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Economic efficiency of mechanised fishing in Tamil Nadu – a case study in Chennai

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ABSTRACT

A study was conducted to analyse the economic efficiency of mechanised fishing in Chennai in Tamil Nadu along the east coast of India. The craft and gear combinations over the years witnessed dramatic changes on account of the huge cost of fishing, duration and depth of operations and maintenance. The mechanised gillnetters showed tremendous increase among the fishing fleet in Chennai mainly due to their assured returns and consistent marketing margin. The present study specifically compares the economic efficiency of mechanised gillnet units and trawlers operating from Chennai. Average operating cost and net income per day for the multiday (MD) gillnetters were ₹17,757 and 6,613 whereas in the case of multiday trawlers, the operating cost and net income per day were ₹18,095 and ₹3,219, respectively. Targeted tuna fishing and better price realisation in the value chain have contributed to better performance of gillnet units. The higher fuel requirement observed for MD trawlers as compared to MD gillnetters is attributed to long distance travelling and the use of mechanical power for propulsion as well as for fishing. The study found that efficiency measures in terms of labour, capital and fuel have established the supremacy of mechanised gillnetters.

Keywords**:** Cost and returns, Economic efficiency, Key economic indicators, Multiday gillnetters, Multiday trawlers

Introduction

Dynamic changes have taken place in the Indian fishery scenario and there were many management interventions introduced by the state and central governments from time to time. Changes also have taken place in the crafts and gear, fisherfolk population structure, availability of resources and their spread, infrastructure facilities and management measures.

The marine fisheries sector in Tamil Nadu plays a crucial role in the overall economic development of the state. There are 591 marine fishing villages and 363 marine fish landing centres in Tamil Nadu (CMFRI, 2010). About 10692 mechanised units and 24942 motorised and non-mechanised units are engaged in marine fishing activities in the state. Trawlers (54%) and gillnetters (38%) are the main crafts in the mechanised sector. The human resource potential of the marine fisheries sector include 1,92,697 families with a total fisher population of 8,02,912. The marine fish production in Tamil Nadu during the year 2011-12 was estimated at 6.30 lakh t (CMFRI, 2012), contributing 10-12% of the total marine fish production in the country. The mechanised and the motorised sectors contributed 75 and 24% of the total landings respectively, while the non-mechanised sector contributed only 1%.

Chennai Fisheries Harbour is one of the major mechanised fisheries harbours and occupies predominant place in marine fish production of Tami Nadu. Chennai has 44 fishing villages and 14 fish landing centres with 15,176 fishermen families and a fisher population of 67,464 (8% of fisherfolk population of the state), out of which 14,398 are active fishers. About 701 mechanised units and 1993 motorised and non-mechanised units are engaged in marine fishing activities in Chennai. Trawlers (81%) and gillnetterss (19%) are the main crafts in the mechanised sector of Chennai. There is a shift towards mechanised fishing by the fisher-folk due to their higher stability and technical efficiency.

The craft and gear combinations in Chennai Fisheries Harbour witnessed dramatic changes on account of the huge cost of fishing, duration and depth of operations. The mechanised gillnetters have shown tremendous increase in the fishing fleet in Chennai due to their assured returns and consistent marketing margin. Targeted fishing, no damage to juveniles, less labour dexterity, high fuel efficiency and marginal engine depreciation by gillnetters lead to sustainable fishing as compared to trawlers.

With the increasing number of different fast moving mechanised units and reduction in mesh size of gears, certain fishery resources have been over-exploited and the catch per unit effort has been reduced in the recent past (Devaraj and Paralkar, 1988). Over-exploitation of resources with devastating gears and methods of fishing have caused tremendous pressure on fishery resources, especially within the zone of 50 - 60 m depth

creating management and financial problems in fishing sector (Narayanakumar, 2012). Reduction in the quantity of catch per unit effort on one hand and increasing cost of fishing inputs on the other hand, the investment in capital intensive fishing units have become risky (Narayanakumar and Sathaidhas, 2005). It is mainly due to continuous increase in the price of fishes that the fishing units are able to earn moderate profits. The depletion in the stock of resources targeted by the mechanised units and the rising fuel prices pose a serious threat to the economic viability of most of the mechanised fishing units (Aswathy *et al.*, 2011).

The economic performance of marine fishing operations is affected by various factors *viz.*, diminishing catch per unit of effort, fluctuations in revenue, and unforeseen increase in the cost of key inputs as well as catch and effort restrictions. The economic performance plays a crucial role in the investment decisions at micro-level. For judicious exploitation of resources and for formulating proper fishery policies, it is imperative to study the comparative economics of various types of mechanised fishing units engaged in fishing. In this context, the present study compares the economic efficiency of mechanised gillnet units and trawlers. The paper analyses the viability of various mechanised fishing units of Chennai using different economic and financial indicators.

Materials and methods

The data on investment, operational costs and earnings of mechanised gillnetters and trawlers were collected from 10 units in each category operating at Chennai Fisheries Harbor during 2011-12. The costs and earnings data were collected for 10 days in every month. Data on quantity and value of different species caught by the units, wages to labourers, fuel expenses, auction charges, expenses on repair and maintenance and other operational expenditures, cost of various inputs, details of craft and gear, crew details and capital investment were collected from the randomly selected units for a period of one year through a specially designed questionnaire.

In addition to this, the fixed cost details of 100 crafts in each category were collected from the owners of the sample units. The details on the fixed cost included the cost of the fishing equipments, insurance premium paid and related investment particulars. From this, the annual fixed cost was worked out by adding the depreciation on fishing equipment, insurance premium paid and the interest on fixed capital.

Both primary and secondary data were collected and used for the study. The secondary data pertaining to the fishing craft and gear, marine fish production over the years by different sectors and socio-economic details were collected from various publications of CMFRl and statistical reports of the Government of Tamil Nadu.

The analysis of the economic performance of fishing methods was assessed by working out the fixed cost, operating cost per trip, gross revenue per trip, net operating income per trip and annual net income through tabular analysis. The capital and labour productivity were also worked out using operating ratio and catch per labour per trip respectively to assess the economic performance (Sathiadhas, 1996). In general, operating ratio, net profit, capital and labour productivity were considered as the indicators of economic efficiency of the unit.

Cost-income ratios were used to measure the overall input and output efficiency in terms of value. Operating cost ratio relates variable costs to gross income. The revenue or the gross income of a unit is the sum total of value by multiplying the quantities of different species/groups with their respective price.

Operating ratio = Operating costs/Gross returns

The primary data were collected on operating costs per trip, which included the cost of fuel, crew wages, food expenses, auction charges, repair and maintenance and other day-to-day expenses for carrying out fishing operations. The operating cost per trip was thus calculated as follows:

Operating cost, OC/trip = (Fuel charges + Crew wage + Food expenses + Auction charges + Repair charges + Other charges)

The gross revenue per trip is calculated from the species composition of the catch and price per species. The gross revenue per trip is estimated as follows:

$$\text{GR per trip} = \sum_{i=1}^{n} qi\ pi$$

where,

qi is the quantity of catch in kg of the i^{th} variety

pi is the price per kg of fish of the i^{th} variety and

Labour productivity = Gross revenue/Man days

Net profit is the profit obtained after deducting operating expenses, depreciation and interest from the gross income earned.

Results and discussion

Analysis of economics of different types of fishing units indicated that almost all type of fishing units, on an average, run on profit as their production surpasses the breakeven point. In spite of the increase in fleet size and decrease in the catch rates, the mechanised sectors still sustain mainly due to the increase in the price of almost all the varieties of fishes. However, due to the nature of competition of open access marine fisheries, many of the less efficient units belonging to each category are being phased out of operation due to losses. The comparative economic efficiency of mechanised trawlers and gillnetters in terms of various key economic indicators estimated on

the basis of costs and returns data are given in Table 1. The economic performance of the trawling operations was analysed estimating the annual cost and returns, net operating income, net income and other productivity measures.

Table 1. Key economic indicators of mechanised fishing units during 2011-12 at Chennai Fisheries Harbour

Particulars	MD trawler (6-10 days)	MD gillnetter (>6 days)
Number of fishing trips in a year	35.0	30.0
Quantity of fish production per litre of fuel (kg)	2.0	3.4
Average fuel cost per fishing day ₹	9840.0	6285.0
Average operating cost per fishing day ₹	18095.5	17757.1
Average fixed cost per fishing day ₹	595.0	675.0
Average total cost per fishing day ₹	18690.5	18432.1
Average value realized per kg of fish ₹	46.8	51.8
Average gross revenue per day ₹	21910.0	25045.7
Annual net profit ₹	804875.0	1322712.0
Operating ratio (OC/GR)	0.83	0.71
Gross ratio (Total cost/GR)	0.85	0.73

On comparing different types of units operating from Chennai Fisheries Harbour, the initial investment was lower for gillnetters when compared to trawlers under study. The average initial investment worked out at ₹30 to 45 lakhs for a multiday (MD) trawl unit and ₹20 to 25 lakhs for a MD gillnet unit undertaking 250 and 200 fishing trips in a year, respectively (Selvaraj *et al.*, 2000). The catch by trawlers and gillnetters was 468 and 483 kg per fishing day respectively.

MD trawlers which undertook fishing trips of 6 to 10 days duration had an overall length (OAL) of 17 m with an engine capacity of 120 hp. The average fuel consumption of MD trawler was 2400 l per trip. They carried nearly 50 to 70 blocks of ice in a fishing trip. On an average, eight crew members operated in a multiday trawler (Sathiadhas, 1989). Average number of fishing trips by MD trawler was 35 in a year. The overall length of the MD gillnetter was 16.5 m. The duration of fishing trips varied from 6 to 12 days. They conducted an average number of 30 fishing trips in a year. The engine capacity varied from 120 to 170 hp, consumed nearly 1000 l of diesel per trip and the crew size went up to 8.

Key economic indicators

Cost and earnings study of MD trawlers and gillnetters operating at Chennai Fisheries Harbour of Tamil Nadu were collected and averages worked out during 2011-12. It showed that the average operating cost and net income per day for the multiday gillnetters were ₹17,757 and ₹6613 whereas in the case of multiday trawlers, the operating cost and net income per day were ₹18,095 and ₹3219 respectively (Fig. 1). Targeted tuna fishing and better price realisation in the value chain have contributed to better performance of gillnet units.

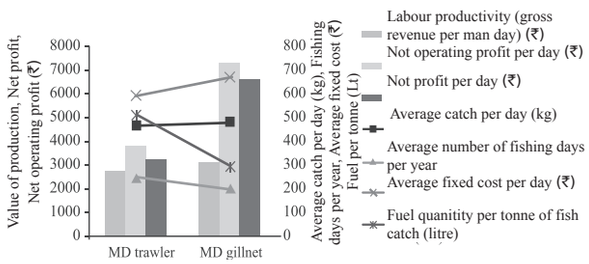

Fig. 1. Comparison of economic performance of mechanised gillnetters and trawlers in Chennai during 2011-12

The gross revenue realised per day for the MD gillnetter works out at ₹25,045 and the total cost at ₹18,432. A MD trawler, on an average, incurred ₹18,690 as total cost and earned about ₹21,910 as gross revenue per fishing day during 2011-12. The net operating income per fishing day of multi-day gillnetter was higher (₹7288) than the MD trawling (₹3814). With an average number of 35 fishing trips in a year, the fixed cost per trip was ₹595 per fishing day in the case of multiday trawlers (6-10 days) and with an average 30 fishing trips per year for multiday gillnetters (more than six days) the fixed cost worked out to ₹675 per fishing day.

In Chennai Fisheries Harbour, the average operating cost per kg of fish of the MD gillnetter worked out to ₹36.7 earning a revenue of ₹51.8, whereas average operating cost and value realised per kg of fish for MD trawler was ₹38.7 and 46.8 respectively (Fig. 2). The labour productivity, wages, quantum of catch, gross revenue and net profit were comparatively higher for MD gillnetter (Datta and Dan, 1992). It is noteworthy that prawns, cephalopods and perches contributed to more than 40% of the revenue of MD trawlers where as, tuna, seer fish and carangids contributed about 60% of the revenue of MD gillnetters. The other major groups contributing to the gillnet fishery are sailfish, sharks, dolphin fishes, queen fish and devil rays.

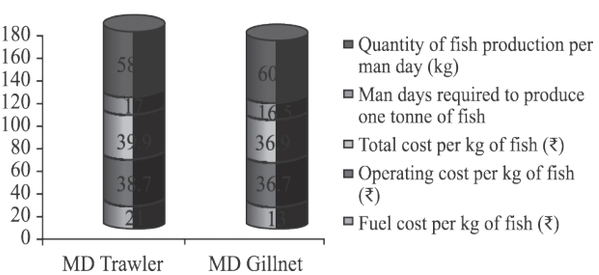

Fig. 2. Key economic indicators of mechanised fishing units during 2011-12 at Chennai Fisheries Harbour.

Owner and crew share in mechanised fishing

The expenditure and income details of owner and labour for the different mechanised sectors in Chennai Fisheries Harbour are given in Table 2.

Seventy per cent of multiday trawlers in Chennai follow share system while others use bata system to deduct expenditure from total fishing income. Labour would get less income in share system compared to bata system which may be due to reduced labour share in case of sudden unexpected expenses for share system. Crew members of multiday gillnetter and trawler realised an average of 20% of total fishing income (Table 2).

Drivers of MD trawler get a share in addition to crew wage. Wages to labourers and fuel expenses are the major components of the operational cost for mechanised fishing. The fuel cost and labour cost accounted 54 and 25% of the total operating cost of mechanised trawlers (Narayanakumar, 2012), whereas MD gillnetter incurred 38 and 35% of operating cost towards diesel and crew wage respectively (Table 3).

Table 2. Expenditure details for mechanised MD trawlers and gillnetters in Chennai Fisheries Harbour

S. No.	Particulars	Multiday trawlers (%)		Multiday gillnetter (%)
		Share (70%)	Bata (30%)	
1.	Total fishing income	100	100	--
2.	Food and other expenses			
	a) Food			5
	b) Driver	5	5	4
	c) Catamaran Boats	4	4	4
	d) Watchman	4	4	1
	e) Incentives	4	4	1 (Auction charge) 2 (Net depreciation)
	Total (a-e)	18	18	20
3.	Diesel expenses after deducting (2)	Deduct total diesel cost and all other expenses	Deduct diesel cost @ ₹ 20 per litre	Deduct diesel and other expenses
4.	Crew share after deducting (2 &3)	50%	20%	20%
5.	Owner share after deducting (2, 3 & 4)	50%	Balance income after deducting extra diesel cost and other expenses	25%
6.	Others			Combine extra profits of 2-3 months of all trips. Out of total profit, 15% goes to engine depreciation. Owner and crew share 60 & 40% respectively from the remaining profit.

Input-output efficiency

While comparing efficiency of different types of fishing gears, it was found that input-output, labour efficiency and fuel efficiency were higher for MD gillnetters as compared to MD trawlers.

The operating cost ratio indicates that 70 and 82.5% of the gross income were spent towards operating expenses by MD gillnetters and trawlers respectively. Similarly the fixed ratio indicates that every one rupee earned, 2.7% of gross income of MD trawler and 2.6% of the MD gillnetter were fixed expenses. The estimated gross ratio was 85.3% and 73.6% for MD trawler and gillnetter respectively. It may be noted that in terms of input-output efficiency, mechanised boats operating gillnets are found to be more efficient as compared to multiday trawlers. Gillnet units are showing highest capital productivity with lowest operating ratio of 0.7 than that of MD trawlers (operating ratio of 0.82). Targeted tuna fishing and better price realisation in the value chain have contributed to better performance of gillnet units (Sehara *et al.*, 2000).

Labour efficiency

Labour efficiency is often measured by dividing total output by units of labour engaged. An analysis of labour productivity showed that MD gillnetters are earning ₹3131 per labour man day while for MD trawlers, it was ₹2739 per labour man day. The labour efficiency was higher for MD gillnetter as the catch per man day was 60.4 kg as compared to 58.5 kg for MD trawler. The man days required to produce one tonne of fish worked out at 16.5 for MD gillnetter and 17 for MD trawler. The study found that MD gillnetters were labour efficient as compared to MD trawlers. Labour efficiency of MD trawler was low since it requires more labourers for both propulsion and fishing. Since MD trawler catch mainly comprised of juveniles and multi-species of fishes, labourers had more work load. Labour dexterity was low for multiday gillnetter due to targeted fishing.

Fuel efficiency

MD gillnets consumed 295 l of diesel on an average to catch one tonne of fish, whereas MD trawler used ₹513 l. The average fuel cost per fishing day worked out to

Table 3. Economic performance of mechanised trawlers and gillnetters operating in Chennai Fisheries Harbor during 2011-12

Particulars	Expenditure (% to total operating cost)	
	MD trawler	MD gillnetter
Fuel	54.38	38.32
Bata	2.21	2.25
Wages	25.28	35.39
Repairs	1.11	1.69
Auction charges	0.28	0.23
Others	16.74	22.12

₹6285 for MD gillnetter and ₹9840 for multiday trawling. The average cost of fuel requirement for producing one kg of fish for MD trawlers and MD gillnetters were ₹21 and ₹13 respectively. On comparison of mechanised gillnetters and trawlers, fish production per litre of fuel was found to be 3.4 kg for mechanised gillnetter and 2 kg for mechanised trawler. The study revealed that mechanised gillnetter earned more carbon credit by releasing less carbon dioxide during fishing expeditions in terms of fuel quantity and value. The higher fuel requirement by MD trawlers was because of longer distance travelled and use of mechanical power for propulsion and fishing.

Multiday gillnetters were found more efficient as indicated by different creiteria of economic viability. The study revealed that efficiency measures in terms of labour, input-output ratio and fuel have established the supremacy of mechanised gillnetters. Targeted fishing, no damage to juveniles, less labour dexterity, high fuel efficiency and marginal engine depreciation by gillnetters lead to sustainable fishing when compared to trawlers. The results of the present study on economic analysis of marine fishing would provide vital information for framing appropriate policies for the balanced and sustainable development of the marine fisheries in the state.

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