	10	11.2	11.2	69.7
Getting arrested by other countries	6	6.7	6.7	76.4
No idea	21	23.6	23.6	100.0
Total	89	100.0	100.0	

The highest problem with captains (26%) was foreign fishing vessels, poaching in Sri Lankan EEZ. They claimed that their fishing nets were damaged and physical damages had occurred to their vessels as well. In many occasions in the past fishermen and fishermen´ organizations have staged protests against the authorities to compel them to take measures to prevent poaching of foreign vessels. Thordarson (2008) in his study on the value chain of yellow fin tuna in Sri Lanka found that foreign fishing vessels by their operations were seen threatening the profitability of deep sea fishing companies in Sri Lanka.

Nearly 21% of captains found that fluctuation of selling prices of fish at the landing centres as a problem in deep sea fisheries. The lack of competition at the markets, due to the small number of buyers, was found to be the main reason for this price fluctuation. They claimed that export oriented tuna prices were distorted by export agents hiding important market information. This supports the importance, in accordance with the Icelandic benchmarking, of the necessary role of the active fish markets and the necessity for easy access to market information.

Nearly 13% of the vessel captains claimed that they had problem with poor harbour services. Lack of fresh water, ice and fuel were major issue for them. Inadequate harbour services may have delayed the start of fishing operations. It can be helpful to see how the Icelandic fish markets and harbours activities are designed so as to minimize these issues.

Nearly 12% of the captains had problem with the country's rising material input prices. They claimed that increased fuel prices at the market had had major effect on the increase of the operational cost of fishing.

Nearly 7% of the captains also feared crossing country boarders and getting arrested by other neighbouring countries. Sri Lankan vessels and fishermen were arrested and detained by other countries claiming that they were crossing EEZ boarders illegally and later released, most of the time without legal actions. Captains claimed that in many occasions they were taken even though they were in Sri Lankan EEZ. Kumara (2001) studied the detention of fishermen in custody of other countries and found that several social problems had created to their families in absence of husbands. The captains stated that the lack of modern technological equipment and knowledge caused their unwanted crossing of borders.

6 ANALYSIS OF THE BENCHMARKING INTERVIEWS

For many years senior managers in business companies all over the world have used benchmarking intensively as quality management tool. Although a universally accepted definition cannot be found the essence of benchmarking might be summarised as "*benchmarking is the process by which organizations learn, modelled on human learning process"* (Watson 1993). It shows the need of understanding of the organization business process and governing process enablers for the improvement of the performance. The interviews conducted revealed that many significant changes have taken place in the Icelandic fishing companies and their marketing process over the years. Collected information was summarised as follows in line with identified changes.

6.1 Fish processing companies

6.1.1 Importance of quality aspects of the products

Four fish processing company managers mentioned that the attribute of quality and maintaining quality standards of products is of critically importance to the companies. They experienced that quality attributes of the products is highly connected with market demand and price of the product. Further they emphasised that the maintenance of quality should be started immediately after the harvesting of fish. Proper handling, cooling and icing as well as storing are needed to maintain quality of fish aboard the vessel. For storing fish all the companies used tubs, which are produced with insulation for maintaining of quality. All the companies have their own vessels operating in deep sea fisheries and adequate quotas. The vessel captain and his assistant are responsible for the handling of fish aboard the boat until they unload them at the harbour. They have to follow all necessary steps and the company guidelines, which were recommended for maintaining quality of fish at the sea. All vessels are equipped with necessary equipment and materials for maintaining quality of fish. Apart from the above measures in maintaining quality of products all companies have taken measures to reduce the duration of the fishing trip to maximum of five days.

In 4 factories quality control processes have been improved by deploying well trained quality control teams under the supervision of a quality control manager. Overall, the companies' attitudes have shifted towards enhancing quality of products instead of quantity.

6.1.2 Importance of continuous product supply to buyers

Four fish processing companies visited have realized that continuous supply of raw materials to their factories as well as processed products to buyers are very important for the growth of the company and its market share in the industry. Existing quota management system enables them to have quota since many years, which benefitted them in acquiring enough raw materials for their production process. If the company does not have enough own quota it can be get quota on rental basis from others. Some companies have successfully been practicing the culture of fish in the supporting of continuous supply of raw materials to the production process. All companies categorically accepted that the quota system always assures continuous supply of raw material for the production process resulted in stabilizing the market supply.

6.1.3 Importance of vertical integration

A very important distinguishing feature of all the fish processing companies was the status of collaboration with marketing companies to sale their production. In these four cases the processing companies did not undertake direct marketing of products to buyers and consumers. These marketing activities were done through marketing companies. In some cases the Icelandic fishing companies are taking care of their marketing activities themselves through vertical integration. In all those four cases the producers were vertically integrated in processing and harvesting giving the opportunity to control the flow of the raw material according to the marketing demands'.

All the fish processing companies had a good link with the fish markets, and for marketing information, always use modern electronic communication equipment and direct meetings. They emphasised that acquiring of real time marketing information is very important and that can even better be achieved through vertical integration. Due to high degree of vertical integration in Icelandic fish industry managers in the industry maintains that they can better manage the marketing effort, quickly react to the markets signals and thus better fulfil the customer's requirement (Knútsson, *et.al*. 2009) Furthermore Knútsson *et al.* (2009) claim that the Icelandic fish industry has gone through development were it is becoming marketing driving, using information from the markets to control the flow of raw material through fishing and production. For achieving this, vessels have shortened their fishing trips putting more emphasis on bringing in raw material of higher quality.

6.1.4 Importance of targeting export market and price

The fish processing companies had targeted specific export markets for their products while not focusing the local market. Local market supply of all companies was less than 1 percent of their annual production. Export markets could be characterized as fresh, frozen and salted but presently more emphasise was given to fresh fish which fetched a higher price at the consumer markets, especially in Europe. Export market prices of Icelandic fish products have been increasing since last decade partly due to increase in quality attributes of the products and the companies´ better understanding of their consumer requirements.

6.1.5 Importance of competitive position compared to other countries

All the processing companies are profitable. They are competing with rivals who produce similar fish products in other countries. Some interviewees mentioned that they had succeeded in making commitments with new buyers who were earlier dealing with Norwegian producers. All companies had achieved their position in the industry through the quality of their products and by vertically integrating the marketing function thus continuously being able to supply buyers with their products.

6.2 Fish markets

6.2.1 Fish auction company

According to the executive of the computer service company that handles the all the online marketing of fish in Iceland almost half of the Icelandic fish production is sold through the auction markets annually. The Reiknistofa Fiskmarkaða hf (RSF) is the computer service company that handles the Icelandic fish auction connecting with 168 auctions located in 30 places in to one network. It conducts daily auction where the 200-300 buyers connect online remotely. The company collects payments from buyers and disburses to sellers and other relevant authorities. The RSF does not handle fish itself but specialises in fish auctioning. The company presently takes one percent commission from sales revenue for the maintaining its services and covering up of its expenses. Buyers need to have a bank guarantee or pay in advance to buy fish through the online auction. The buyer is given a registered number and using it buyer can log on to the system to buy fish remotely. Auction- clock is used to show the details of fish and handle of the auction. The company is the only company in Iceland handling the fish auctioning system and the company management is optimistic with reliability and accuracy of the ongoing auctioning system.

6.2.2 The Fish market in Ísafjörður

The Ísafjörður fish market operates 6 days of the week except Sunday. This fish market is linked into the Icelandic fish auctioning system. Auctioning of fish is handled by the Icelandic fish auctioning company (RSF) and payment for the services provided by the fish market is disbursed. All fish sold at the market should be graded and iced by vessel captains but if buyers request market officials take the responsibility to add more ice on the fish. Market officials often check the fish graded by the vessel captains to verify the accuracy of the information. The market manager interviewed explained that some complaints have been received in the past regarding a mismatch of the grading of fish in the fish boxes. The market officials are responsible for the distributing of fish to buyers but do not take responsibility for checking or maintaining the quality of the fish. At the same time they take full measures in carefully handling the fish at the market premises. The market manager assured the interviewer that the existing online fish marketing system is quite accurate as well as a convenience to buyers since they can, even from their home, participate in the auction. Because of the online fish marketing system the operational cost of fish markets has been reduced dramatically due to the low requirement of staff.

6.3 The Sri Lankan relevance

The benchmarking interviews at the Icelandic fisheries companies pointed out, clearly, that a lack of collaboration between actors in the value chain can be harmful for the profitability of the industry in Iceland. This implies that a collaboration of the state, vessel owners and other stakeholders is necessary for improvement of the profitability of deep sea fishing operations. For this to happen in Sri Lanka either a vertical integration of companies is needed, privately owned or owned by the state, or a closer collaboration of the harvesting companies with export agents and the marketing entities become a reality.

Through their vertically integrated value chain structure, some of the Icelandic companies were able to market their own products directly to buyers and thus make a better profit. This can be applied to the Sri Lankan deep sea fisheries by promoting more vertical integration of companies, combining deep sea fish harvesting, processing and even the marketing functions within a company. This will probably lead to the improvement of the quality of products and the possibility of maintaining continuous supply to the market. For the yellow fin tuna industry, which presently mostly targets sashimi in Japan, this can be extremely important in its development. This will, through better quality products assure the constant supply to the export markets and bring a higher unit price at the markets.

The benchmarking interviews at the Icelandic companies clearly showed that a constant supply to markets is very important for the profitability and the maintaining the market segment of the company. The interviewees pointed clearly out that getting real time marketing information is very important for the control of the right quality of raw materials and products. This implies that a real time marketing information system is also necessary for an efficient operation of the value chain. In Sri Lanka this can be acquired through establishing a central body, possibly under state supervision, coordinating fish markets operations and enabling the necessary dissemination of market information to relevant parties.

The importance of product quality for the companies was also a major factor for the effectiveness of the Icelandic fishing companies. This implies that both onboard fish handling immediately after the harvesting and quality control in the processing of the catch has a critical impact on the quality of raw materials and processed products and therefore the unit price at the market. The practicing of quality standards for onboard fish handling and the processing is thus necessary for the improvement of both catch and product quality. In order to realize major quality improvements in the Sri Lankan deep sea fishing industry quality awareness or training programs, educating both crew members on onboard fish handling and fish production workers and managers on hygiene, quality and quality standards in fish processing.

7 CONCLUSION AND RECCOMENDATIONS

The introduction of deep sea vessels into Sri Lankan fisheries in the late 1980s has lead to an increase in catch from about 8,000 t in 1989 to about 109,000 t in 2008. The MDOVs in operation vary in lengths, degree of sophisticated equipment and in fishing efficiencies. Bimodal pattern of monsoons, the North east and the South west has given rise to three different areas of fishing operations. The number of fishing trips of a year has inverse relationship with the size of the vessels. The Tsunami on the 26^{th} of December 2004 destroyed 195 vessels and damaged 402 vessels thereby making a setback to the development of the deep sea fisheries.

According to the findings of this study all vessels groups operating in the deep sea fisheries have earned net profits indicating that the fishing operations are profitable. The 35 to 39 ft vessel group followed by the 28 to 34 ft group earned the highest net profit. The lowest net profit was earned by the > 44 ft vessel group. The 35 to 39 ft vessels group is the most profitable group and also the smallest group made up of 28 to 34 ft also seems to be very compatible. This indicates that the smaller vessels are more economical for the deep sea fisheries in Sri Lanka. In terms of periodic (yearly) return on the capital investment, the highest, 66%, was earned by the 35-39 ft vessel group followed by 28 to 34 ft and 40 to 44 ft groups earning 51 and 29% respectively. The lowest, 9%, was earned by the > 44 ft vessels group.

The study shows that revenues are highest for the group size 35-39 feet and lowest for the biggest vessel or over 44 feet. No clear explanation can be found to this but the vessel over 44 feet gets the highest price for the Tuna of all the groups which could indicate that they are targeting the export markets or bring in higher quality of Tuna. In contrast to this finding the vessels over 44 feet has the fewest hooks on the lines and seam, according to Table 3, to depend more on gillnet. The total catch of the vessels over 44 feet is only around 54% of the total catch of the smallest vessel group and only 46% of the vessels group 35-39 feet.

The composition of the operational costs differs slightly between the vessel groups. Still, the main cost item was labour, it contributed about 39 to 45% followed by fuel contributing about 37 to 41% to the total cost. Food cost contributes about 12 to 13% while ice is about 6 to 7% to the operational cost of vessel. The lowest cost was for water that contributed only about 1% to the operational costs of all vessel groups. The study results show that the total cost is highest for the group size 35-39 feet and surprisingly lowest for the biggest vessel or the group over 44 feet. The group sizes 28-34 and 40-44 are similar in cost.

Results of the study have revealed that the highest proportion of capital investment is for the hull followed by engine, gear and equipment in sequence in all groups. About 55 to 64% of total capital investment for the different vessel groups was for the hull followed by 19 to 24% for the engine, 14 to 19% for gear and 3 to 6%, for equipment respectively. Not surprisingly the biggest vessel was the most capital intensive group and then the capital intensity decreases in accordance the shorter size of the vessel groups.

According to the captains the critical factors of operations are many and some of them, in their opinion, are out of their control. As an example, because of incomplete information and lack of harbour services the market price is lower than necessary. The captains also complained about the low and fluctuating price on the fish markets. Further research is needed to study the reasons for this, whether that comes from the lack of transparency of the pricing of fish on the markets or the lack of quality or instability of the quality of the fish.

Other critical factors in the operation of the deep sea fleet in Sri Lanka are the poor results that vessel over 44 feet show in this study. The questionnaire survey on the four vessel groups found that revenues, costs, profits and return on capital investment for the group of > 44 ft seems to be relatively uneconomical compared to the smaller vessel groups. It is not clear whether this is due to a small sample size of the survey. It is therefore recommended that a special study should be conducted on the economic feasibility of larger vessels for the deep sea fisheries in Sri Lanka.

The benchmarking with Icelandic fish industry unveiled that importance of quality and steady supply of raw material in right quality is important. The Icelandic fish industry has gone through development were it is marketing driving using information from the markets to control flow of raw material through fishing and production. In archiving this vessels have shorten their fishing trips putting more emphasis on bringing in raw material in higher quality. Fish markets plays big role in this were information about price and bidding is open and electronically accessible. Part of this development is also high vertical integration between harvesting and production sector in the Icelandic industry giving the managers better opportunity to synchronise the flow of raw material to processing and markets. It is recommended here the Sri Lankan fish markets could learn from the Icelandic benchmarking by increasing it transparency of pricing supporting better understanding of connection between price and quality.

This study indicates that the profitability of the deep sea fisheries operations in Sri Lanka can be further increased if collaboration and cooperation between all necessary stakeholders can be developed. According to the benchmarking with the Icelandic executives it is recommended that the possibility of introducing more vertical integration of companies in the deep sea fisheries value chain should be explored. This could be valuable for the development of the deep sea fisheries in Sri Lanka.

In this study only one form of a company fishing strategy, individual fishing, was studied. It is concluded and recommended here that a study on the possibilities of a collective fishing strategy should be conducted comparing it with the benefits of the individual fishing strategy. From this, recommendations of changes in the operation strategy of the deep sea fleet of Sri Lanka could be suggested. The critical factors of the deep sea fisheries of Sri Lanka should be studied more fully as it is important to further conduct a study on the quality of the catch to get a holistic view on the operation and the efficiency of the deep sea fleet.

This study has fulfilled all its objectives and, even if the quality of the data used has not been as solid as the author had hoped, the survey results and the interview answers have given interesting indications of the economic efficiency of the vessels used in the deep sea fishing industry in Sri Lanka. It is hoped that the conclusions can be used as a management tool for the improvement of these fisheries.

ACKNOWLEDGEMENTS

I would like to thank the United Nation University for giving me a fellowship to participate (UNU-FTP) fisheries training programme in Iceland. If not for the invitation of attending this program from Dr.Tumi Tómasson, director of the UNU-FTP programme, I would not have had the opportunity to finish this thesis and therefore, my heartiest thank goes to him.

My sincere gratitude especially goes to Mr. Þór Ásgeirsson, Deputy Director of the programme and Mrs. Sigríður Kr. Ingvarsdóttir, the Programme Officer, for their invaluable support and encouragement they provided me to complete this programme successfully. I would like to extend my thanks the Director of marine research institute (MRI), Iceland and his staff for their warm welcome and assistance. My sincere thank to my two supervisors, Professor, Ögmundur Knútsson and Mr. Helgi Gestsson for their excellent and invaluable guidance given to me.

I like to thank Mr. Gunnar Thordarson and his wife for their fullest support and encouragement given to me. Also I thank Mr. Bjarni Eiriksson for his kind supports during my stay in Akureyri. I extend my sincere gratitude to all the company managers and representatives who accepted to be interviewed by me and provided me with valuable information during my benchmarking interviews in Iceland. My sincere thank goes to the staff of University of Akureyri, Iceland, for their warm welcome and assistance.

I would like to extend my gratitude the Chairman and Director General of National Aquatic Resources Research and Development Agency (NARA), Sri Lanka, for nominating me for this training programme. I would also like to extend my thanks the staff of the Socio-economic and Marketing Research Division of NARA for their excellent assistance in field data collection.

Finally, I should remember my wife Tharanga Ekenayaka and daughter Asalisa Kariyawasam.

LIST OF REFERENCES

Amaralal, L. (2004). *Market structure and key success factors in fish marketing and distribution in Sri Lanka*. Unpublished M.Sc. dissertation, University of Tromso, Norway.

Amarasinghe, O. (2001). Economic and social implications of multi-day fishing in Sri Lanka. “In proceedings of coastal communities and Indian Ocean future”. Indian institute of technology, Chennai, India.

Bhimani, C.A., Srikant, M. T., Foster, G. (2008). *Management and Cost Accounting*. 4^{th} ed. Prentice Hall.

CIA n.d. *The World Factbook – Sri Lanka*. [February 22, 2010] https://www.cia.gov/library/publications/the-world-factbook/geos/ce.html

Gulbrandsen, O. (1998). *Marine fisheries development – Tuna Long liners.* Food and Agriculture Organization, Field Document SRL/91/022. Bangkok.

IOTC. Indian Ocean Tuna Commission (2009). *Report of the eleventh session of the IOTC working party on Tropical Tunas.* Kenya.

Kumara, H. (2001). Issues related to deep-sea fishermen and their families due to detention in foreign countries. “In proceedings of coastal communities and Indian Ocean future”. Indian institute of technology, Chennai, India.

Knútsson, Ö., Klemenson, Ó. and Gestsson, H. (2009). *Changes in strategic positioning in the Icelandic fish industry´s value chain* Ingjaldur Hannibalsson (eds.): *Rannsóknir í félagsvísindum X (Researches in the Social Sciences X).* Reykjavík: Institute of Social Sciences.

Lane, D.E. (1988). Investment decision making by fishermen. *Canadian Journal of Fisheries and Aquatic Sciences* 45: 782-796.

Maldeniya, R. and Amarasooriya, D. (1998). *Tuna fisheries in Sri Lanka. Indian Ocean Tuna Commission (IOTC) Proceedings 1* : 21-25.

Maldeniya, R. and Suraweera. (1991). *Exploratory fishing for large pelagic species in Sri Lanka.* Bay of Bengal Programme (BOBP), S.L. BOBP Technical Paper 47. Colombo, Sri lanka.

Ministry of Fisheries and Aquatic Resources (MFAR). (2007). Census of fishing boats 2006/2007 Sri Lanka, Colombo, Sri Lanka: MFAR.

National Aquatic Resources Research and Development Agency (NARA). (2008). *Sri Lanka Fisheries Yearbook 2007*. Crow Island, Colombo, Sri Lanka: NARA.

Pajot, G. (1993). *Small Fishing Boats in Sri Lanka*. Bay of Bengal Program (BOBP), Technical Paper 61. Madras, India.

Richardson, S.A., Sloan, R.G., Soliman, M.T., Tuna, I. (2005). Accrual reliability, earnings persistence, and stock prices. *Journal of Accounting and Economics* 39:437–485.

Thompson, A.A., Strickland, A.J. and Gamble, J.E. (2010). *Crafting and Executing Strategy*. 15th ed. New York: McGraw-Hill/Irwin.

Thordarson, G. (2008). Value chain of yellow- fin tuna in Sri Lanka. Unpublished M.Sc. dissertation, University of Bifrost, Iceland.

Watson, H. (1993). *Strategic Benchmarking.* USA: John Wiley and Sons, Inc.

Willmann, R. (2001). International instruments for managing fisheries in the Indian Ocean. "In proceedings of coastal communities and Indian Ocean future". Indian institute of technology, Chennai, India.

Appendix 1

Study of Cost of Production of Fishing Operation

DFEO Division: **FI Division:**

Landing Centre **Date:**

Name of Respondent:

1. Ownership of fishing assets

	Type of Craft		
	Multi-day	One day (in-board)	One day (out board)
Number of Crafts			
Brand of Engine			
Engine HP			
Fishing Gears			
Drift Net			
Set Net			
Tuna Long Line			
Shark Long Line			
Troll Line			
Hand Line			
Bottom Long Line			
Purse Seine			
Ring Net			
Trammel Net			
Other			

2. Capital investment

Cost Item	Type of Craft		
	Multi-day	One day (in-board)	One day (out board)
Hull			
Engine			
Fishing gear			
GPS			
Radio set			
Installation			
Other			

3. Annual expenditure

Cost Item	Type of Craft		
	Multi-day	One day (in-board)	One day (out board)
License			
Insurance			
Berthing/landing fees			
Loan interest			
Repair & maintenance			
Caretaker's wages			
Non-durable goods			

4. Capacities of Craft

Specification	Type of Craft		
	Multi-day	One day (in-board)	One day (out board)
Boat length			
Fuel tank			
Water tank			
Ice storage			
Fish storage			
Gross tonnage			

5. Operational expenditure*

Cost Item	Type of Craft		
	Multi-day	One day (in-board)	One day (out board)
Fuel			
Ice			
Water			
Food			
Bait			
Berthing/landing fees			
Fish unloading fees			
Crew share-skipper			
Crew share-mates			
Marketing commission			
Other			

* Information based on previous fishing operation

6. Fish production & income of previous fishing operation

	Type of Craft					
	Multi-day		One day (in-board)		One day (out board)	
	Catch (kg)	Revenue (Rs)	Catch (kg)	Revenue (Rs)	Catch (kg)	Revenue (Rs)
Tuna						
Billfish						
Shark						
Demersal fish						
Small pelagic						
Shell fish						
Other						

6. Average number of fishing days/trips operate in a month

	Type of Craft		
	Multi-day	One day (in-board)	One day (out board)
Season			
Off-season			

7. What sort of problems do you encounter in connection with fishing operation?

----

8. Any other remarks

Appendix 2

A Benchmarking study on Icelandic multi day boat fisheries

(Questions to be used in the interviews of company managers)

1. Can you tell me a bit about your company history and operations today?
2. Can you tell me about yourself and your position in the company?
3. Can you tell me your views on importance of quality of catch/products of your company?
   i What measures did you implement to maintain the quality of your products?
   Ii How do you continue those measures regularly?
   Iii What measures do you use to identify quality standards?
   Iv What types of attributes do you use to standardise quality of your products?
   V What is the relationship between price and quality?
   Vi Is this relationship always true?
   Vii How do you maintain this relationship with your products?
   Viii Does your company have competitive advantage in the market through this relationship?
4. Can you explain what the key cost factors of your operations are and how you manage them?
   I what is the trend of operational costs of your company in fast few years?
   Ii What are the main operational cost factors and what percentages they represent in the total operational cost?
   Iii What measures do you follow to maintain the present trend?
5. Can you explain the way you manage your/rental fish quotas and scheduling of fishing?
6. Can you tell me how do you use marketing information in selling and distributing of your products?
   I what kind of marketing systems do you use to market your products?
   Ii How do you communicate with buyers and sellers?
   Iii How do you get marketing information on quality and price?
   iV How do you maintain your market segment?
   V What are your value chain components?
   Vi What is the contribution each support to the value addition to the product?
   Vii Which kind of management integration your company practice in the market?
7. What do you consider as key success factors of your company and how did you achieve them?
   I Quality of catch
   Ii Access and management of quotas
   Iii Skilled employees, skippers and mates
   Iv Employees, skippers and mates turn over from the company
   V employees, skippers and mates contribution to the management decisions

Appendix 3

A Benchmarking study of Icelandic multi day fish markets

(Questions to be used in the interviews of market managers)

1. Can you tell me a bit about your company/market history and operations today?
2. Can you tell me about yourself and your position in the company/market?
3. Can you tell me your views on importance of quality of catch/products of your company/market?
   i What measures did you implement to maintain the quality of your products at the market?
   Ii How do you continue those measures regularly at the market?
   Iii What measures do you use to identify quality standards?
   Iv What types of attributes do you use to standardise quality of your products at the market?
   V What is the relationship between price and quality at the market?
   Vi Is this relationship always true?
   Vii How do you maintain this relationship with your products at the market?
   Viii Does your company/market have competitive advantage in the market through this relationship?
4. Can you explain what the key cost factors of your operations are and how you manage them?
   I what is the trend of operational costs of your company in fast few years?
   Ii What are the main operational cost factors and what percentages they represent in the total operational cost?
   Iii What measures do you follow to maintain the present trend?
5. Can you explain the way you manage your market segment / quotas and services after selling?
6. Can you tell me how do you use marketing information and new technology in selling and distributing of your products?
   I what kind of marketing systems do you use to market your products?
   Ii How do you communicate with buyers and sellers?
   Iii How do you get marketing information on quality and price?
   iV How do you maintain your market segment?
   V What are your value chain components?
   Vi What is the contribution each support to the value addition to the product?
   Vii Which kind of management integration your company practice in the market?
   Viii How do you get your supplies regularly?
7. What do you consider as key success factors of your company/market and how did you achieve them?
   I Quality of catch
   Ii Access and management of marketing information
   Iii Skilled employees
   Iv Employees turn over from the company/market
   V employees’ contribution to the management decision