ECONOMIC EFFICIENCY OF DEEP SEA SHRIMP FISHERY OPERATIONS IN KERALA, INDIA

C. P. Rajool Shanis[1*], Shyam S. Salim[2], Nivedita Shridhar[3] and N. G. K. Pillai[4]

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ABSTRACT

Since the past many years the marine fishery sector of Kerala has been and continues to be one of the major sources of fish. The trend shows that the consumption of fish is on a rise and there has been an unceasing increase of issues pertaining to food security in terms of spiraling of the fish prices as well as non-availability of fish. With the decrease in catch per unit effort of fish resources, there is a critical requisite to identify new fishery resources to sustain the fish food security of the country. The marine fishing sector has witnessed vast technological developments in both harvest and post-harvest fisheries during the last few decades. Deep-sea shrimp fishing operations in Kerala started in 1999 with its initial phase registering high landings, but dropped down considerably in the subsequent years. This study was carried out to analyze the economic evaluation of deep-sea shrimp fishery of Kerala. The study was conducted in Sakthikulangara (Kollam District), Vypin and Cochin Fisheries Harbours (Ernakulum District) along the Kerala coast during the period August 2010 – May 2011. The primary data on craft and gear, capital investment, fixed cost, operational cost, catch, species composition and revenue were collected from 90 deep-sea shrimp trawlers. The results indicated that the operational cost for deep-sea shrimp trawlers was very huge when compared to coastal trawlers. The average operational costs for deep-sea shrimp trawlers targeted for Red ring was Rs. 209391 and the net operating income was Rs. 94163 per trip, whereas, in the case of other deep-sea shrimps the average operating costs and net operating income were Rs. 146737 and Rs. 55870, respectively. Of the total operational cost, expense incurred on fuel was the most significant factor contributing 55 percent followed by crew share (22 percent) and ice (7 percent). The study suggests that concerted efforts are required for the sustenance of the sector, which would indisputably contribute additional fish landings for the State and would ensure fish food security.

Keywords: Trawl performance, Deep-sea, Shrimp, India, Pandalidae, Aristidae

[1] Former Research Fellow at Central Marine Fisheries Research Institute (CMFRI), P.B. No: 1603, Cochin - 682 018; and presently: Technical Assistant, National Bureau of Fish Genetic Resources, Cochin Unit, CMFRI Campus, Cochin – 682 018, Kerala, India.

[*] Corresponding author: E-mail: rshanis@gmail.com

[2] Senior Scientist, Socio-Economic Evaluation & Technology Transfer Division (SEETTD), Central Marine Fisheries Research Institute, Cochin – 682 018, Kerala, India.

[3] Senior Research Fellow, Socio-Economic Evaluation & Technology Transfer Division (SEETTD), Central Marine Fisheries Research Institute, Cochin – 682 018, Kerala, India.

[4] Emeritus Scientist (ICAR), Central Marine Fisheries Research Institute, Cochin – 682 018, Kerala, India

I. INTRODUCTION

The fishery sector continues to be one of the fastest growing food sectors in India, in addition to aquaculture. The current value of fish production in India is around 3.81 million tonnes (CMFRI, 2012), of which Kerala produces around 8 lakh tonnes of fish annually with a sizeable contribution by pelagic fishes (73 percent), demersal fishes (16 percent), crustaceans (6 percent) and molluscans (5 percent). The major crustaceans - Shrimps, occupy a prominent position in the economy owing to their high export value amongst the marine fishery resources of the State. During the year 2012-13, the shrimp export generated a forex earning of around 14 thousand crore rupees, with a total catch of around three lakh tonnes (MPEDA, 2012).

Kerala economy has shown a consistent growth of 4.5 percent triggering an increased purchasing power of consumers, thus leading to high fish consumption (Shyam et al., 2013). The per capita fish consumption in Kerala was found to be 27 kg/year which is thrice that of the national average (Shyam, 2013). Off late the non-availability of fish, reduced catches and increased competition for demand in national and international market, coupled with increasing price has led to a situation where there is a stipulation to harvest and harness the new fishery resources to meet the demand and supply relationship (Shyam, 2013). Thus, there exists a demand and supply gap which could lead to domestic fish food security concerns for the people of Kerala (Shyam, 2014).

In India, deep-sea fisheries sector development has shown a slow pace probably due to lack of awareness, expertise and government support. The current level of commercial exploitation of deep-sea resources is limited only to deep-sea shrimps and sharks (Vivekanadan, 2010). Studies conducted by Nandakumar et al. (2001), Dineshbabu et al. (2001), Thirumilu and Rajan (2003), Radhika (2004), Radhika and Kurup (2005) from Kerala, Karnataka and Tamil Nadu coasts accounted the catch, species composition and fishing operation details of deep-sea shrimp fishery.

The economic performance of fishing operations is often affected by numerous factors such as fluctuations in revenue and catch, unexpected increases in the fuel cost, and weather condition. The depletion in the stock of resources targeted by the mechanized units and the rising fuel prices pose serious threat to the economic viability of most of the mechanised fishing units. The economic performance of the fishing method is an important indicator, which decides the operation of the fleet. The economic evaluation of all types of fishing units in the mechanised, motorised and non-motorised sectors have been studied by many researchers in India. Economic viability of different fishing methods was studied by Geetha et al. (2014), Aswathy et al. (2011), Narayanakumar et al. (2009) and Sehara et al. (2000). The cost and earning of mechanised trawlers was analysed by many researchers (Sathiadhas et al., 1992; Sathiadhas and Panikkar, 1989; Devaraj and Smitha,

1988). The economics of gill-netters (Sathiadhas et al., 1991; Sehara and Karbhari, 1989), purse seiners and ring seiners (Sathiadhas et al., 1993; Narayanakumar and Sathiadhas, 2005) has also been studied along the Indian coast.

The commercial fishery of deep-sea shrimps began in Kerala during the late 1990s with the use of small and medium sized conventional trawlers (Rajan et al., 2001). The number of deep-sea shrimp trawlers increased and the landings peaked in 2000-2001 followed by a significant drop in the following years (Radhika and Kurup, 2005).

Objective of the study

The present study aims to evaluate the economic efficiency of deep-sea shrimp fishing operations in Kerala and estimate the profitability of deep-sea fishing operations. The economic efficiency is estimated by computing the cost and earning of fishing unit per trip/ year.

II. METHODOLOGY

Three places were chosen for the purpose of study, namely Sakthikulangara (Kollam District), Vypin and Cochin Fisheries Harbour (Ernakulum District) along the Kerala coast of India during the period August 2010 – May 2011. The primary data were collected using structured schedules after a reconnaissance study. The schedule contained information related to craft and gear, capital investment, fixed cost, operational cost, catch, species composition and revenue. The following computations were done to assess the various parameters of economic efficiency:

Total cost = Fixed Cost + Operating Cost
Net Profit = Revenue – Total Cost
Net Operating Income = Revenue – Operating Cost
Rate of Return = Net Profit / Total Cost
Profitability Ratio = Net Profit / Operating Cost
Net Profit Ratio = Net Profit / Revenue
Operating Ratio = Operating Cost / Revenue
The data collected from the research sites were tabulated and evaluated.

III. RESULTS & DISCUSSION

a) Trawling Operation

On the Kerala coast, there exists two types of deep-sea shrimping operations, based on the targeted species group. The first one being the Red ring (Aristeus alcocki), for which fishing operation is normally conducted at greater depth range (> 350 m). The other one includes deep-sea shrimps which primarily constitutes pandalid shrimps and operates at a depth that ranges between 190 - 350 m. The fishing ground, duration of fishing, fishing operation time varies in the targeted

species group. For the Red ring, the duration of fishing operation extends up to 15 days, while the fishing operation was conducted for the entire day (day and night). In contrast, the trawlers targeting the other deep-sea shrimps operated only during the day time with the crew occupied in tuna fishing using small long-lines during the nights. The number of hauls ranged from 2 - 3/day with a duration of 4 - 5 hrs.

The season for deep-sea shrimp fishery usually starts from the end of August to the mid of May, with a peak fishing season between October and February. During the initial days of study, the landings of deep-sea shrimps were reported from about ten major as well as minor fisheries harbours along the Kerala coast, but later narrowed down to three harbours, namely Sakthikulangara, Vypin and Cochin.

b) Craft and Gear

The analysis proved that the entire fleet engaged in the deep-sea shrimp fishery was built of steel and was well equipped with adequate fishing devices. The overall length (OAL) of deep-sea trawlers ranged from 60 - 72 feet and there were 3 - 5 deep-sea shrimp trawl nets kept in the trawler. The trawl net was made of 0.75 mm dia twine twisted poly ethylene (PE) netting except for the cod end, which was of 1.25 mm dia twine. The head rope and foot rope were made of 14.0 mm dia poly ethylene (PP). The head rope's length ranged from 32 - 45 meter. The average cod end mesh size was 24 mm and ranged between 22 - 26 mm.

Almost all the trawlers had yard-fabricated winches, which were mechanical in nature and had steel wire ropes of different diameters for trawling operations. The entire fleet of trawlers had V-shaped otter board, with an average weight of 75 kg ranging + 15 kg each. The average fish hold capacity of trawlers was 8 tonnes and it ranged from 10 - 15 tonnes. The ownership rights of trawlers indicated that 78 percent of boat ownership was shared across the fishermen from Tamil Nadu. However, 75 percent of owners and 90 percent crew members working in the deep-sea trawlers were from Tamil Nadu, especially from Kanyakumari and Thuthoor. In most of the trawlers, the skipper (locally called Srang) performed dual duties of both cruise as well as fishing (towing).

c) Capital Investment

The average capital investment for shrimp trawlers worked out to be Rs. 42.85 lakhs. The capital investment consisted of the cost of construction of hull, cost of engine, gear and other accessories. It was found that all trawlers were equipped with echo-sounder, GPS, wireless set, mobile phone, television set and other state-of-the-art gadgets. More than 50 percent of the deep-sea shrimp trawlers were less than five years old. It was deduced that the cost for engine contributed to 24% of the total capital investment. The shrimp trawlers often used engines with 100 - 180 hp. Recently, there has been a shift in the type of engine used, from

indigenous engine to high horse power (300 - 420 hp) Chinese engine. The trawling speed of Chinese engine was found to be 4.5 nm/hr, which is twice the speed of normal indigenous engine (Ashok Leyland). The price of Chinese engines ranged from 12 -16 lakhs but with no guarantee on the engine and difficulty in maintenance and purchase of spares. The details of the average capital investment are listed in Figure 1.

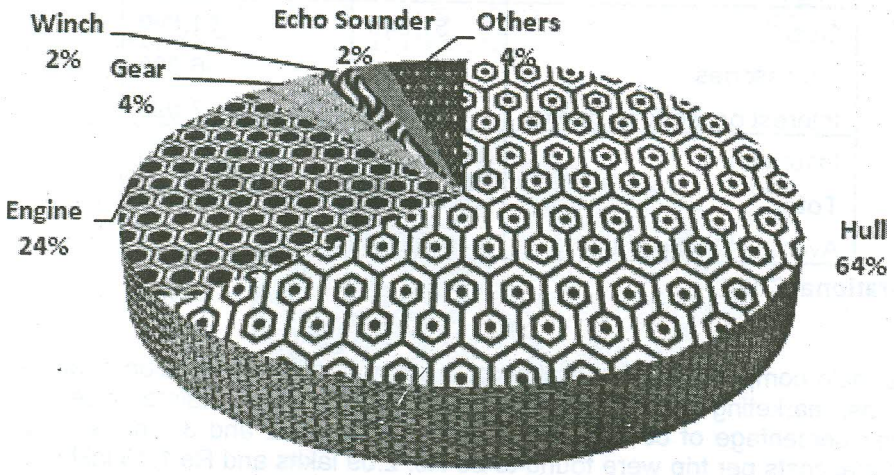

Figure 1. Average capital investments of deep-sea shrimp trawlers operated along Kerala coast

d) Fixed Cost

The average annual fixed cost was computed by employing the elements of capital investment, insurance and interest on working capital. The value of hull, engine and gear depreciated at the rate of five percent, seven percent, and thirty percent, respectively. In order to calculate the depreciation, the straight line method of computing annual depreciation using the cost of purchase, its salvage value (residual value) and its expected life in years was used.

The interest on working capital (5 percent) was worked out to be Rs. 10470 and Rs. 7095 for targeting of Red ring and other shrimp, respectively. The details of the fixed cost are furnished in Table 1. The average annual number of fishing trips for trawler targeting Red ring was 29 and other deep-sea shrimps was found to be 34.

Table 1: Average annual fixed cost of deep-sea shrimp trawlers operated along Kerala coast

Cost Head	Red ring	Other deep-sea shrimp
Hull	136,625	136,625
Engine	70,712	70,712
Gear	51,840	51,840
Accessories	36,998	36,998
Interest on working capital	10,470	7,095
Insurance	1,28,563	1,28,563
Total	**4,35,207**	**4,31,833**
Average Cost per trip	15,007	12,701

e) Operational Cost

The main components of operating cost such as fuel, ice, auction charges, provisions, marketing charge, allowance (Bata), crew share, maintenance cost and their percentage of contribution is given in Figures 2 and 3. The average operational costs per trip were found to be Rs. 2.09 lakhs and Rs.1.46 lakhs for Red ring and other shrimp, respectively. It was found that the operational cost of trawlers targeting Red ring was found high on an account of day - night fishing operation, lengthy fishing days and distance of fishing ground.

The total operational cost indicated that the cost of fuel was the maximal component contributing around 55 percent of the total costs. This was followed by the crew share (22 percent) and then by provision for ice (7 percent). The percentages were found to be high when studied in comparison with the case of multiday trawlers operating less than 200 meter depth, where the fuel cost contributed to 49 percent (Aswathy et al., 2011). The frequent price hike of diesel has an adverse effect on the sector. There is a mismatch in the market price of the deep-sea shrimp in relation with the increase of fuel price. The rate of Red ring was found to be Rs. 80-100/kg ten years back (Rajan et al., 2001), while, presently the rate is Rs. 110-140/kg, but in the case of diesel price the rate increased more than double during the same period.

The auction charges (commission) varies depending on harbours and generally differs from 5 - 7 percent of the total catch. Ice is crushed using crushing machine at the harbour and stored in the fish hold of the trawler. The trawler targeting Red ring and other deep-sea shrimps carries 250-300 and 200-250 block ice, respectively. The deep-sea trawlers carry 2000 - 4000 litres of water for drinking and cooking purpose.

Crew payment is based on an agreed share of net revenue between the owner and the crew members. Fishing crew is paid a share of the returns and daily allowance (Bata). The Bata of one crew member is around Rs. 100 - 150 per fishing day. After reducing the operational cost such as fuel, auction, provisions, marketing, and berthing charges from the net revenue, 65 percent of the remaining revenue goes to the boat owner and the rest 35 percent is divided among the crew members. Crew members of some deep-sea trawlers engaged in the tuna fishing at night using small long-liners, earn from both tuna and its by-catch, this is again distributed equally among the crew members.

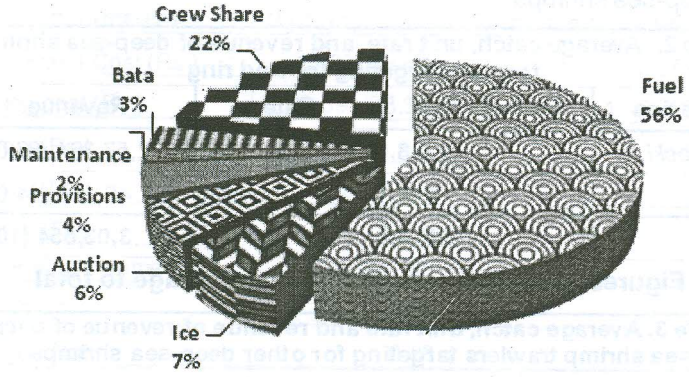

Figure 2. The average operational cost of trawlers targeted for Red ring operating in Kerala (2010-11)

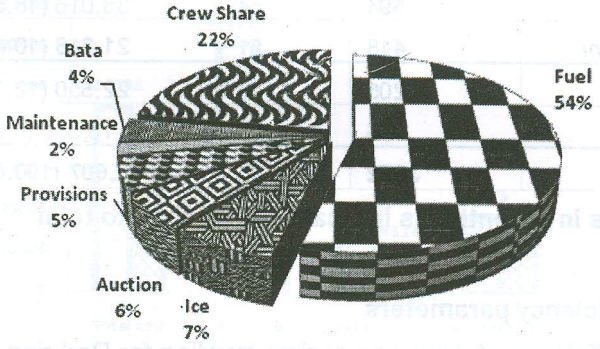

Figure 3. The average operational cost of trawlers targeted for other deep-sea shrimps operating in Kerala (2010-11)

f) Gross Revenue

The catch composition and revenue from the deep-sea shrimp operation is given in Table 2. The major catch targeting Red ring is Aristeus alcockii, whereas, in the case of other deep-sea shrimps, the target species includes Plesionika quasigrandis, Heterocarpus gibbossus, H. woodmasoni and Metapenaeopsis andamanensis. It was found that the trawlers that target Red ring often catch large quantities of deep-sea shark as a by-catch. The landing price of deep-sea shrimp fluctuated with species, size and quality. The Red ring, A. alockii is the most valued species among deep-sea shrimps landing in Kerala and P. quasigrandis is the most dominant species in the landings. The average revenue per trip has been estimated at Rs. 303,554 for Red ring and Rs. 202,607 for targeting for Red ring and other deep-sea shrimps.

Table 2. Average catch, unit rate and revenue of deep-sea shrimp trawlers targeting for Red ring

Species	Quantity (kg)	Rate	Revenue
A. alcocki	2383	108	2,57,364 (86.00)
Shark	298	155	46,190 (14.00)
Total	**2574**	-	**3,03,554 (100)**

Figures in parenthesis indicate percentage to total

Table 3. Average catch, unit rate and revenue of revenue of deep-sea shrimp trawlers targeting for other deep-sea shrimps

Species	Catch (kg)	Rate/kg	Revenue (Rs.)
Plesionika sp.	1238	46	56,948 (27.82)
M. andamanensis	1121	45	50,445 (24.64)
H. gibbosus	594	64	38,016 (18.57)
H. woodmasoni	418	51	21,318 (10.41)
Tuna	205	110	22,550 (12.02)
Shark	86	155	13,330 (6.51)
Total	**3662**		**2,02,607 (100.00)**

Figures in parenthesis indicate percentage to total

g) Economic efficiency parameters

The economic efficiency of deep-sea shrimp trawling for Red ring and other shrimps are listed in Table 4. The analysis indicated that the average fixed cost of Red ring to be Rs.15,007, which accounts for 6.68% of the total cost, thus the variable cost incurred in the operation is 93.32% of the total cost and the operating cost was computed to be Rs. 2,09,391, which yields to a total cost of Rs. 2,24,398.

The revenue generated through this operation is Rs. 3,03,554 with a net profit gain of Rs. 79,156 and Rs. 94,163 being the net operating income. In comparison, the average fixed cost of other deep-sea shrimp was found to be Rs. 12,701, which accounts for 7.97 percent of the total cost, the variable cost being 92.03 percent. The operating cost was estimated to be Rs.1,46,737 giving rise to a total cost of Rs.1,59,438 and generating a revenue of Rs. 2,02,607. The net profit from other deep-sea shrimps was found to be Rs. 43,169 and the net operating income was Rs. 55,870. The above values are graphically represented in Figure 4.

Table 4. Economic efficiency indicators of deep-sea shrimp trawlers (per trip)

Efficiency parameters	Red ring	Other deep-sea shrimp
Average Fixed Cost (Rs.)	15,007 (6.68)	12,701 (7.96)
Operating cost (Rs.)	2,09,391(93.31)	1,46,737(92.03)
Total cost (Rs.)	2,24,398	1,59,438
Revenue (Rs.)	3,03,554	2,02,607
Net Profit (Rs.)	79,156	43,169
Net Operating Income (Rs.)	94,163	55,870
Rate of return	0.35	0.28
Profitability Ratio	0.38	0.29
Net profit Ratio	0.26	0.21
Operating Ratio	0.69	0.72

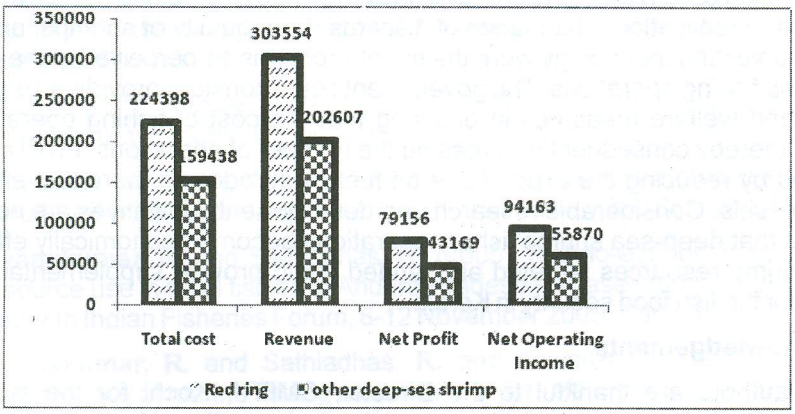

Figure 4. Cost and revenue of deep-sea shrimp trawling operations

The operating ratio worked out to be 0.69 and 0.72 for trawlers targeting for

Red ring and other deep-sea shrimps, respectively; indicating that 69 percent and 72 percent of the net revenue generated is used in its operating charge. The average operating ratio of deep-sea shrimp trawlers was 0.70, which is high when compared to coastal multiday trawlers (0.58) (CMFRI, 2010). Rate of return, profitability ratio and the net profit ratio for the Red ring is estimated to be 0.35, 0.38 and 0.26, respectively; while for the other deep-sea shrimps it was found to be 0.28, 0.29 and 0.21 (Figure 4).

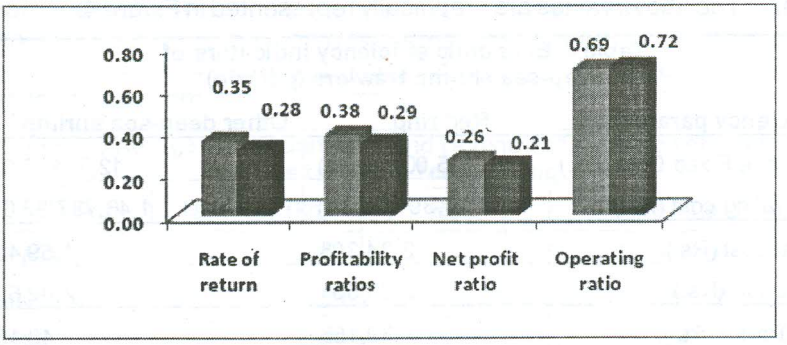

Figure 5. The economic efficiency indicators of deep-sea shrimp trawlers

IV. CONCLUSIONS AND SUGGESTIONS

The study indicated that fuel is the most important and significant cost involved in the fishing operation, in addition to the huge capital investment required for the construction of the hull, engine, gear and other equipment. The profits were found to be 24 - 25 percent. However, discussions with the trawl owners indicated that high operation cost, high risk and efforts, lack of skilled and trained manpower, low market price realisation, abundance of discards, poor quality of shrimps, and low level of harvesting technology were the major problems as perceived in the deep-sea shrimp fishing operations. The government could consider providing adequate support and welfare measures in ensuring that the cost of fishing operation is lowered, thereby consequently increasing the number of operations. Profit can be enhanced by reducing the expenditure on fuel by introducing more fuel-efficient fishing vessels. Considerable research and developmental initiatives are needed to ensure that deep-sea shrimp fishery operations become economically efficient as the shrimp resources targeted and landed could provide supplementary fish sources for the fish food security in Kerala.

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