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Economic analysis of hook and line fishery of Thiruvananthapuram coast, Kerala

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Original Article

Abstract

Hook and line fishing has been used for the last two decades along the Vizhinjam Coast targeting mainly tunas especially bullet tuna. The fishing methodology is in use for more than several decades, but systematic study in relation to the modifications in fishing practice and its impact on the improvement in catch and income generation of fishermen has not yet been done. This paper aims to bring out the modifications in the gear/ craft and area of operation of line fishery and its impact on the income generation of fishers in the Vizhinjam Coast.

Keywords: *Hook and line fishery, bullet tuna, economic analysis*

Introduction

Mechanisation and multiday trawler based fishing has largely influenced the fishing sector in Kerala, but the fishermen of Trivandrum Coast are still largely single-day operators who mainly use motorised craft with Out Board Motor (OBM) using gillnets, seines and lines. At Vizhinjam, the motorisation programmes were initiated by the middle of 1982 (Gopakumar *et al.*, 1995) and since then several modifications and improvisation have been made to enhance the efficiency of the fishery. The most significant change in the annual landings of hook and line due to motorisation was the catch of bullet tuna, which formed an insignificant catch during the pre-motorisation period (Gopakumar *et al.*, 1995). *Auxis rochei* (Risso, 1810), commonly known as the bullet tuna is the smallest among all tuna species and is abundantly present in the epi/meso-pelagic waters of Trivandrum Coast. It is harvested on a commercial scale by operating gillnets and lines (Jasmine *et al.*, 2013). The fishermen in this area have developed and mastered the technique of operating the vertical hook and line from non-motorised/ motorised craft to exploit various resources including bullet tuna. This method can be classified under the "hand lining" as per the FAO technical measures for responsible fishing. However, a systematic study on the modifications in gear and craft, changes in the area of operation and its impact on the catch and income of fishermen have not been done after 1983 (Gopakumar *et al.*, 1986). Modifications in fishing pattern are usually done by the fishermen for increasing efficiency of operation, improving catch, reducing long duration of physical burden, and making fishing operation hassle free and less cumbersome. These improvised fishing operations need to be studied and documented for the better understanding of the fishery. Moreover, economic analysis of the modified hook and

line fishery will show the feasibility of operation as compared to the earlier practice described by Gopakumar *et al.* (1986).

Material and methods

Explanatory case study design was used where a systematic semi-structured approach that use a combination of methods to assess and understand a situation with the participation of local people (Swathi Lekshmi *et al*., 2013) was used to understand and document the details of fishing operation. A semi-structured interview was conducted with 42 fishermen in Vizhinjam Village during the year 2014-15 who were involved in the capture of bullet tuna using vertical hook and line fishing. For questionnaire interviews, random sampling method was followed (Das *et al.,* 2015). A questionnaire was prepared to obtain the data pertaining to age, type of fishermen, educational qualification, annual income and their experience in the fishery. The data pertaining to the changes observed in technical and operational characters and their perception on the need to adopt these changes were also collected.

For socio-economic study, the percentage analysis method was used to examine the different variables pertaining to the respondents of the survey. Percentage analysis of respondents' age, education, average annual income and years of experience in fishing activity was used for the analysis. Additionally, respondents' perceptions on the various changes undergone in the hook and line fishery and its impact on income generation were also analysed.

The catch, effort and price data of hook and line fishery of Vizhinjam Landing centre for the last 10 years (2005-2014) was obtained from the Fisheries Resources Assessment Division (FRAD) of ICAR-CMFRI. Economics was worked out using data from 3 motorised crafts per month, involved in hook and line operations from April 2014 to October 2014. The selections of these 21 crafts were based on simple random sampling method (Das *et al.,* 2015). The operating cost per trip was calculated using the formulae followed by Geetha *et al.* (2014).

Operating cost, OC/trip = Fuel charges + Crew wage + miscellaneous expenditures which include food expenses, auction charges, hook cost and other charges + Interest on working capital (9%) where fuel charges were calculated using

Fuel Charges (FC) per trip = [{(Qs* Ps) + (Qus*Pus)}/200] + (Qp* Pp)

Where Qs – quantity of subsidised kerosene (in litres) obtained a year, Ps- price of subsidised kerosene per litre, Qus- Quantity of unsubsidised kerosene (in litres) required a year, average' Pus- price of unsubsidised kerosene, Qp – Quantity of Petrol (in litres) required in a trip, Pp – Price of petrol (in litres) and '200' is the average number of fishing days a year.

Fixed cost consist of interest rate (9%), depreciation, repairs and maintenance. The depreciation on fixed assets was calculated using straight line method.The gross revenue per trip is estimated as follows:

n GR per trip = Σ qi pi, Where, qi=quantity of 'i'th variety of fish in Kg, pi is the price per kg of fish of the i^{th} variety.

Net profit is the profit obtained after deducting total cost (operating cost + fixed cost) from the gross income earned. Along with these, the following computations were done to assess the various parameters of economic efficiency.

Rate of Return = Net Profit /Total Cost
Profitability Ratio = Net Profit/ Revenue
Operating Ratio = Operating Cost/ Revenue
Benefit Cost Ratio = Gross Income /Total Cost

The modifications that have occurred in the line fishery, in terms of gear and craft specifications, area of operation and its impact on the income generation of motorised fishers, were compared with the previous study (1983-84) conducted in same area by Gopakumar *et al.* (1986). The previous study period (1983-84) is termed as 'pre-modification' and current study conducted in 2014 as 'post modification' in the text to prevent repetition. In the pre-modification studies, data on the fixed cost was not available and hence these data were taken from the studies conducted by Sathiadhas and Panikkar (1988). Standardised real price based on whole sale price index for the base year 1983 and 1986 were multiplied with the key economic indicators of the earlier studies (Gopakumar *et al.,* 1986; Sathiadhas and Panikkar, 1988) for easy comparison.

Results and discussion

Socio-economic profile

All the respondents were male fishers with age between 13 and 64 years. Of these, 42.8% were middle aged (age 30-45 years) followed by young adults 28% (age 15-30 years), senior group 25% (age 45-60 years) and rest (4.2%) falls in the below 15 and above 60 categories. The educational qualification of the respondents indicates 50% of them had only primary education (Class I to VII) while 40.2% were having higher secondary education (Class VIII to XII). The rest (9.8%) of the population were illiterate which mainly comprised of fishermen above 60 years of age. Among the fishers interviewed, 83% were labourers who do not own crafts but worked as crew in onboard motorised crafts. Only 17% of the fishermen owned motorised craft. Years of experience of fishers indicate that 57%

were involved in fishing for more than 20 years. Survey on the average annual income showed that 87% of the respondents have an average annual income of less than INR 1.5 lakhs while 13% of the fishermen have average annual income between INR 1.5 to 3 lakhs.

Techno-operational characteristics and economics of the fishery

The motorised hook and line units undertook fishing trips for 200 days in a year. The total revenue generated was divided into three portions. One portion for the operational expenses (variable cost) that occur during the trip while the second portion was given to the boat and OBM owner. The third portion was equally shared between the crews in the trip. If the boat owner participates in the cruise, (usual practice) he too gets one portion of the labour wages. The comparison of the modifications observed in technical and operational characteristics of the hook and line operations are represented in Table 1.

The operational characteristics of hook and line fishery showed changes in the area and depth of operations while the duration of absence from the shore remains almost unchanged. This is due to the usage of double OBM having 9.9 horsepower (HP) against single OBM with 7HP. The fuel consumption has also shown tremendous increase from 20-25 l of kerosene and 1-2 l petrol to 50-55 l of kerosene and 1-2 l petrol, for each trip.

The technical characteristics showed changes in the type of materials used in lines and sinkers, baits used and usage of shining cloth yarns as fish attractants. The sinkers used are modified automobile metal scrap locally known as "Super Iron" (Fig. 1). The kingpin of lorry and other heavy motor vehicles are modified and used as "Super Iron" sinkers. The kingpins of automobiles are made of Grey Cast Iron. This alloy is a mixture

Fig. 1. (a) View of super-iron sinker and (b) kingpin piece

of iron, manganese, carbon, sulphur and phosphorous. The alloy composition makes the cast iron highly durable as it can withstand wear and tear, and most importantly can resist corrosion. All fishermen (100%) involved in hook and line fishing prefers super iron as they help in the species specific capture of bullet tuna.

In the regular hook and line fishing, low cost fishes are used as baits. Low value fishes like sardine are also used for human consumption and the price of bait has also increased considerably over a period of time (Radhakrishnan *et al.,* 2016). Hence, the fishermen of Vizhinjam Village use fish waste as baits. Usually

Table 1. Technical and operational changes observed in hook and line fishery

Sl.No:	Criteria	Current study in 2014	Previous study in 1983(Gopakumar *et al.,* 1986)
1.	Type of fishing vessel	Motorised FRP boat	Motorised Plank built boat
2.	Engine horse power	9.9 HP X 2	7HP
3.	Craft size	5-6 m	3-4m*
4.	Crew size	3-4	4
5.	Duration of fishing (absence from the shore)	8-16 hours	8-13 hours
6.	No of fishing days an year	200 (average)	240-300 days
7.	Depth of operation	80-120m	60-80m
8.	Distance from the shore	25-30Km	< 25Km
9.	Bait type	Domestic fish cutting waste and trash fishes	Low cost fishes (cuttlefish pieces, anchovies etc.)*
10.	Whether artificial lures are used	Yes (yarns separated from shining cloth materials)	No*
11.	Type of sinker used	Super iron sinkers (recycled kingpins of large automobiles)	Polished granite stones/ lead sinkers*
12.	Material for lines	Monofilament lines (Nylon)	Cotton lines*
13.	Peak fishing season	May to October	July to October

*Data collected by enquiry

the head of sardine or small sized scads obtained after fish processing for domestic consumption and pieces of small sized squids and cuttlefish with no commercial value were used as lure. In the present study, 76% of fishermen interviewed preferred sardine waste over others as the hooking rate was comparatively high.

In the current study, it was observed that yarns separated from shining cloth materials (Fig. 2) were tied on the hook's

Fig. 2. View of yarns (a) separated from shining cloth materials (b) which are used as fish attractants

eye to attract fishes. However, only 59% of fishermen used fish attractants while the rest never felt the need to use them. Most of the fishermen who used, fish attractants were young and below 40 years of age. The cost of this cloth material was Rs 5/- per bundle. One bundle was sufficient for a single line.

The average catch per trip per boat was 62.5 Kg during pre-modification periods (Gopakumar *et al.*, 1986) while it increased to 121 Kg/trip/ boat in 2014. The percentage composition of catch per trip, in the hook & line fishery, during post and pre modification are compared in Figures 3 and 4. It is clear that the major catch during pre-modification period was *Decapterus* spp. (52%), followed by *Nemipterus* spp. (11%) while *Auxis rochei* (49%) followed by *Euthynnus affinis* (17%) dominated the catches of post-modification times. In Trivandrum Coast, tunas in general and *Auxis rochei* in specific have good local demand (Jasmine *et al.*, 2013) and fetches better price than other fishes like scads, pink perch *etc.*, in the local market. The major technical and operational characters like the changes in the depth and area of operation of the gear (Gopakumar *et al.*, 1986, 1995), use of artificial lures, materials used in gear and type of sinker might have contributed to the variation in species composition and catch dominance.

The average quantity of bullet tuna captured per trip has increased from 3.94% of the total catch (pre-modification) to 49% (post-modification). This increase has definitely reflected on the economic indicators as well. The income of the boat

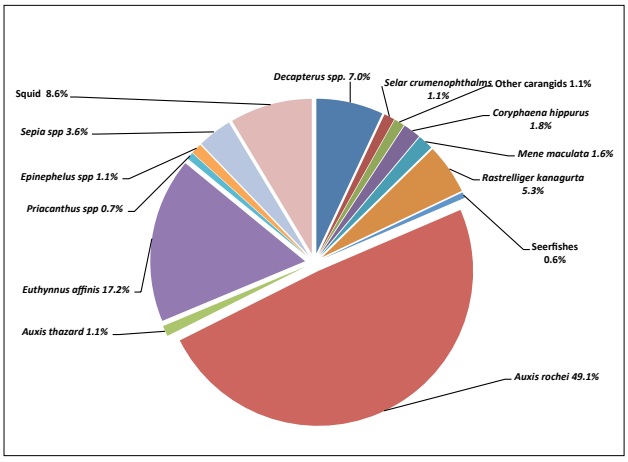

Fig. 3. Percentage composition of catch in hook & line fishing in post-modification period (Current study, 2014)

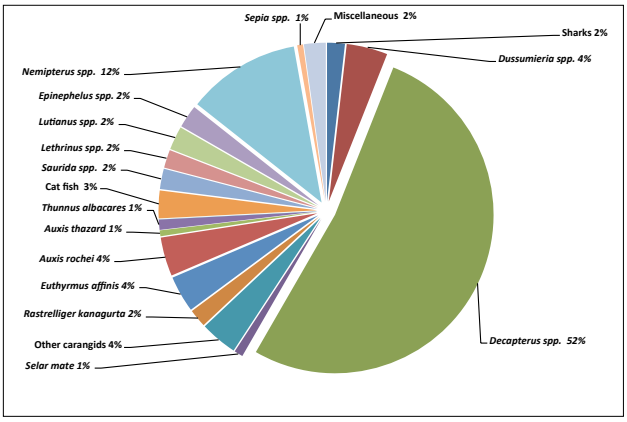

Fig. 4. Percentage composition of catch in hook & line fishing in the pre-modification period (Gopakumar *et al.*,1986)

owner participating in cruise was nearly INR 250 (equivalent to INR 2565 in 2014) while labourer was INR 83.3 (equivalent to INR 855 in 2014) in the pre-modification period (Gopakumar *et al.*, 1986). In the post-modification period, the income of boat owner who participated in cruise was INR 7160 while the labour gets INR 1432. This shows that the income of owner has increased almost 2.8 times while for the labourer the increase is 1.7 times post-modification. Better profits and income could be due to targeted fishing, species specific capture and better price realisation due to freshness of the catch which are the results of modifications observed in technical and operation characters undergone in the hook and line fishery (Geetha *et al.*, 2014; Gopakumar *et al.*, 1986). The key economic indicators of hook and line operations are in Table 2. Kerosene is provided by the fisheries department on subsidised rate of INR 35/L.The fishermen get approximately 100L/boat of subsidised kerosene a month while they required nearly 55 L of kerosene for a single trip. The subsidised kerosene provided by the fisheries department are usually not sufficient for the fishermen to undertake fishing activity round the year. So fishermen are forced to take fuel at

Table 2. Economic indicators of hook and line fishery of Vizhinjam Coast

Sl. No:	Particulars	Amount in INR (per trip in 2014)
1	Variable Cost	
	Fuel	3425
	Ice	100
	Gear and Craft maintenance charges	300
	Other expenses	275
	Total	4100
2	Interest on working capital @ 9%	369
3	Fixed Cost	
	Craft with OBM	360000
	Gear	4000
	Total	364000
4	Depreciation (per trip)	538
5	Interest on fixed cost (@ 9%)	162
6	Gross revenue	19656
7	Net Profit	15556
8	Owner share (including one labour share)	7160
9	Owner share (excluding one labour share)	5728
10	Share of each crew	1432
11	Benefit Cost Ratio	3.8
12	Rate of Return	2.8
13	Profitability Ratio	0.74
14	Operating Ratio	0.63

higher rate (INR 65/L) which impacts their returns negatively. Earlier, the quantity of subsidised kerosene was almost 350L/ boat per month and hence the average operational expenditure (Variable Cost) was around INR 1026 against INR 4100. So the profit of the fishing operation was mainly based on the availability/ price of kerosene for operating OBM.

Analysing the economics of motorised boats is complicated due to the highly variable fishing practices seen in the village. During every fishing trip, fishermen tend to carry minimum of nine different types of gears. The use of these gears depends on the climatic conditions and availability of fish shoals in the fishing grounds. Hence profit will be naturally higher than what is calculated here, where only catch from a single gear is considered. Analysis of economics of hooks and line fishing showed that operations were profitable for both the boat owners as well as the crews, which can be attributed to the better catch of high priced fishes due to modifications in the gear and craft, and changes in the area and depth of operation of line fishery. The standard economic indices of hook and line operations derived here are helpful in understanding the changes that the small scale fisheries system has undergone over a span of two decades.

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References

Das, M. R., S. Ray, U. Kumar, S. Begum and S. R. Tarafdar. 2015. Livelihood assessment of the fishermen community in theSouth West region of Bangladesh. *J. Exp. Biol. Agric. Sci.,* 3: 353-361.

Geetha, R, R. Narayanakumar, Shyam. S. Salim, N. Aswathy, S. Chandrasekar, V. Srinivasa Raghavan and Indira Divipala, 2014. Economic efficiency of mechanised fishing in Tamil Nadu – A case study in Chennai, *Indian J. Fish,* 61(4): 31-35.

Gopakumar, G., P. S. Sarma, A. K., Sadasiva Velayudhan, K. T. Thomas, T. A. Omana, and K. S. Pillai, 1995. *Comparative assessment of the impact of motorisation on the artisanal fisheries at Vizhinajam. Mar. Fish. Infor. Serv. T & E Ser.,* 138: 5-9.

Gopakumar, G., N. G. K. Pillai and P. N. R. Nair. 1986. Mechanisation of traditional crafts with outboard motors at Vizhinjam. *Mar. Fish. Infor. Serv. T&E Ser.,* 69: 23-28.

Jasmine, S., P. Rohit, E. M. Abdussamad, K. P. Said Koya, K. K. Joshi, S. Kemparaju, D. Prakasan, M. N. K. Elayathu and M. Sebastine, 2013. Biology and fishery of the bullet tuna, *Auxisrochei* (Risso, 1810) in Indian waters. *Indian J. Fish.*, 60: 13-20.

Radhakrishnan, K., M. Kalaiarasan, M. S. Madan, P. N. Ananth, T. Umamaheshwari and R. Velmurugan. 2016. Economic analysis of the hook and line fishery in Kombuthurai Coast, Tamil Nadu. *Current World Environment*, 11(3): 926-933.

Sathiadhas, R. and K. K. P. Panikkar. 1988. Socioeconomics of small scale fishermen with emphasis on cost and earnings of traditional fishing units along Trivandrum coast, Kerala-A case study. *Seafood Exp. Journal,* 20(11): 21-36.

SwathiLekshmi, P. S., G. Sasikumar, S. Kemparaju, R. Saravanan andG. Sampathkumar. 2013. Agarala: A traditional fishing boat of Karnataka. *Indian Journal of Traditional Knowledge*, 12(1): 166-168.