

## **DEEP SEA FISHING IN SRI LANKA**

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### **ABSTRACT**

The deep sea fisheries in Sri Lanka have been in existence since the late 1980s. After 2000 a significant growth has been experienced in the industry. This has mostly been due to the rapid increase of new vessels with modern technology and the development of export market opportunities. The Sri Lankan deep sea fishing totalled 102 kMT in 2008 or around 41% of the country's marine fisheries catch that year. The authors' research aimed at both determining the economic efficiency and estimating critical operational factors for different length groups of the deep sea fisheries vessels operating in Sri Lanka. Building on studies from Merrilene Peramune in 2005 and Gunnar Thordarson in 2008, a new interview survey was conducted. A cross sectional questionnaire survey interview data, taken during January through August of 2009 on operating costs, income and trip length of deep sea vessels was undertaken in order to collect data from a convenience sample. The sample consisted of 89 captains operating on multi-day boats out of the 3,318 deep sea vessels operating in 2008. The findings suggest a strong link between size and revenue supporting earlier conclusions that most of the multi-day boats (smaller than 40 feet) are unsuitable for providing fish quality fulfilling export standards. This is mostly due to the poor fish preservation systems of the smaller deep sea vessels and the lack of coordinated fishing and marketing. It is suggested that in order to improve the quality of the catch collective fishing and information sharing should be implemented.

### **INTRODUCTION**

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 Sri Lankan state decided to expand fish production by introducing multi-day offshore fishing vessels (MDOV) in the late 1980s for the development of Sri Lankan offshore fisheries.

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.

This paper intends to present a description of the multi-day offshore fishing technology introduced into Sri Lankan fisheries and its economic efficiency. This study is based on the results of field studies carried out representing all types of vessels operating out of seven fishery harbours of Sri Lanka. All vessels

registered for deep sea fisheries were in the study categorized into 4 groups according to their size; 28-34ft, 35-39ft, 40-44ft and >44ft. This categorization was decided on after considering the available technical recommendations suggested by previous studies of the deep sea fisheries in Sri Lanka.

A convenience sample of 100 MDOVs captains were interviewed during the time period of January to August 2009. 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 analysis of this study was done with SPSS (17) software package and some graph were developed using Microsoft Excel software package. The highest proportion of total operational cost goes to labour followed by fuel and foods while the lowest for ice in all vessel groups. The average net profit showed that all size classes operated with profit.

### **HISTORY AND DEVELOPMENT OF SRI LANKAN MULTI-DAY OFFSHORE FISHING**

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 crew members (Amarasinghe, 2001).

The main areas and seasons of operation of the MDOVs' within and outside the Sri Lanka's EEZ are shown in Figure 1.

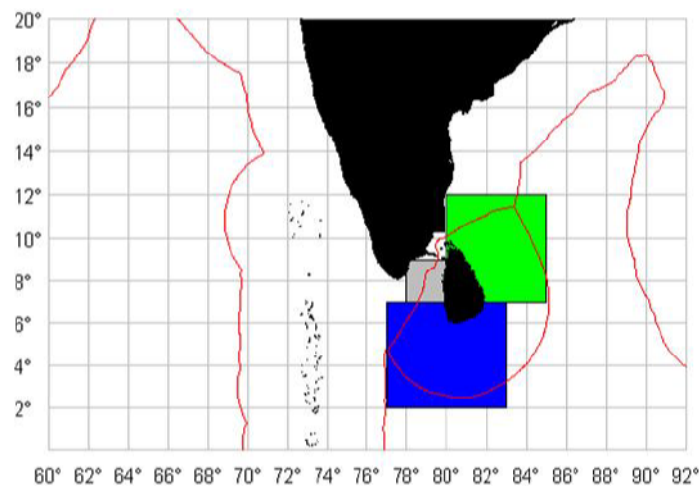


Figure 1: Areas and seasons of operation of MDOVs' in Sri Lanka

Deep sea fisheries in Sri Lanka operate mostly in 3 areas (indicated by the 3 colours in Figure 1) 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. 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).

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 equipments. The lengths of these vessels generally vary from 28 to 60 ft and they are powered by inboard-engines. 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 they are facilitated by a water tank, two fuel tanks, an ice hold, a fish hold and a cabin for crew members. 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 33-44 ft. Most of the time vessels > 44 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.

The average number of trips per year for 28-34 ft group was found to be 27 followed by 21 for the 35-39 ft, 14 for the 40-44 ft and 12 for the >44 ft vessels groups respectively. The number of sea days and fishing days per trip is governed by the distance to the fishing area, the number of days that the fish can maintain export quality on ice or in the chill baths. The bigger vessels which have chill baths can sail long distance having more sea days and fishing days. The highest number of days of a trip and actual fishing days of a trip are seen for the > 44ft group while the lowest is found for the 28-34 ft group. The highest number of trips a year is 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.

### **Number and age of operating vessels**

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 2 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.

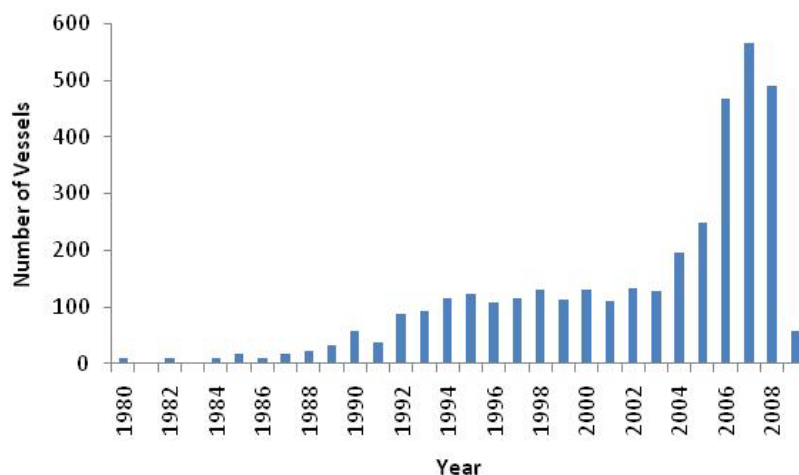


Figure 2: Registration year of vessels operating at the end of September 2009

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 sea 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 3 presents the age of registered vessels of the 4 categories: 28-34, 35-39, 40-44 and >44 ft.

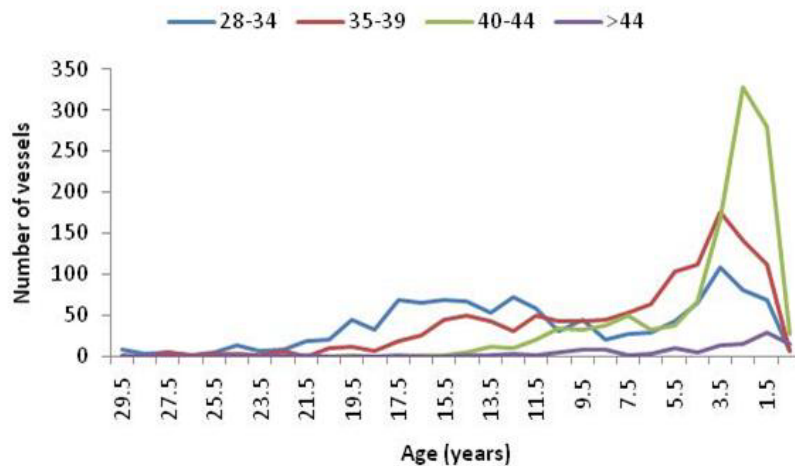


Figure 3: Present age composition of deep sea vessels by size groups (in feet). Age 0.5 represents newly registered vessels of 2009 while 29.5 for year the vessel registered in 1980.

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.

### 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 platypterus*), 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 criticized 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 4 below the annual total fish catch of the country and its trend are shown based on official catch statistics.

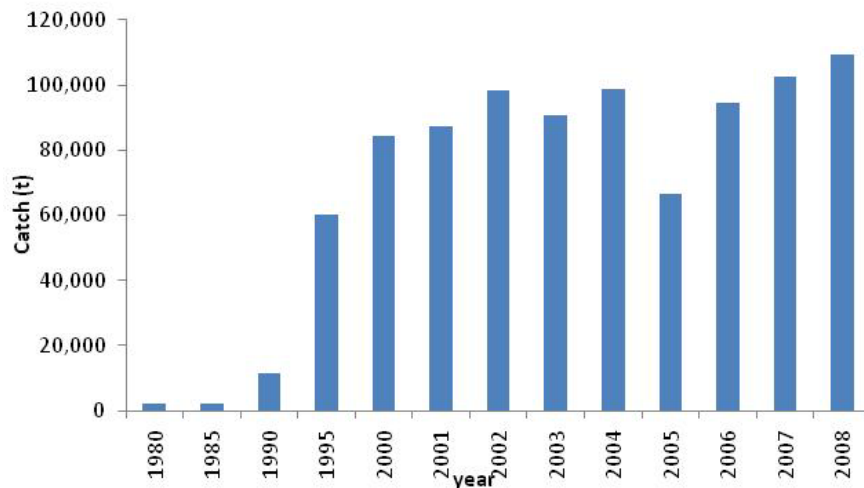


Figure 4: Annual Sri Lankan deep sea fish catch (t) 1980-2008

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 2), 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.

### 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 value chain (Figure 5)

**The value chain of deep sea fisheries of Sri Lanka**

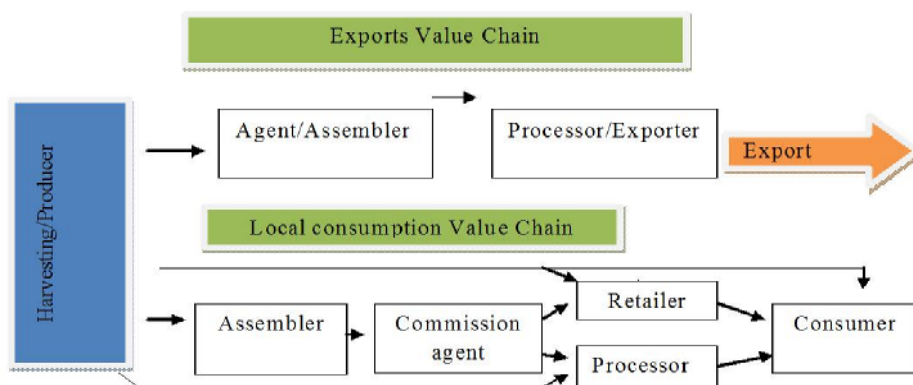


Figure 5: Value chain of the deep sea fisheries in Sri Lanka

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.

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.

## STUDY DESIGN AND LIMITATIONS

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. 100 vessel captains were interviewed by NARA officials from January to August 2009. Some captains were unaware of the capital investment of the vessel so that information had to be gotten from the vessels owner.

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.

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 guaranteed than with the individual fishing. In the 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 had 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 had some effect on the results of the study.

## ECONOMIC EFFICIENCY OF DEEP SEA FISHING

### Catch and the Price

Figure 6 shows that the highest proportion of the catch in all vessel groups is yellow fin tuna, up to 60% while the second highest proportion is Skipjack. Of the total catch proportions of marlin and other species are more or less similar in all vessels groups. The reason for this is yellow fin tuna and skipjack tuna are the dominant varieties in normal in deep sea catch.

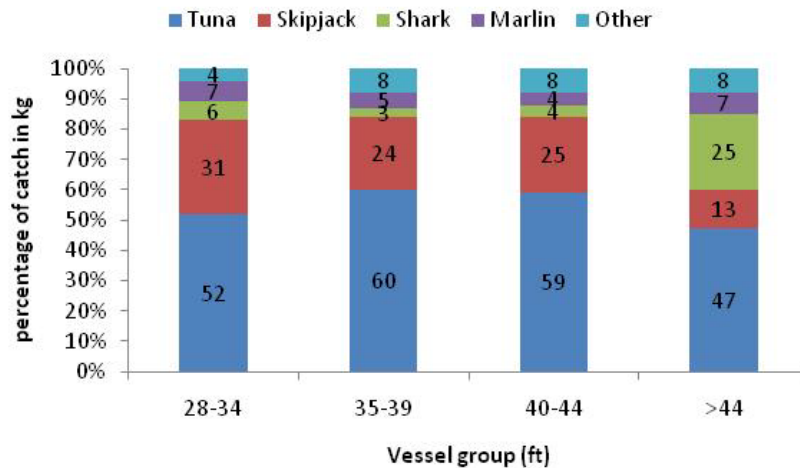


Figure 6: Catch composition (Kg)

Larger vessels normally target yellow fin tuna for export markets due to their high prices at the export markets. Figure 7 shows that the largest vessels fetch noticeably higher prices for yellow fin tuna than other size categories of vessels. This price could be assumed as export market price for high quality fish.

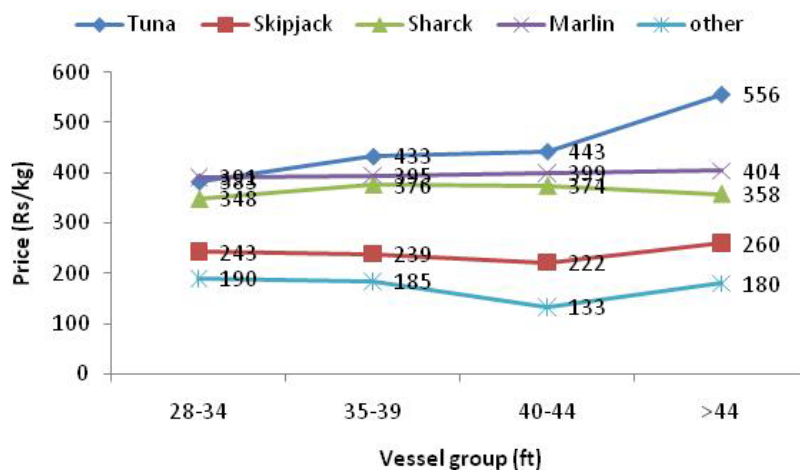


Figure 7: Price of fish (1Kg/Rs)

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.



### Cost of Vessel

Cost of the vessels generally varies according to the length of the vessels, as shown in Table 2. In general, the hull, engine and gear and accessories are represented of the cost of the vessels.

Table 2: Average cost of vessel (Rs)

Item	28-34 ft	35-39 ft	40-44 ft	>44 ft
Hull	2,076,052	2,449,876	3,194,746	4,950,080
Engine	830,420	979,950	1,369,177	1,469,555
Gear	717,181	757,234	912,784	1,082,830
Accessories	150,987	267,260	228,196	232,035
All	3,774,640	4,454,320	5,704,903	7,734,500

1 US\$=Rs 114, Source: field study 2009.

The main accessories in multi-day craft include radio communication equipment and satellite navigators. The hull accounts for about 58 percent of the total cost, the engine (22), gear (14) and accessories (6).

### Variable Costs

Variable costs of fishing operations include costs of labour, fuel, food and ice. The total cost of operation of different vessels varies due to the variations in vessel size and the length of fishing trips (see Table 3). Labour cost is a highly influential factor on operational costs which is totally governed by gross profit of the operation since this calculated as a percentage of the total gross profit, 50 percent for the crew and 5 percent for the captain.

Table 3: Average annual variable cost of vessel (Rs)

Item	28-34 ft	35-39 ft	40-44 ft	>44 ft
Labour	2,377,490	2,656,554	2,080,839	1,434,422
Fuel	1,954,825	2,591,760	2,080,839	1,507,982
Food	633,997	777,528	676,273	478,141
Ice	316,998	453,557	364,146	257,461
All	5,283,310	6,479,400	5,202,097	3,678,006

1 US\$=Rs 114, Source: field study 2009.

Labour accounts for about 42 percent of the total variable costs, followed by fuel (40 per cent). Of the other cost items, the major component is the cost of food on board which accounts for about 13 percent of the total variable cost.

### Revenues and Profits

From information collected during the studies average gross profit and net profit were calculated for each type of vessels, as shown in Table 4.

Table: 4 Average annual costs and revenues associated with deep sea operations (Rs)

Type of vessel	Fixed cost	Variable cost	Total cost	Revenue	Gross profit	Net profit
28-34 ft	454,537	5,283,310	5,737,847	7,680,717	2,397,407	1,942,870
35-39 ft	470,743	6,479,400	6,950,143	9,339,834	2,860,434	2,389,691
40-44 ft	598,372	5,202,097	5,800,469	7,501,460	2,299,363	1,700,990
>44 ft	765,245	3,678,006	4,443,251	5,028,225	1,350,220	584,975

1 US\$=Rs 114, Source: field study 2009.

Gross profits were obtained by deducting all variable costs from total revenue. According to Table 4, all categories of vessels enjoyed positive gross profits. The highest gross profit is earned by 28.34ft vessel group followed by 28-34 ft while the lowest for > 44 ft. net profits were obtained by deducting fixed cost from gross profit, as can be seen from table 3, all categories of vessels earned positive net profits, indicating their long term viability.

### **Barriers in Deep sea Fisheries**

In responding to a question on barriers to deep sea fisheries, the captains of multi-day deep sea vessels said that poaching of foreign vessels on EEZ of Sri Lanka was the highest problem (26 percent) followed by fluctuation of fish prices at the market (20 percent). 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. Especially captains claimed that export oriented tuna prices were distorted by export agents hiding important market information. Of other barriers, poor harbour services and getting arrested by other neighbouring countries were major. Inadequate harbour services such as fresh water, ice and fuel were major influential factors for delaying the start of fishing operations. Many Sri Lankan vessels and fishermen were arrested and detained by neighbouring countries claiming that they had been crossing EEZ borders illegally. This has created several social problems for their families (Kumara, 2001). Lack of modern technological equipment and knowledge could be seen as major reasons for the unwanted crossing of borders.

### **CONCLUSION**

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. Generally all size categories of vessels deploy both nets and hooks and how much so depends on oceanographic condition of the resource area. Almost all vessels, irrespective of their size categories, use hooks and drift gill nets for fishing. Vessels targeting the best quality tuna for export markets mostly use long line, while other vessels use both long line and drift gill nets. The highest proportion of total operational cost goes to labour followed by fuel and foods. The number of fishing trips of a year has inverse relationship with the size of the vessels.

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 highest net profit was earned by the 35 to 39 ft vessel group followed by the 28 to 34 ft group. 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 51 and 29% for the 28 to 34 ft and 40 to 44 ft groups respectively. The lowest, 9%, was earned by the > 44 ft vessels group. The reason for the lowest gross profit of > 44 group is the lower corresponding catches of this vessel category and also the cost of the higher initial investment of the group for the net profit.

### **ACKNOWLEDGMENT**

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