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Economic performance of marine fishing operations in the state of Odisha, India

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ABSTRACT

The marine fish landings in Odisha State, India during 2020 was estimated at 1.75 lakh t, contributing 6.4% of the total marine fish landings in the country. The techno-economic evaluation of different fishing methods in Odisha was carried out for assessing the economic efficiency. Crew wages contributed the major share (62.59 to 87.55%) in motorised crafts and (81.53 to 95.37%) in non-motorised crafts. In motorised crafts, the contribution of fuel to operational costs ranged from 7.2 to 21.8%. Net profit margin and Return on Investment was 35 to 46% and 1 to 4.38 for motorised fishing operations and 42.07 to 74.01% and 2.45 to 12.15 for non-motorised fishing operations, indicating non-motorised fishing operations to be the most economically efficient method. Capital productivity and Input-output ratio was 0.53 to 0.62 and 0.07 to 0.23 for motorised fishing operations and 0.34 to 0.57 and close to nil for non-motorised fishing operations. The gross value added (GVA) of all fishing operations worked out to about 75 % of the gross revenue, which is a significant contribution to the economy. The major fishery resources landed in various fishing operations were clupeids, penaeid shrimps, croakers, pomfrets and carangids. In fishing operations, the increased cost of fishing per trip, the reduced catch and subsequent decline in the gross returns per trip have been cited as important constraints affecting the economic returns from different fishing methods, by the fishers.

Keywords: Capital productivity, Costs, Gross value added, Input-output ratio, Labour productivity, Returns

Introduction

Marine capture fisheries serve as significant sources of employment, income and foreign exchange earnings besides providing nutritional security to people. The sector has transformed from subsistence fishing to the status of a multi-crore industry due to dynamic technological changes in both harvesting and post-harvesting methods. For achieving the objectives of United Nations Sustainable Development Goals (SDG 14), it is imperative that fishing operations should become environmentally sustainable, socially acceptable and economically viable. Though, there are a plethora of studies available on the environmental aspects of fisheries, information on social and economic aspects are only available in isolated patches and regions. This when used for national computations often leads to erroneous estimates. Besides, lot of structural changes has taken place in the socio-techno-economic aspects of fishing, which has far reached implications in the performance of the sector.

Odisha is located between 17^{0}78’ and 22^{0}73’N and 81^{0}37’ and 87^{0}53’E and is bordered by Jharkhand in the north, West Bengal in north-east, the Bay of Bengal in the east, Andhra Pradesh to the south and Chhattisgarh to the north-west (Fig.1). The marine fishery resources of Odisha include, 480 km of coastline encompassing a continental shelf area of 23,830 sq. km, 739 marine fishing villages and 55 marine fish landing centers scattered in 6 coastal districts of Odisha (CMFRI, 2016). About 1,748 mechanised crafts and 5,678 motorised and 1,256 non-motorised crafts are engaged in marine fishing activities in the state. The human resource potential of the marine fisheries sector includes 1.15 lakh families with a total fisher population of 5.18 lakhs. The marine fish landings in Odisha during the year 2020 was estimated at 1.75 lakh t (CMFRI, 2020), contributing 6.4% of the total marine fish landings in the country. The composition of the fish landed included pelagic (44%), demersal (35%), crustaceans (16%) and molluscan (4%) resources. The mechanised and the motorised sectors contributed 82 and 13% of the total landings respectively, while the non-motorised sector contributed only 5%. Major share to the total marine fish landings in the state was attributed to the mechanised sector (CMFRI, 2020). The fishermen use trawl nets, gill nets, ring seines, hooks and lines as well as artisanal nets, for fishing operations in the marine waters.

The major fishery resources of Odisha include clupeids, penaeid shrimps, croakers, pomfrets and carangids. The valuation of the marine fish landings of the state during 2020 was estimated at ₹2,784 crores at landing and ₹4,560 crores at retail level. The unit price per kg of fish at landing centre was ₹159.09 and at retail was ₹260.57 (CMFRI, 2020).

During 2011-2012, the total value of seafood fish from Odisha was ₹793 crores which enhanced to ₹3,100 crores during 2017-18 (DoF, 2020). The sector is providing employment to nearly 2.6 lakhs people directly and indirectly.

Overexploitation of resources caused by use of devastating gears and methods of fishing has caused tremendous pressure on the fishery resources (Narayanakumar, 2012). Reduction in the quantity of catch per unit effort is caused by the depletion in the stock of resources coupled with the increasing cost of fishing inputs (Narayanakumar and Sathiadhas, 2005; Aswathy *et al.*, 2011). For the benefit of the fishers and the fisheries sector, ICAR-Central Marine Fisheries Research Institute (ICAR-CMFRI) has been undertaking primary studies on cost and earnings of different types of fishing crafts for the past three decades. The economic performance of marine fishing operations in the country is affected by various factors *viz.,* diminishing catch per unit of effort, fluctuations in revenue and unforeseen increases in the cost of key inputs as well as catch and effort restrictions. Again, it is the economic performance which determines/decides the investment decisions at the micro level.

The craft and gear combination in Odisha had undergone dramatic changes in the past decade on account of the huge cost of fishing, the duration and depth of operations and the drastic decline in the availability of marine fishery resources. In fact, detailed studies on this aspect are lacking from the state. It is in this context that the present study on comparing the economic efficiency of various crafts and gears in Odisha assumes paramount importance. The paper analyses the viability of various fishing craft-gear combinations using different economic and financial indicators for effective fisheries governance. The economic analysis of marine fishing in the present manuscript will provide vital information for framing appropriate policies for the balanced and sustainable development of the marine fisheries in the Odisha state and when replicated for other maritime states, can lead to the development of a national policy document on techno-economic performance of fishing fleets, which can be the guiding principles in rejuvenating our marine fishery.

Materials and methods

The data on investment, operational costs and earnings of various craft gear combinations were collected from 10 units in each category operating at Gopalpur landing centre (Ganjam District) and Penthakota landing centre (Puri District) of Odisha, during the triennium period (2017-18 to 2019-20). The costs and earnings data were collected for 10 days in each month from ten sample units. Data on quantity and value of different species caught by the units; labour share costs and wages including food, stores and other provisions; fuel (energy) expenses;

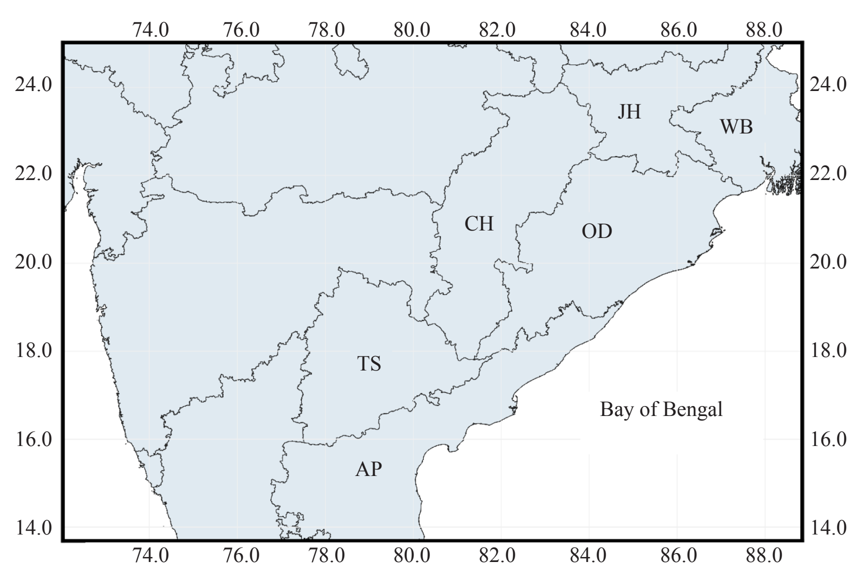

Fig. 1. Map of Odisha showing its neighboring states. (OD-Odisha; AP- Andhra Pradesh; TS-Telangana; JH-Jharkhand; CH-Chhattisgarh; WB-West Bengal)

expenses on craft and gear repair and maintenance and other operational expenditures; cost of various inputs; auction charges, berthing charges and taxes; capital costs involving investment on fishing crafts and gears; details of craft and gear and crew details were collected from the randomly selected units for a period of three years through a pre-tested schedule.

The data pertaining to the fishing crafts and gears, marine fish production over the years by different sectors and socio-economic details were collected from various publications of ICAR-CMFRI, Kochi and Directorate of Fisheries, Government of Odisha.

The economic performance of fishing methods was assessed by working out the operating cost per trip, gross revenue per trip and net cash flow per trip through tabular analysis. The capital and labour productivity were also worked out using operating ratio and catch per crew per trip, respectively to assess the economic performance (Sathiadhas, 1989). In general, operating ratio, net cash flow, capital productivity, labour productivity (kg crew^{-1} trip^{-1}), input-output ratios, Gross value added (GAV) and GAV as %Gross revenue (Narayanakumar *et al.,* 2009) were worked out as the indicators of economic efficiency of different fishing units.

Cost-return ratios were used to measure the overall input and output efficiency in terms of value. Operating 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.

Input-output ratio = Input costs / Gross revenue…... (1)

Operating ratio = Operating costs / Gross revenue....(2)

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

Operating cost/trip = (Fuel + Crew wage + Food + Auction + Repair and maintenance + Other charges)......................(3)

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

$$GR \text{ per trip} = \sum_{i=1}^{n} q_i \, p_i \quad \ldots\ldots(4)$$

where,

q_i is the quantity of catch in kg of the ith variety

p_i is the price per kg of fish of the ith variety

n = No. of fish species caught per trip

Labour productivity = Catch (kg) / No. of Crew……...(5)

Net cash flow (NCF) = Gross revenue - Operational cost....(6)

The net cash flow is regarded as an award for entrepreneurship.

Gross profit = Net cash flow - Depreciation…………(7)

Net profit before taxes (NPBT) = Gross profit - Interest ….(8)

Net profit Margin = NPBT / Revenue from landings ……..(9)

The net profit margin is a measure of profitability after all costs have been accounted for and reflects the percentage of revenue that a vessel owner retains as profit.

Return on Investment (ROI) = NPBT / Value of assets..…(10)

The return on investment is the most commonly used indicator for financial performance.

Gross value added (GVA) = Net cash flow + Labour costs...(11)

The gross value added shows the return of the fishing vessel operations to the economy and is useful for making future fisheries sector investment and expenditure decisions.

GVA to revenue = GVA / Gross revenue from landings………..……(12)

The GVA to revenue figure is expressed as percentage and provides for the share of revenue that contributes to the economy through the production factors (Carvalho *et al*., 2020).

Results and discussion

Review on 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 (Sathiadhas, 1989; Narayanakumar *et al.,* 2009). In spite of the increase in fleet size and the decrease in the catch rates, the fishing sector is able to sustain mostly due to the increase in the price of almost, all the species of fishes. However, owing to the open-access nature of marine capture fisheries and the intense competitions for resources associated with it, many of the less efficient fishing units are being gradually phased out of operation due to the losses. Hence, the comparative economic efficiency of various craft-gear combinations in terms of various key economic indicators was estimated on the basis of costs and returns data.

Fishing operations

Motorised fishing crafts: The motorised crafts, mostly operating hooks and lines, trammel-net, gill net

(*Discovala*) and a variety of small-meshed gill nets (*Jogavala, Katlavala*) and large-meshed gill nets (*Gagaravala*) perform single day fishing (SDF) operations and are of an average of 28-30 feet overall length (OAL) with engine power ranging from 9-10 HP. *Discovala*, a triple layered gill net, is chiefly employed in the near shore waters to catch penaeid shrimps. Catfishes, snappers, eels and seer fishes are caught chiefly in hooks and lines. The two small-meshed gillnets (*Jagavala* and *Katlavala*), among which the former is mostly a bottom-set type gillnet whereas the latter is drift type gill net and land mostly sciaenids, horse mackerel, ribbon fishes, crabs, Indian mackerel and anchovies. Large-meshed gill nets (*Gagaravala*) are operated both as bottom-set and as drifting off the coast and the major catches obtained were seerfishes, tunas, catfishes, grunts, sharks, queenfishes and giant trevally. Penaeid shrimps, snappers, catfishes, eels and seer fishes are in high demand both in domestic as well as in export markets. The average crew size was found to be 6-7. The single day fishing normally operates along the Odisha waters between 26-35 m depth and travel 25-48 km south-west (SW) and north-east (NE) to reach the fishing grounds. The boats are usually making one to two hauls every day with an active hauling duration of 1.1 to 5 h (Table 1).

Non-motorised fishing crafts: The traditional/ non-motorised crafts (SDF), operating *hooks and lines, Jogavala, katlavala, Discovala* and *Gagaravala* have an average OAL of 21-29 feet. Mostly catfishes, snappers, seer fishes, eels, groupers, rays, grunters and tunas are landed in hooks and lines. The catch in the small-meshed *gillnet* comprised chiefly of penaeid shrimps, Indian mackerel, threadfin breams, horse mackerel, sciaenids, wolf herring and ribbon fishes. The average crew size was found to be 5-7. The non-motorised boats normally operate between 11-30 m depth and travel 18-40 km SW/ NE to reach the fishing grounds for catch. The boats are usually making one haul every day with an active duration of one to five hours (Table 2).

Economic performance

The analysis of the resource use in marine fishing methods indicated that in motorised crafts, share of fuel in the total operational cost ranged from 11.6% in case of *Katlavala* to 21.8% in G*agaravala*. However, higher contribution by fuel to operational costs in motorised crafts, ranging from 35 to 42% was earlier reported from Andhra Pradesh during 2003-2004 by Venkata Raju *et al*. (2017). Crew wages ranged from 62.6% (*Discovala*) to 82.4% (*Katlavala*). Similar reports on labour costs to be significantly higher in motorised crafts were reported from Kerala by Balan *et al*. (1989).

In non-motorised crafts, almost the entire operational costs were towards crew wages (81.53 to 93.57%). There was no expense towards fuel as non-motorised crafts are driven by the power of wind using sails. For most European Union (EU) mechanised fleets, input costs were either comparable or more than labour costs (Carvalho *et al*., 2020). In Turkey, UK and Italy, input costs (25 to 61%) were higher than labour costs (21 to 34%). In Spain and France, for demersal trawlers which undergo long distance fleets, input costs were more (33 to 53%). On the contrary, for Norway and Germany, which do trawl in nearshore waters, inputs costs (15 to 26%) were comparatively less (Carvalho *et al*., 2020). Also, as found in the present study, for smaller fishing crafts, in most

Table 1. Motorised fishing (SDF) pattern details in Odisha (2017-2020)

Particulars	*Hook and line*	*Jogavala*	*Katlavala*	*Discovala*	*Gagaravala*
Overall length (OAL) (feet)	30	28	28	28	28
Engine (HP)	9-10	9	9	9	9
Number of crew	6	7	7	7	7
Depth of fishing (m)	26-35	33	32	35	30
Distance to fishing ground (km)	25-32	48	44	48	41
Number of hauls per trip	1	2	2	2	2
Duration of haul (h)	3.5-5	1.6	1.4	1.4	1.1

Table 2. Non-motorised fishing (SDF) pattern details in Odisha (2017-2020)

Particulars	*Hook and line*	*Jogavala*	*Katlavala*	*Discovala*	*Gagaravala*
Overall length (OAL) (feet)	21	29	27	27	27
Number of crew	5	7	7	7	7
Depth of fishing (m)	24	11-30	30	30	25
Distance to fishing ground (km)	18	40	35	40	31
Number of hauls per trip	1	1	1	1	1
Duration of haul (h)	5	2	1	1	2

European countries, labour costs are the highest cost component (Carvalho *et al*., 2020).

The average total value of assets (including craft, engine, gear, GPS and all other accessories required to perform fishing) was ₹2.93 lakh for a motorised unit, whereas for non-motorised unit, it was ₹0.951 lakh. Annual depreciation of motorised crafts was high (₹50,186), whereas for non-motorised (₹18,856), it was low. The depreciation was calculated taking into consideration the purchase value of the assets and the economic life of the assets. Similarly, the annual interest on fixed capital assets was high (₹20,560) for motorised crafts and low for non-motorised (₹6659) crafts.

The marine fisheries of Odisha exhibited seasonal variations to a great extent and the quantity-wise and valuation-wise landings of major species in motorised fishing and non-motorised fishing are given in Tables 3 and 4.

The economic performance of motorised and non-motorised fishing operations are presented in Tables 5 and 6. It is seen from the tables that the net profit margin was highest (43.24 to 74.01%) for non-motorised fishing operations, followed by motorised fishing operations (35 to 43%). A net profit margin higher than 20% is considered to be good with higher operating efficiency. This indicated non-motorised fishing operations to be the most profitable and motorised fishing operations to be the least profitable. Similarly, Sathiadhas (1989) when comparing the economic efficiency of sail boats operating different fishing gears in Tamil Nadu concluded that non-motorised sailboats operating gill netters were economically more efficient than the boats fitted with engines. However, the amount of money, and subsequent profit generated or produced from motorised fishing operations is superior to that of non-motorised fishing operations, as evident from the values of Net cash flow and Gross profit.

Among non-motorised fishing operations, *Gagaravala* fishing was found to be the most economically efficient. Among motorised fishing operations, hooks and lines, *Jogavala* and *Katlavala* fishing were found to be the best in terms of capital productivity. In an earlier study conducted by Venkata Raju *et al*. (2017) in Andhra Pradesh during 2003-2004, the average rate of return in non-motorised fishing operations was superior when compared to motorised fishing operations.

Similar to Net profit margin, Return on Investment (RoI) was also highest (2.45 to 12.15) in non-motorised fishing operations, signifying it to be the best in terms of financial performance. For non-motorised fishing operations, the average cost of assets is very low as the crafts are manufactured using wooden logs, but motorised crafts are made up of fibre reinforced plastic (FRP) and hence, the asset cost is higher in motorised fishing operations. Motorised fishing operations, with the exception of *Jogavala* (2.58) had low RoI. This could be attributed to the fact that Net cash flow and Gross profit was low for other motorised fishing operations (*Discovala, Gagaravala* and *Hooks and lines*) and therefore, could be considered to be financially inferior.

Table 3. Species composition in motorised fishing of Odisha (%)

Species	Quantity share	Species	Value share
Plicofollis dussumieri	21.89	*Pomadasys kaakan*	14.12
Netuma bilineata	12.35		
Pomadasys kaakan	10.10		
Muraenesox bagio	7.53	*Muraenesox bagio*	10.04
Rhabdosaruus sarba	6.66	*Scomberoides commersonianus*	7.84
Epinephelus coioides	5.36	*Netuma bilineata*	7.22
Scomberomorus commerson	5.11	*Rhabdosargus sarba*	6.50
Plicofollis layardi	5.04	*Epinephelus coioides*	5.11
Scomberoides commersonianus	3.52	*Lutjanus johnii*	4.31
Lutjanus indicus	3.42	*Lutjanus indicus*	4.31
Lutjanus johnii	3.41	*Plicofollis layardi*	2.69
Congresox talabonoides	1.70	*Lutjanus rivulatus*	2.24
Terapon jarbua	1.69	*Paeneus indicus*	1.98
Lutjanus rivulatus	1.62	*Congresox talabonoides*	1.80
Scomberomorus sp.	1.33	*Rachycentron canadum*	1.48
Rachycentron canadum	1.24	Others	6.37
Paeneus indicus	1.19		
Otolithes ruber	1.17		
Coryphaena hippurus	1.06		
Others	5.33		

Table 4. Species composition in non-motorised fishing of Odisha (%)

Species	Quantity share	Species	Value share
Opisthopterus tardore	7.85	*Lutjanus johnii*	11.75
Portunus sanguinolentus	7.18	*Lutjanus indicus*	10.12
Hilsa kelee	6.37	*Epinephelus coioides*	7.23
Otolithes ruber	6.09	*Lutjanus rivulatus*	6.56
Lutjanus johnii	5.75	*Portunuss sanguinolentus*	5.98
Sardinella fimbriata	5.34	*Otolithes ruber*	5.81
Plicofollis layardi	4.75	*Opisthopterus tardoore*	5.27
Lutjanus indicus	4.53	*Hilsa kelee*	4.34
Epinephelus coioides	4.24	*Plicofollis tenuispinis*	3.91
Leignathus spp.	3.98	*Pomadasys kaakan*	3.78
Maculabatis gerrardi	3.47	*Rhabdosargus sarba*	2.96
Brevitrygonim imbricata	3.16	*Sardinella fimbriata*	2.78
Nibea maculata	3.09	*Plicofollis dussumieri*	2.50
Plicofollis dussumieri	3.09	*Nibea maculata*	1.99
Lutjanus rivulatus	2.81	*Maculabatis gerrardi*	1.69
Johnius spp.	1.99	*Rastrelliger kanagurta*	1.69
Johnius carutta	1.98	*Rachycentron canadum*	1.67
Secutor insidiator	1.98	*Congresox talabonoides*	1.66
Rastrelliger kanagurta	1.94	*Leiognathus* spp.	1.54
Pomadasys kaakan	1.79	*Brevitrygon imbricata*	1.35
Rhabdosargus sarba	1.64	*Johnius carutta*	1.28
Alepes kleinii	1.51	*Pristipomoides filamentosus*	1.21
Pennahia spp.	1.48	Carangids	1.20
Terapon jarbua	1.35	*Johnius* spp.	1.20
Lepturocanthus savala	1.29	*Lepturocanthus savala*	1.08
Carangids	1.06	Others	9.51
Others	10.34		

Table 5. Economic performance of motorised fishing (SDF) operations in Odisha (2017-2020)

S. No.	Component	*Hook and line*	*Jogavala*	*Katlavala*	*Discovala*	*Gagaravala*
1	Crew wages (₹)	6437 (80.75)	8195 (81.86)	7780 (82.39)	3147 (62.59)	4544 (65.09)
2	Crew bata value, including food, stores and provisions (₹)	8 (0.10)	13 (0.13)	6 (0.06)	25 (0.50)	36 (0.52)
3	Sub-total labour costs (₹)	6445 (80.85)	8208 (81.86)	7786 (82.45)	3172 (62.59)	4580 (65.09)
4	Fuel cost (₹)	1194 (14.98)	1030 (10.29)	1094 (11.59)	1090 (21.68)	1522 (21.80)
5	Other charges, including craft and gear repairs and maintenance (₹)	333 (4.18)	773 (7.72)	563 (5.93)	766 (15.23)	879 (12.59)
6	Sub-total input costs (₹)	1527 (19.16)	1803 (18.01)	1657 (17.55)	1856 (36.91)	2401 (34.39)
7	Total operating cost (₹)	7972 (100)	10011 (100)	9443 (100)	5028 (100)	6981 (100)
8	Catch(kg)	102	96	113	29	66
9	Gross revenue (₹)	14400	18193	17216	8150	11448
10	Crew size (Number)	6	7	7	7	7
11	Net cash flow (₹)	6428	8182	7773	3122	4467
12	Gross profit (₹)	6188	7937	7542	2924	4252
13	Net profit before taxes (₹)	6085	7831	7436	2821	4151
14	Net profit margin (%)	42	43	43	35	36
15	Return on Investment (ROI)	2.08	2.58	2.45	1	1.42
16	Capital productivity (Operating ratio)	0.55	0.55	0.55	0.62	0.61
17	Labour productivity (kg crew^{-1} trip^{-1})	17	13.7	16.14	4.11	9.41
18	Input-output ratio	0.11	0.10	0.10	0.23	0.21
19	Gross value added (GVA, ₹)	12865	16377	15553	6299	9011
20	GVA as % Gross revenue	89.34	90.02	90.34	76.92	78.71

Figures in parenthesis indicate % to total operating cost

Table 6. Economic performance of Non-motorised fishing (SDF) operations in Odisha (2017-2020)

S. No.	Component	*Hook and line*	*Jogavala*	*Katlavala*	*Discovala*	*Gagaravala*
1	Crew wages (₹)	6411 (95.37)	5656 (88.82)	2795 (93.57)	2961 (81.53)	3102(81.59)
2	Crew bata value, including food, stores and provisions (₹)	10 (0.15)	0	0	25 (0.69)	35 (0.92)
3	Sub-total labourcosts (₹)	6421 (95.52)	5656 (88.82)	2795 (93.57)	2986 (82.22)	3137 (82.51)
4	Other charges, including craft and gear repairs and maintenance (₹)	301 (4.48)	712 (11.18)	192 (6.43)	646 (17.78)	665 (17.49)
5	Sub-total input costs (₹)	301 (4.48)	712 (11.18)	192 (6.43)	646 (17.78)	665 (17.49)
6	Total operating cost (₹)	6722 (100)	6368 (100)	2987 (100)	3632 (100)	3802 (100)
7	Catch (kg)	77	89	58	22	74
8	Gross revenue (₹)	13122	11312	5616	6568	15069
9	Crew size (Number)	5	7	4	7	7
10	Net cash flow (₹)	6400	4944	2629	2936	11267
11	Gross profit (₹)	6267	4934	2529	2869	11184
12	Net profit before taxes (₹)	6231	4898	2493	2840	11152
13	Net profit margin (%)	47.49	43.30	44.39	43.24	74.01
14	Return on Investment (RoI)	6.12	4.81	2.45	3.47	12.15
15	Capital productivity (Operating ratio)	0.51	0.56	0.53	0.57	0.34
16	Labour productivity (kg crew^{-1} trip^{-1})	15.4	12.68	14.5	3.12	10.5
17	Input-output ratio	0.023	0.06	0.034	0.1	0.04
18	Gross value added (GVA, ₹)	12811	10600	5424	5897	14369
19	GVA as a per cent to Gross revenue	97.63	93.71	96.58	89.78	95.35

Figures in parenthesis indicate % to total operating cost

Capital productivity for motorised and non-motorised fishing operations ranged from 0.55 to 0.62 and 0.34 to 0.57. This indicated that across all sectors, a minimum of 40% of the Gross revenue is left with the owner to meet the capital (fixed) costs and the rest is profit. Similar observations were made by Narayanakumar and Sathiadhas (2005).

Input-output ratio for motorised and non-motorised fishing operations, was pretty low. The values ranged from 0.10 to 0.23 for motorised fishing operations and for non-motorised fishing operations, it was 0.023 to 0.1. With fuel usage in motorised fishing operations, input costs accounted for 18-37% of the operational costs of motorised fishing operations, hence, high Input-output ratio. On the contrary, in non-motorised fishing operations, input costs are low (4 to 18%), due to the non-requirement of fuel for propulsion or fishing. Sathiadhas and Panikkar (1988) from Trivandrum reported that non-motorised fishing operations exhibit better Input-output and Capital productivity as compared to other fishing operations as the initial investment is comparatively less.

Maximum contribution to the economy in terms of cash or money was from production factors, as evident in high values of GVA. Among both, motorised and non-motorised fishing operations, *Jogavala* and *Gagaravala* provided the best returns to the economy with high amount of GVA, when compared to its counterparts. The share of the revenue that contributed to the economy was high for motorised and non-motorised fishing operations because of low input costs. The results of GVA to Gross revenue are comparable to that of EU fleets (60%) (Carvalho *et al*., 2020).

The analysis of the economic performance indicated that the consistent and continuous increase in the cost of fuel and declining market prices of the catch in recent years has had an adverse effect on profitability. In fishing operations, the increased cost of fishing per trip, the reduced catch and subsequent decline in the gross returns per trip have become important constraints affecting the economic returns from different fishing methods. The marine production from the inshore waters has reached its optimum and even for some resources are over exploited, Further increase in production from marine capture fisheries can only be achieved through judicious management of inshore fishery resources, through proper utilisation of harvested resources using or enhancing shore based facilities, implementation of Code of Conduct for Responsible Fisheries (CCRF), participatory management and by diversifying to deep sea fishing operations. With higher operating expenses incurred for the fishing operations, as evident from the values of financial indicators obtained in the present study, it is necessary to provide institutional financial assistance to small scale fishing sector at a lower interest rate. This would be helpful to get rid of the middlemen, who provide finance at a higher interest rate, therefore ensuring higher profitability for fishing operators. The study recommends optimisation of resource use to improve the techno-economic efficiency of single day fishing operations (both motorised and non-motorised). Odisha has established itself as a major fish producer in the country. However, more work is required to realise its full potential. Traditional fishing method, which has been neglected, must be explored and employed sustainably to increase fish catch. Considering the contribution of traditional sector to fish production, employment and as sustainable fishing method, promoting and encouraging non-mechanised fisheries is required for the state's fisheries sector to grow sustainably.

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