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Economic analysis of fishing crafts in Tharuvaikulam fishing village, Tamil Nadu: A comparative study

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Abstract
Marine capture fishing is one of the important sectors in fisheries. In study area Tharuvaikulam, a gill net an eco-friendly fishing gear is used by two types of fishing craft sectors namely motorized and mechanized for marine capture fishing. For judicious exploitation of resources and for formulating proper fishery policies, it is imperative to study the comparative economics of types of fishing units engaged in fishing. The efficiency of inputs and the profitability ratio among the two fishing craft sectors were estimated by using appropriate statistical tools in order to find out the effective and economically viable fishing craft methods among two fishing craft sectors.

Keywords: gillnet fishing, eco-friendly, comparative economics

1. Introduction
Marine capture fishing is one of the important for nutrition security and livelihood of the people in Tamil Nadu. Tamil Nadu ranks 5th in total fish production of the country and the total fish production of the State during 2014-15 were 6.97 lakhs tones. The export of marine products of 93,477 MT and earned a foreign exchange of Rs.5, 308.17 crores during 2014-15 (Rs-Rupees).

The fisheries sector of Tamil Nadu has contributed 0.7 percent of the total Gross State Domestic Product (GSDP) of the State (Policy note, 2015-2016) [7]. Thoothukudi is one of the major coastal districts in Tamil Nadu for marine fish production. Still it has major issues such as lack of sustainable management in fisheries.

In the present study area where the gillnet fishing was successfully adopted long period by fishermen in marine capture fishing. The objective of the study are to study the socio economic profile and fishing details among the fisher folk and to estimate the cost of and returns for three types fishing crafts sector in present study area. Gillnet is a passive gear and gillnet fishing method was one of the eco-friendly method in marine fishing. Gillnet fishing will help to maintain the sustainable level in marine fishery resources. Here, mechanized and motorized fishing crafts are using gill net. But the efficiency and profitability will vary depend upon the fishing crafts sector. 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. In this context, the present study compares the economic efficiency of motorized and mechanized sectors.

2. Materials and Methods
Tharuvaikulam fishing village was selected as present study area where sustainable fishing method was successfully practiced for a long period. Tharuvaikulam fishing village, Ottapidaram taluk, Thoothukudi district is located in the southern part of the Tamil Nadu where two types of fishing craft sectors is operated namely motorized and mechanized. Both sectors were doing Multi Day (MD) fishing by gillnet. Total sample size of the study was 90 which were distributed as 30 for motorized and 60 for mechanized sectors. The above stated samples were selected randomly for data collection in the present study. A survey schedule was designed based on the objectives of the study and it was used for collection of data from the fishermen. The fishermen were contacted individually and the objectives of the study were explained to them before conducting the data collection to ensure their co-operation. Tabular analyses were used to analyze the general characteristics of the fisherman and fishing details. The analysis of the economic performance of fishing methods was assessed by working out the following indicators.

1. Operating cost /year = (Fuel charges + Food expenses + Auction charges + Ice charges + Transport charges + Other's charges).
2. The fixed cost (FC) was calculated as sum of depreciation of craft, gear, and engine, interest on capital cost, insurance and repair and maintenance.
3. The gross revenue is calculated from the species composition of the catch and price per species. The gross revenue is estimated as follows: $\text{GR per year} = \sum_{i=1}^{n} qi\ pi$
4. Where, q_i is the quantity of catch in kg of the i_{th} variety; p_i is the price per kg of fish of the i_{th} variety;
5. Net profit is the profit obtained after deducting operating expenses and fixed cost from the gross income earned per year (Geetha *et al.*, 2014) [4].

Ratio Analysis
Ratio analysis will help to know the efficiency of the each input such as fixed cost, operating cost and variable cost in marine fishing.

1) Fixed cost ratio is the proportion of fixed expenses in gross income of fishing (Reddy, S. *et al.*, 2004) [10].

$$\text{Fixed cost ratio} = \frac{\text{Fixed cost}}{\text{Gross returns}} \times 100$$

2) Gross return ratio is the total cost of the fishing to the gross return (Reddy, S. *et al.*, 2004) [10].

$$\text{Gross return ratio} = \frac{\text{Total cost}}{\text{Gross returns}} \times 100$$

3) Operating cost ratio relates variable costs to gross income. The gross income of a craft is the sum total of value by multiplying the quantities of different species/groups with respective price (Aswathy *et al.*, 2011) [2].

$$\text{Operating cost ratio} = \frac{\text{Operating cost}}{\text{Gross returns}} \times 100$$

4) Profit margin ratio is a closely related indicator of economic performance, which expresses the net profit as a percentage of the total revenue. A ratio of more than 10% can be considered as good business. (Tietze *et al.*, 2005) [12].

$$\text{Profit margin (\%)} = \frac{\text{Net Returns (NI)}}{\text{Total Returns (TR)}} \times 100$$

5) Benefit cost ratio: If the benefit cost ratio is greater than 1 (> 1) the fishing is profitable and if it is exactly 1, it means the fishing is at breakeven, i.e., neither making profit nor loss. When the ratio is less than 1 (< 1), the project is operating at a loss.

$$\text{Benefit Cost Ratio (BCR)} = \frac{\text{Total Returns (TR)}}{\text{Total Cost (TC)}}$$

3. Result and Discussion

3.1 Key factors in marine fishing

The distance of the fishing ground is a vital factor disturbing the economics of operation of a fishing vessel. In the study area, the average distance of fishing operation for motorized and mechanized sectors were upto 60 miles along the shore area. But time to reach fishing ground varied like 6-8 hours for motorized and for mechanized range was 6-7 hours due to engine HP.

Table 1: Fishing details

Factors	Motorized crafts	Mechanized crafts
Time to reach the fishing ground (hrs)	8-10	6-8
Distance of fishing ground (miles)	60	60
Size of crew (no.)	6-8	8-10
Crew share (ratio)	50:50	50:50
Average no. of fishing trip (no./month)	3-4	3-4
Type of gears used	Gill net, *Mural net*	Gill net, *Mural net*

The average crew strength for motorized ranged from 6 to 8 and 8 to 10 in the case mechanized sectors. The motorized and mechanized sectors normally had multiday fishing operations and the number of fishing days per trip was varied from 6 to 10 in marine fishing of the study area. The gears like *mural valai* and *paru valai* were largely used by motorized and mechanized sectors in marine fishing. In the study area, crew share ratio was 50:50 which means 50% for owner and 50% for labour from the catch value after covering the operating cost. The fishing trips per month for motorized and mechanized sectors it was 3 to 4 due to variation of fishing days.

3.2 Economic analysis of marine capture fishing

The study analyses the viability of various fishing units of Tharuvaikulam fishing village using different economic and financial indicators.

The capital investment of a fishing unit varied with size of craft, type of engine and the numbers and pieces of gear owned. These factors are influencing the economic efficiency of the fishing craft sectors. Most of the fishing units in operation were old. There was considerable cost difference in the initial investment of old and new units. The capital investment details of different fishing craft categories are shown in Table 2.

Table 2: Estimation of capital cost (Rs in lakhs)

Items	Motorized crafts	Mechanized crafts	Overall
Craft Original cost	5.56±4.25	16.18±0.94	10.87±2.59
	2.00-15.00	7.00-50.00	2.00-7.00
	76.5	58.4	67.45
Present worth	3.05±2.84	8.61±6.82	5.83±4.83
	0.10-11.00	0.50-30.00	0.10-30.00
	93.3	79.2	86.25
Gear Original cost	3.06±2.51	9.18±5.36	6.12±3.95
	0.30-10.00	1.00-20.00	0.30-20.00
	82.3	58.2	70.25
Present worth	1.03±1.40	1.72±9.68	1.37±5.54
	0.01-5.00	0.52-5.00	0.01-5.00
	81.3	56.1	68.7
Engine Original cost	1.00±0.32	0.53±0.42	0.76±0.37
	0.10-3.00	0.10-2.00	0.10-3.00
	91.3	80.4	85.85

Present worth	0.42±0.59	0.07±0.12	0.24±0.35
	0.05-2.00	0.07-0.50	0.05-2.00
	82.3	63.2	72.75

(The values in first, second and third rows indicate mean and S.D, range and C.V in percentage, respectively)

The capital investment of a fishing unit varies with the size of craft, type of engine and the number and units of gear owned. It was found that average original cost and present worth of craft was higher for mechanized sector (OC: mean- 16.18, C.V- 58.4; PW: mean- 8.61, C.V-79.2). The average original cost and present worth of fishing gear for mechanized sector viz., OC: mean- 9.18, C.V- 58.2 %; PW: mean-1.72, C.V-56.1 %. When comparing two fishing sectors, high investment of craft and gear for mechanized sector due to modern technology and high fish holding capacity. The average original cost and present worth of engine was higher for motorized sector (OC: mean- 1.01, C.V-38.2%; mean-0.42, C.V-82.3%) due to replacement with advanced engine for marine fishing. Depreciation of the fishing unit, interest for capital cost, repairs and maintenance and insurance per year constitute the fixed cost. Depreciation was worked out on the basis of the expected life of the fishing boat and accessories and interest was calculated at the rate of 7.50% per annum. The fixed cost details of different fishing craft categories are shown in Table 3.

Table 3: Estimation of fixed cost (in Rs / year)

Items	Motorized crafts	Mechanized crafts	Overall
Depreciation of fishing craft	60,575±38,821	1,79,625±2,70,907	2,10,922±2,68,918
	18,000-1,66,666	50000-14,66,667	18,000 -14,66,667
	64.4	62.3	65.8
Depreciation of fishing gear	1,56,116±1,22,971	3,98,180±3,34,011	4,78,841±35,4074
	14,500-5,00,000	60,000-15,00,000	14,500-15,00,000
	78.1	83.2	66.2
Depreciation of engine	19,733±14,451	21,886±8,591	28,586±12,631
	1,250-59,000	2,500-55,000	1,250-55,000
	73.2	39.5	56.3
Interest on capital cost	1,19,019±70,274	3,42,946±1,37,940	2,30,982±1,04,107
	25,350-2,53,500	85,800-7,02,000	25,350-7,02,000
	59	40.3	42.0
Repairs and maintenance cost	1,43,833±51,580	1,95,600±4,25,842	1,69,716±2,38,711
	36,000-2,00,000	1,00,000-3,00,000	36,000-3,00,000
	58.2	36.5	61.4
Insurance	433±568	1,625±631	1,029±599.5
	0-2,000	1,000-3,200	0-3,200
	78.9	38.6	51.3

(The values in first, second and third rows indicate mean and S.D, range and C.V in percentage, respectively)

The day to day expenses incurred for the operation of the boat is termed as operating expenses or variable costs. The expenses on fuel, wages, food, ice, transport and auctioning of fishes were the major components of variable cost. The variable cost for marine fishing is given in Table 4.

For motorized sector the mean total cost was computed as Rs 10.88 lakhs of which total variable cost and total fixed cost accounted for Rs 5.44 lakhs and Rs 5.44 lakhs, respectively. Among the variable cost items auction charge paid 46% and fuel 25% were the major components. Geetha *et al.* (2014) [4] stated that the average operating cost per kg of fish of the MD gillnetter was worked out to Rs 36.7 lakhs. In the same line, present study revealed that highest annual average total variable cost was observed for mechanized (gillnetter) sector. Senthiladeban *et al.* (2015) [9] recorded that the mean total variable cost was calculated as Rs 2, 11, 161 per year for *vallam* category. Among the fixed cost items, depreciation of gear 36% and interest on capital cost formed the major share 29 % while insurance had no share. The average total returns and net returns were Rs 15.37 lakhs and Rs 39.77 lakhs respectively.

Table 4: Estimation of variable cost (lakhs / year)

Items	Motorized crafts	Mechanized crafts	Overall values
Fuel cost	4.84±1.54	5.67±1.44	5.25±1.49
	2.03-7.95	3.08-8.82	2.03-8.82
	31.0	25.3	28.1
Food expenses	1.46±0.45	2.91±3.58	2.18±2.01
	0.72-2.40	0.63-29.40	0.72-29.40
	30.0	98.2	64.1
Ice cost	0.70±0.34	1.29±0.44	0.99±0.39
	0.36-1.44	0.52-2.62	0.36-2.62
	48.1	34.3	41.2

Transport cost	2.05±1.11	4.36±7.12	3.20 ±4.11
	0.48-4.80	0.63-5.25	0.48-5.25
	54.4	58.0	56.2
Auction charge	6.87±2.22	9.07±2.24	7.97 ±2.23
	5.01-12.58	4.49-15.65	5.01-15.65
	25.0	24.0	24.5
Other expenditure	0.22±0.09	0.41±0.17	0.31±0.13
	0.10-0.48	0.12-1.05	0.10-1.05
	40.0	43.0	41.3

(The values in first, second and third rows indicate mean and S.D, range and C.V in percentage, respectively)

Table 5: Estimation of total cost Rs in lakh /year

Items	Motorized crafts	Mechanized crafts	Overall
Total fixed cost	5.44±4.97	10.87±5.02	8.15 ±4.99
	1.34-29.53	2.87-27.93	1.34-27.93
	91	46	68.5
Total variable cost	5.63±4.97	23.74±9.70	14.68±7.33
	1.34-29.53	0.99-75.77	1.34-75.77
	91	40	65.5
Total cost	10.88±9.94	34.62±10.75	22.75±10.34
	1.09-59.07	20.96-85.23	1.09-85.23
	10	31	20.5
Total returns (excluding crew wage)	15.37±22.09	89.06±24.49	52.21±23.29
	45.14-127.49	11.19-156.58	45.14-156.58
	25	27	26
Net returns	39.77±11.92	28.05±10.20	33.91±11.06
	12.55-61.70	9.98-60.46	12.55-60.46
	29	36	14.5

(The values in first, second and third rows indicate mean and S.D, range and C.V in percentage, respectively)

For motorized sector the mean total cost was computed as Rs 10.88 lakhs of which total variable cost and total fixed cost accounted for Rs 5.44 lakhs and Rs 5.44 lakhs, respectively. Among the variable cost items auction charge paid 46% and fuel 25% were the major components. Geetha *et al.* (2014) [4] stated that the average operating cost per kg of fish of the MD gillnetter was worked out to Rs 36.7 lakhs. In the same line, present study revealed that highest annual average total variable cost was observed for mechanized (gillnetter) sector. Senthiladeban *et al.* (2015) [9] recorded that the mean total variable cost was calculated as Rs. 2, 11, 161 per year for *vallam* category. Among the fixed cost items, depreciation of gear 36% and interest on capital cost formed the major share 29 % while insurance had no share. The average total returns and net returns were Rs 15.37 lakhs and Rs 39.77 lakhs respectively.

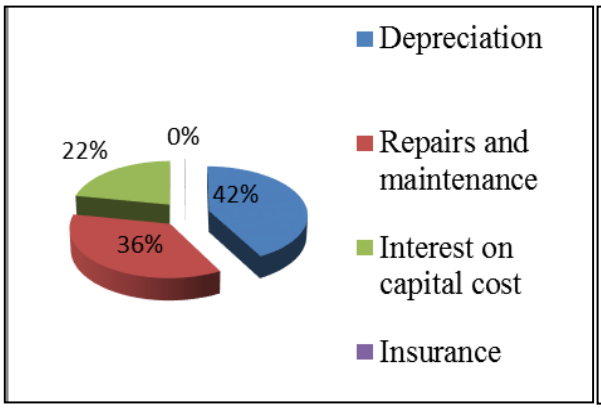

Fig 1: Distribution of fixed cost for motorized sector

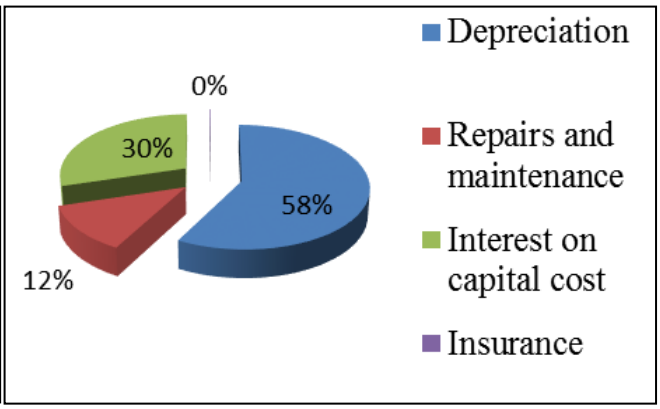

Fig 2: Distribution of fixed cost for mechanised sector

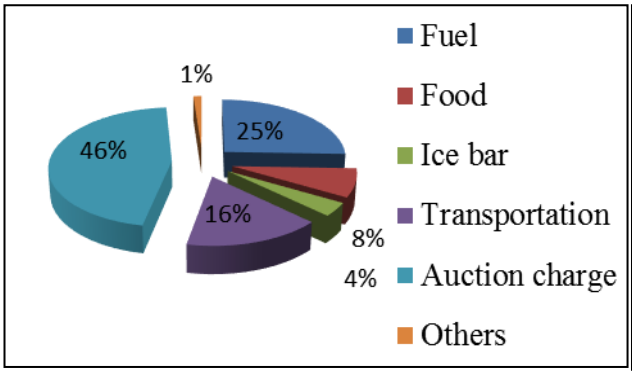

Fig 3: Variable cost for motorized sector

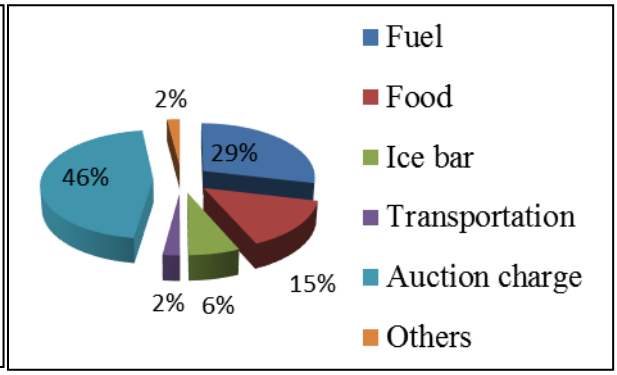

Fig 4: Variable cost for mechanised sector

In mechanized sector, the mean total variable cost of Rs 23.74 lakhs and total fixed cost of Rs 10.87 lakhs constituted to Rs 34.61 lakhs as total cost. Auction charge (46%) and fuel cost (29%) took the major share among the variable cost items (fig 7). Among the fixed cost items, depreciation of fishing gear (34%) and interest on capital cost (30%) were the major ones. The average total returns and net returns were calculated as Rs 89.06 lakhs and Rs 28.05 lakhs, respectively. Among the two sectors fuel cost was high for mechanized crafts due hauling with mechanical power. Food charges also high for mechanized sector because of high crew size and number of days per trip. Ice charge was high for mechanized crafts due to high holding capacity of crafts. Mechanized crafts felt to difficulty to reach the fish landing centre. Therefore, use small vallam used to transfer the catch from crafts to landing centre and cost spends for this action is called transport cost. For that reason, transport cost also high for mechanized sector.

Ratio analysis

Ratio analyses provide information to decide on whether the existing cost of marine fishing are higher or lower. These ratios indicated proportion of gross benefit is used to meet different types of expenditures in fishing (Reddy, S. *et al.*, 2004) [10].

Table 6: Ratio analysis in marine fishing

Ratios	Motorized crafts	Mechanized crafts
Operating cost ratio (%)	24.2	26.1
Fixed cost ratio (%)	6.9	11.9
Productivity ratio (%)	31.2	38.1
Profit margin (%)	46.5	50.0
Benefit Cost Ratio (BCR)	2.72	2.63

The operating cost ratio for motorized and mechanized sectors were worked out as 24.2% and 26.1%, respectively, indicated that the operating cost ratio was higher for mechanised sector when compared to motorized due to low variable cost (table 6). The results of Geetha *et al.* (2014) [4] revealed that 70% of the gross income was spent towards operating expenses by MD gillnetter. Similarly, Datta, K.K and Dan (1992) reported that in the mechanized sector (Gillnetter) operating cost ratio was calculated as 39% to the gross income. Fixed cost ratio gave the proportion of fixed expenses to the gross benefits of fishing operation. The ratio for motorized and mechanisd sectors was worked out as 6.9% and 11.9%, respectively. Geetha *et al.* (2014) [4] stated that for every one rupee earnings 2.6% was shared by fixed expenses of the gillnetter.

The financial performance was measured by profitability of marine fishing. A level of 10% was generally considered to be a good result. The net profit expressed as a percentage of the invested capital, indicated the profitability of the investment in relation to other alternative investments (Tietze *et al.*, 2005) [12]. In the present study, profitability of motorized and mechanized sectors was worked out as 31.2% and 38.1%, respectively. Geetha *et al.* (2014) [4] estimated 73.6% as profit margin ratio for gillnetter. For mechanized have high fixed cost efficiency among the two fishing sectors. Profit margin and benefit cost ratio is high for the motorized sector due to high quantity of fish catch and total cost efficiency.

If BCR was greater than 1, the project is profitable. BCR for motorized and mechanized sectors were estimated at 2.72 and 2.63, respectively. It was found that among the two sectors in the study area adopted gillnet fishing method with profitability. Gillnetters were found to be more efficient as indicated by different criteria of economic viability and gill net fishing leads to sustainable fishing when compared to trawlers (Geetha *et al.*, 2014) [4].

The present study suggested that motorized and mechanized sectors (gillnetter) are economically and financially viable and generate sufficient revenue to cover the cost of depreciation, interest on capital cost and thus generate sufficient funds for reinvestment.

4. Conclusion

The present study showed that the depreciation of fishing gear and interest on capital cost were found to be the major items in the estimation of total fixed cost in both craft sectors. Auction charge and fuel cost are the major costs is accounting in the total variable cost among the two fishing craft sectors. Total variable cost contributed more in the total cost of motorized and mechanized crafts. The motorized fishing sector had higher net returns in marine fishing due to less operational cost with higher returns. Hence this study explaining that gillnet fishing doing by all craft sectors in the study area was sustainable and economically viable fishing method. By encouraging this fishing method will help to maintain sustainable level of fishery resources.

It could be recommended from the study that conversion of trawler to gillnetter in marine fishing as motorized and mechanised sectors because both craft sectors would be

profitable and environment friendly thereby not causing much damages to bottom marine fishery resources.

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