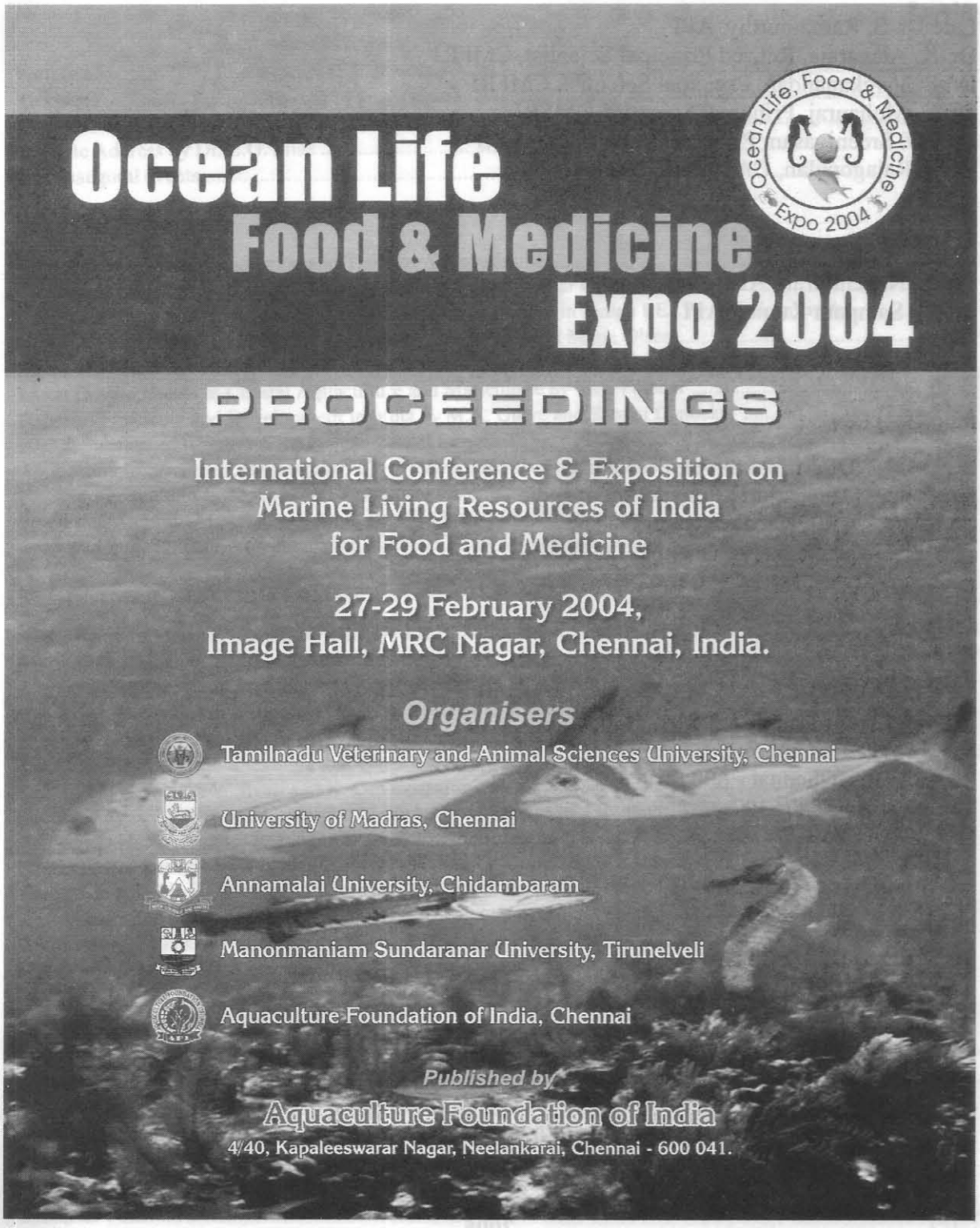
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ECONOMIC LOSS AND GAINS OF MARINE FISHING ALONG KERALA COAST

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ABSTRACT

Along the Kerala coast, the capital investment in mechanised, motorised and non-mechanised sectors of various craft-gear combinations, on an average, ranges from Rs. 23,000 for a small *catamaran* unit in the non-motorised sector to Rs.25 lakh for a small trawler in the mechanised sector. The average operating cost of individual craft among these categories varies between Rs.8,000 and Rs.13 lakh providing returns to the tune of 15 per cent to 140 per cent of the capital investment. Economic loss due to juvenile fishing is severe for species like flatfish with a differential ratio 0.14, anchovies with 0.20, threadfin breams with 0.21, carangids 0.29 and shrimps 0.33. The annual average profit of various craft-gear combinations is often not sufficient to compensate the overall loss generated by the same. The gross earnings as well as economic loss made due to juvenile fishing by trawlers, purse seiners, ring seiners and mini trawlers are worked out separately. The annual gross estimate shows that the economic loss made by these units is about Rs.1,847 crore whereas the revenue generated by them comes to only Rs.705 crore, thus causing a loss of Rs.1,142 crore to the coastal economy of Kerala. The production function analysis indicates that there is also scope for increasing the operational efficiency of trawlers by way of optimising the number of fishing days. The case is proved to have wider economic implications and environmental importance.

INTRODUCTION

There are 30,471 fishing craft along the Kerala coast. Of this, 5,088 are mechanised, 14,662 are motorised and 10,721 are non-motorised boats. Inspite of low capacity utilisation in some sectors, overexploitation prevails for some resources depending upon the technological inputs under use. This intricate problem is studied with the following objectives: i) to evaluate the economic configuration of various fishing units, their craft-gear combinations and catch composition, ii) to assess the costs and earnings of different fishing units, iii) to assess the economic cost of juvenile fishing, and iv) to evaluate the economic efficiency of input utilization in trawler operation.

MATERIALS AND METHODS

The study is part of a research work on Environmental Economic Analysis of Inshore Fishery Resource Utilization of Coastal Kerala funded by Indira Gandhi Institute of Development Research (IGIDR) under the Environmental Capacity Building Project of World Bank implemented through the Ministry of Environment and Forests of Government of India. A preliminary survey was carried out in all the fishing villages covering the entire study area from Poovar in the south to Munambam in the north along four coastal districts, viz., Thiruvananthapuram, Kollam, Alappuzha and Ernakulam of Kerala. Altogether 11 representative villages were identified from these four districts for a detailed study on

mechanised, motorised and non-mechanised fishing units. The costs and earnings data of sample units for all days from each landing centre, covering all seasons in a year (2001-2002) were collected. Average capital investment, total fixed cost, gross and net returns of each craft-gear combinations in operation were calculated. Data on juvenile landings in the catch composition of each unit were also collected from the landing centres. The length of specimens from the tip of the snout to the tip of the longest caudal ray was measured to categorise the landings into juveniles and adults. The quantity of juveniles landed in each fishing unit was recorded along with the corresponding price from the landing centre. The length-weight relationship of the form $W = {}_aL^b$ (where W-weight of the fish, L-length of the fish, a-constant, b-exponent) was fitted to obtain the weight of the adult fish corresponding to the weight of the juvenile fish. Economic loss due to juvenile fishing by different fishing units is estimated using the method.

$$EL = \left(\frac{\sum_{\iota=1}^{n} C_i Q_i}{N} \right) - \left(\frac{\sum_{\iota=1}^{n} c_i q_i}{N} \right)$$

Where,

EL = Average Economic Loss per unit trip
C = Value of the marketable size fish/trip
Q = Quantity of the marketable size fish corresponding to the quantity of juvenile fish/trip
c = Value of the juvenile fish
q = Quantity of juvenile fish in the catch
N = number of trips/boat

The input-output relationship and the consequent economic efficiency of trawlers were assessed. For this purpose, data were collected from three centres, viz., Neendakara, Cochin Fisheries Harbour and Munambam. The relationship is studied using Cobb-Douglas production function model. The data were collected from 50 trawlers for a five-year period from 1996 to 2000. Cobb-Douglas production function used to evaluate the economic efficiency of input utilization in trawler operation is given below:

$$Y = a.\, X_1^{b1} .X_2^{b2} .X_3^{b3}$$

Where,

Y - Gross output in kilograms
X_1 - Number of fishing days per unit in a year
X_2 - Quantity of fuel used in a year/unit
X_3 - Annual repairing & maintenance charges/unit
$b1, b2, b3$ - Regression coefficients

Marginal value productivity (MVP) was also computed for all the explanatory variables X_1, X_2 and X_3. MVP of a particular input is the addition to gross returns for the increase in one more unit of that input while other inputs are kept constant. It was obtained by multiplying the regression coefficients of explanatory variables with the ratio of geometric mean (GM) of gross returns to geometric mean of given input.

RESULTS AND DISCUSSION

Capital investment on different craft-gear combinations

Mechanised crafts of purse seine, gill net and trawl units require higher capital investment. Mechanised trawler of Overall Length (OAL) > 50ft needs a total capital investment of Rs.25 lakh whereas that of purse seine units require Rs.20 lakhs. Purse seiners invest, on an average, 18 to 28 per cent of its total investment on gears, whereas this varies between 3 to 6 per cent for mechanised trawlers. Mechanised gillnet units require a total investment of Rs.11.5 lakhs with 15 per cent of the total investment on gears. The capital investment for mechanised trawler and purse seine of OAL 36-42ft is Rs.6 lakhs and Rs.8.35 lakhs respectively [Table 1 (a)].

Within the motorised sector, ring seine units need more capital investment than that of mini trawl and plywood boats with gillnet units-Ring seine of OAL 32-48ft and <32ft need Rs.5.15 lakh and Rs.2.67 lakh respectively [Table 1 (b)]. Shore seine units dominate the non-mechanised sector with respect to total capital investment requirements. Non-mechanised *dinghi* and *catamaran* both with gillnet units require total capital investments of Rs.28,500 and Rs.23,500 respectively [Table 1 (c)].

Table 1(a). Capital investments (in Rs.) of various mechanised crafts (in ft.) (2001-02)

Item	MECHANISED SECTOR						
	Trawler			Purse Seine			Gillnet
	36-42	45-48	> 50	36-42	45-48	> 50	
Craft & (Engine)	5,70,000	12,45,000	24,28,000	6,50,000	9,00,000	17,00,000	10,00,000
Gear	30,000	55,000	72,000	1,85,000	2,00,000	3,00,000	1,50,000
Total	6,00,000	13,00,000	25,00,000	8,35,000	11,00,000	20,00,000	11,50,000

Costs and Earnings: The Total Fixed Cost (TFC) of mechanised gillnet (Rs.3.14 lakhs) is higher than that of mechanised trawler (Rs.1.68 lakhs) and purse seine units of OAL 36-42ft (Rs.2.35 lakhs). At the same time, the Operating Cost (OC) is minimum for mechanised trawler units of OAL 36-42ft (Rs.8.36 lakhs). Within this sector, the lowest rate of return is estimated for trawlers of OAL > 50ft (31 per cent) (Table 2 (a))

Among motorised units, ring seiner of size >50ft have the highest TFC (R.1.96 lakhs) and OC (Rs.13.18 lakhs) followed by its smaller category of OAL 32-48ft with TFC of Rs.1.47 lakhs and

OC of Rs.9.23 lakhs. Within the motorised sector, mini trawl units have the lowest TFC (Rs.25,340) and OC (Rs.3 lakhs) but have the highest estimated rate of return of 140 per cent, which is followed by ring seine of OAL >50ft with 72 per cent and that of OAL <32ft with 71 per cent. Plywood boats with gill net has the lowest rate of return (55 per cent) within the motorised category [Table 2 (b)].

Table 1(b). Capital investments (in Rs.) of various motorised crafts (in ft.) (2001-02)

Item	MOTORISED SECTOR				
	Ring Seine			Plywood boat with gillnet	Mini trawl
	< 32	32-48	> 50		
Craft & (Engine)	2,30,000	3,77,000	4,07,200	1,40,000	94,000
Gear	37,000	1,38,250	2,52,000	20,000	2,500
Total	2,67,000	5,15,250	6,59,200	1,60,000	96,500

Table 1(c). Capital investments (in Rs.) of various non-mechanised crafts (2001-02)

Item	NON-MECHANISED SECTOR		
	Shore seine	*Dinghi* with gillnet	*Catamaran* with gillnet
Craft	35,000	25,000	10,000
Gear	67,000	3,500	13,500
Total	1,02,000	28,500	23,500

In non-mechanised sector, shore seine unit has the highest TFC (Rs.33,220) and OC (Rs.2.95 lakhs) with a rate of return of 115 per cent. *Dinghi* and *catamaran* with gillnet units have the lowest rate of return of 18 per cent and 15 per cent respecti vely [Table 2 (c)].

Table 2 (a). Annual average costs and earnings (in Rs.) of various mechanised crafts (in ft.)(2001-02)

Item	MECHANISED SECTOR						Mechanised Gillnet
	Mechanised Trawler			Purse Seine			
	36-42	45-48	> 50	36-42	45-48	> 50	
Total Fixed Cost (TFC)*	1,68,000	3,60,000	6,78,800	2,35,600	3,06,000	5,50,000	3,14,000
Operating Cost (OC)**	8,36,622	16,14,895	18,03,290	13,31,176	13,26,628	29,86,768	13,04,830
Rate of Return (%)	53	51	31	36	54	87	55

Table 2 (b). Annual average costs and earnings (in Rs.) of various motorised crafts (in ft.) (2001-02)

Item	MOTORISED SECTOR				
	Ring Seine			Plywood boat with gillnet	Mini trawl
	< 32	32-48	> 50		
Total Fixed Cost (TFC)*	73,120	1,47,790	1,96,592	43,600	25,340
Operating Cost (OC)**	5,10,848	9,23,430	13,18,675	3,70,702	3,01,431
Rate of Return (%)	71	47	72	55	140

Table 2 (c). Average annual costs and earnings (in Rs.) of various non-mechanised crafts (in ft.) (2001-02)

Item	NON-MECHANISED SECTOR		
	Shore seine	*Dinghi* with gillnet	*Catamaran* with gillnet
Total Fixed Cost (TFC)*	33,220	7,760	7,460
Operating Cost (OC)**	2,95,007	33,418	8,700
Rate of Return (%)	115	18	15

**TFC - includes depreciation on crafts and gears, interest on capital investment and insurance charges*
***OC - includes expenditure on fuel, wages, auction, ice, food, repairing and maintenance.*

The key economic indicators of different mechanised craft-gear combinations are given in Tables 3, 4 and 5 for a comparative assessment. Among the three different types of mechanised gears, the average catch per day of operation is highest in trawler (2,775 kg) and lowest in gillnetter (179 kg). However, in terms of average value realisation per kg of fish, it is very much higher in gillnetter (Rs.50.70) compared to that of trawler and purse seiner. This is mainly because the gill net is a selective gear and the species landed are large sized high-value fishes such as seerfish, groupers and tuna. The low value realisation in trawler is an indication of increased by-catch landings. Quantity of fish produced per man-day in trawler is 462.5kg, which shows that the trawling is not labour-intensive. However the highest quantity of fish per litre of fuel was obtained from trawler. Fuel consumption for producing one kg of fish is highest for gillnetter with Rs. 12.65.

Among the motorised craft-gear combinations, the catch and revenue per day of operation is the highest for ring seiners. The average value realisation is high in mini-trawl with Rs.36.45/kg, which is mainly due to the landings of *penaeid* prawns in the mini-trawl. Value of production per man-day is higher in mini-trawl (Rs. 862.50). Among the non-mechanised units, the average catch per day of operation is highest in the shore seine (156 kg) and lowest in *dinghi* with gillnet (6.7 kg). The average value realisation is highest in *dinghi* with Rs.28.96. Even though the average catch per day is the highest in shore seine unit, the quantity of fish produced per man-day is only 8.6 kg, indicating high labour involvement in its operation. The average operational cost is highest in shore seine unit with Rs.1,307/day. *Catamaran* with gill net unit provides the highest return to labour with Rs.208.3/day and lowest value obtained for *dinghi* with gill net.

Table 3. Key Economic Indicators of mechanised fishing units (2001-02)

Sl. No	Particulars	Gillnetter	Trawler	Purse seiner
1.	Average catch per day of operation (kg)	179.00	2,775.00	1,098.00
2.	Average revenue per day (Rs)	9,076.00	15,600.00	11,480.00
3.	Average No. of days faished in a year	230.00	200.00	180.00
4.	Average value realized per Kg of fish (Rs)	50.70	11.02	10.45
5.	Quantity of fish produced per man day (kg)	35.80	462.50	36.60
6.	Quantity of fish produced per litre of fuel (kg)	1.58	12.02	8.14
7.	Value of production per man day (Rs)	1,815.20	2,600.00	382.66
8.	Average fuel cost per day of operation (Rs)	2,265.00	4,620.00	2,696.00
9.	Avg. variable cost per day of operation (Rs)	5,673.00	11,070.00	7,370.00
10.	Avg. total cost per day of operation (Rs)	7,038.00	12,870.00	9,070.00
11.	Fuel cost per Kg of fish (Rs)	12.65	1.70	2.40
12.	Operational cost per Kg of fish (Rs)	31.69	4.00	6.70
13.	Total cost per Kg of fish (Rs)	39.32	4.70	8.26
14.	Man days required to produce one tonne of fish	27.93	2.16	27.32
15.	Fuel required to produce one tonne of fish (ltr)	869.56	83.33	122.86
16.	Returns to Labour (Rs)	855.30	1,003.50	189.40
17.	Gross returns per day of operation (Rs)	3,403.00	4,529.00	4,109.00
18.	Annual operating profit (Rs)	7,82,650.00	9,05,920.00	7,39,772.00
19.	Annual net profit (Rs)	4,68,650.00	5,45,920.00	4,33,772.00

Table 4. Key Economic Indicators of motorised fishing units (2001-02)

Sl. No	Particulars	Plywood Boats	Ring seiner	Mini trawler
1.	Average catch per day of operation (kg)	254.40	384.70	71.00
2.	Average revenue per day (Rs)	3,110.30	5,616.00	2,587.60
3.	Average No. of days fished in a year	215.00	220.00	200.00
4.	Average value realized per Kg of fish (Rs)	12.23	14.60	36.45
5.	Quantity of fish produced per man day (kg)	63.60	32.06	23.67
6.	Quantity of fish produced per litre of fuel (kg)	18.17	3.75	2.33
7.	Value of production per man day (Rs)	777.56	468.00	862.53
8.	Average fuel cost per day of operation (Rs)	280.00	2054.00	607.50
9.	Avg. variable cost per day of operation (Rs)	2,396.50	4,197.00	1,721.00
10.	Avg. total cost per day of operation (Rs)	2,595.30	4,869.00	1,847.60
11.	Fuel cost per Kg of fish (Rs)	1.10	5.40	8.58

12.	Operational cost per Kg of fish (Rs)	9.40	11.00	24.31
13.	Total cost per Kg of fish (Rs)	10.20	12.65	26.00
14.	Man days required to produce one tonne of fish	15.72	31.19	42.25
15.	Fuel required to produce one tonne of fish (ltr)	55.03	266.67	429.18
16.	Returns to Labour (Rs)	606.70	208.60	568.47
17.	Gross returns per day of operation (Rs)	713.70	1418.6.00	866.70
18.	Annual operating profit (Rs)	1,53,448	3,12,119.00	1,73,349
19.	Annual net profit (Rs)	1,10,717.00	1,64,330.00	1,48,009.00

Table 5. Key Economic Indicators of non-mechanised fishing units (2001-02)

Sl. No	Particulars	Gillnetter	Trawler	Purse seiner
1.	Average catch per day of operation (kg)	6.70	37.70	156.00
2.	Average revenue per day (Rs)	194.00	469.2	1,947.00
3.	Average No. of days fished in a year	217.00	230.00	230.00
4.	Average value realized per Kg of fish (Rs)	28.96	12.45	12.48
5.	Quantity of fish produced per man day (kg)	3.35	18.85	8.67
6.	Quantity of fish produced per litre of fuel (kg)	NA	NA	NA
7.	Value of production per man day (Rs)	97.00	234.60	108.17
8.	Average fuel cost per day of operation (Rs)	NA	NA	NA
9.	Avg. variable cost per day of operation (Rs)	154.00	348.50	1,307.50
10.	Avg. total cost per day of operation (Rs)	189.70	380.90	1,452.00
11.	Fuel cost per Kg of fish (Rs)	NA	NA	NA
12.	Operational cost per Kg of fish (Rs)	22.90	9.25	8.38
13.	Total cost per Kg of fish (Rs)	28.20	10.11	9.30
14.	Man-days required to produce one tonne of fish	298.51	53.05	115.38
15.	Fuel required to produce one tonne of fish (ltr)	NA	NA	NA
16.	Returns to Labour (Rs)	70.20	208.3	96.80
17.	Gross returns per day of operation (Rs)	40.20	120.64	639.50
18.	Annual operating profit (Rs)	8,715.00	27,748	1,47,084.00
19.	Annual net profit (Rs)	955.00	20,288.00	1,13,864.00

Economic loss due to juvenile fishing

In the multi-species, multi-gear open access marine fisheries, the greatest negative externality is the untargeted juvenile catches and discards. With the increase in multi-day fishing units combined with less storage capacity, the menace of discards is increasing alarmingly. Although it is difficult to stop, it is imperative to reduce juvenile fishing as much as possible. An attempt

was made to assess the extent of economic loss of juvenile catches by various craft-gear combinations. Landing centre price of adult fish varies significantly with the price of juveniles of the same variety. The differential ratio estimated in Table 6 should be read as no price difference (or no economic cost) if the ratio is '1' and price difference is very high (heavy economic loss) as the ratio approaches '0'. It shows the quantified average earnings that could be derived if the fish is caught at its adult stage. The severity of economic loss is pronounced for species like flatfish (0.14), anchovies (0.20), threadfin breams (0.21) and carangids (0.29). Juveniles of certain species such as bulls-eye (0.41) and oil sardine (0.40) are getting better price due to its high domestic demand and prawns are ranked high mainly due to its high export demand. Some fishes which are too small and with zero economic gains like flat fishes are even discarded for lack of market.

Table 6. Average landing centre price (Rs./kg) of juvenile and adult fish of select species during 2001-02

Species	Juveniles	Adults	Ratio
Anchovies	4	20	0.20
Mackerel	8	25	0.32
Carangids	8	28	0.29
Oil sardine	6	15	0.40
Cuttlefish	25	75	0.33
Threadfin breams	6	28	0.21
Lizardfish	5	14	0.36
Bullseye	9	22	0.41
Flatfish	2	14	0.14
Penaeid prawns	20	60	0.33
D Prawns	18	45	0.40

The catch composition of some selected gears are also assessed. About 50 per cent of the flatfish landed by mini trawlers are juveniles and 30 per cent each of penaeid prawns and anchovies landed by mini trawlers are juveniles. Of the total landings of anchovies by ring seiners and shore seiners, about 40 per cent are juveniles (Table 7).

The gross economic loss due to the capture of juveniles of different species is recorded for each fishing craft (Table 8). The economic loss due to juvenile fishing is worked out for each fishing vessel. It is found that while the annual revenue generated by purse seine units is Rs.19.90 lakhs, it caused an economic loss of Rs.39.58 lakhs due to juvenile fishing in the study region. This ultimately caused a monetary deficit to the tune of Rs.19.67 lakhs. Mechanised trawl units causes a deficit of Rs.16.92 lakhs, ring seine Rs.12.19 lakhs, mini trawl Rs.5.68 lakhs and shore seine Rs.4 lakhs due to juvenile fishing.

Table 7. Average percentage share of juveniles in the catch composition of some selected gears (2001-02)

Species	Mini trawl	Ring Seine	Mech. Trawl	Purse seine	Shore seine
Anchovies	30	40	--	--	40
Mackerel	--	15	--	20	15
Carangids	--	15	--	15	--
Oil sardine	--	30	--	25	20
Cuttlefish	--	--	20	--	--
Threadfin breams	--	--	25	--	--
Lizardfish	--	--	20	--	--
Bullseye	--	--	10	--	--
Flatfish	50	--	--	--	--
Peneaid Prawns	30	--	--	--	--
D Prawns	20	--	30	--	--

Table 8. Average economic loss *(in Rs)* due to juvenile fishing by various gears [2001-2002]

Species	Mini Trawl	Ring seine	Mech.Trawl	Purse seine	Shore seine
Anchovies	67,872	5,84,832	---	---	1,10,208
Mackerel	---	2,07,909	---	35,14,797	3,27,366
Carangids	---	1,00,452	---	---	---
Oil sardine	19,527	10,15,956	---	4,43,187	64,377
Cuttlefish	---	---	14,62,300	---	---
Threadfin breams	---	---	10,12,370	---	---
Lizardfish	---	---	49,187	---	---
Flatfish	96,220	---	---	---	---
Peneaid Prawns	4,75,720	---	---	---	---
D Prawns	29,187	---	3,02,634	---	---
Gross Economic Loss	6,88,526	19,09,149	28,26,491	39,57,984	5,01,951
Net Profit	1,20,555	6,90,362	11,34,883	19,90,828	1,02,610
*Actual Deficit	-5,67,971	-12,18,787	-16,91,608	-19,67,156	-3,99,341

**Actual deficit refers to the difference between Economic Loss due to juvenile fishing and the Net profit created by the respective fishing units.*

The average revenue and deficit generated by each fishing unit could be used for estimating the gross revenue and deficit. This is estimated for a select fishing craft such as the trawlers, purse seiners, mini trawlers and ring seiners. The gross estimate shows that the to total economic loss due to juvenile fishing by trawlers, purse seiners, ring seiners and mini trawlers along the Kerala coast was around Rs.1847 crores where as the annual revenue generated by these fishing units was to only Rs.705 crores, thus causing a total deficit of Rs.1,142 crores to the coastal economy. Mechanised trawlers contribute 70 per cent to the economic loss. There are 4,484 mechanised trawlers in Kerala which incur a gross economic loss of Rs.1,264.40 crores due to juvenile fishing, and these crafts generate an annual revenue of only Rs.508.88 crores, thus causing a deficit of Rs.755.52 crores. The next largest of source economic loss is by the 2,351 ring seiners causing Rs. 286.54 crores per annum. A total of 1,500 mini trawlers incurs loss of Rs. 85.20 crores and the 76 purse seiners Rs.15 crores (Table 9).

Table 9. Gross economic costs of juvenile fishing along Kerala coast *(Rs in Crores)*

Craft	Total Number of Boats	Gross economic loss due to juvenile fishing	Annual revenue of crafts	Economic deficit
Trawler	4,484.00	1,264.40	508.88	755.52
Ring seiner	2,351.00	448.84	162.30	286.54
Mini trawler	1,500.00	103.30	18.10	85.20
Purse Seiner	76.00	30.08	15.13	14.95
Total	**8,411.00**	**1,846.62**	**704.41**	**1,142.21**

Economic efficiency of input utilisation

Trawlers contribute half of the total fish landings along the Kerala coast. An attempt is made to study the input-output relationship in trawler operations. Production function analysis using Cobb-Douglas model indicated that there is ample scope to enhance the net profit of trawlers by increasing the number of fishing days and the area of operation.

Table 10. Estimated Production Function (Y = 0.68901)

Parameters	Region		
	Neendakara	Cochin Fisheries Harbour	Munambam
b_1	0.780**	0.690**	0.720**
b_2	0.312**	0.710**	0.610**
b_3	-0.112^{ns}	0.026^{ns}	0.050^{ns}
R^2	87.2	88.0	75.0

**Significant at 5% level
ns Not significant

Parameters such as number of fishing days per unit and the quantity of fuel used in a year are significant in all the three study regions. Estimation shows that one per cent increase in the number of fishing days would result in an increase in output by 0.78 per cent in Neendakara, 0.69 per cent in Cochin Fisheries Harbour and 0.72 per cent in Munambam. The coefficient of fuel consumption is also a significant variable. An increase in fuel expenditure by one per cent would increase the gross output by 0.31 per cent in Neendakara, 0.71 per cent in Cochin Fisheries Harbour and 0.61 per cent in Munambam (Table 10).

Profit is maximum when

MR = MC,

where MR is marginal revenue and MC is marginal cost.

For X_i

MR = (Y/Xi)*PY and

MC is the acquisition cost for one unit of Xi ie. PXi. Hence

bi * (Y/Xi) * PY = PX_i

Optimum level of X_i = bi * Y *(PY/Xi)

Where, b_i is production coefficient

Y is average annual output

X_i is the average annual input used

PY is the price of output

PX_i is the price or acquisition cost of input X_i

Table 11. Regression coefficients, MVP, Geometric means & ratios of MVPs to their factor costs

Variables	Regression coefft.	MVP of out puts (Rs)	Geometric mean	Acquisition cost (Rs)	Ratio MVPs to their acquisition costs
Neendakara					
Y	-	-	3,07,256 Kg	-	-
X1	0.78	14901	193 days	14070	1.060
X2	0.312	28.89	39,814 Ltr.	20	1.445
X3	-0.112	-0.546	63,000 Rs.	1.15	-0.364
Cochin Fisheries Harbour					
Y	-	-	63,168 Kg	-	-
X1	0.69	4307	192 days	4271	1.008
X2	0.72	26.21	32,064 Ltr.	20	1.310
X3	0.026	2.5	12,480 Rs	1.15	2.174

Munambam					
Y	-	-	87,800 Kg	-	-
X1	0.63	4632	203 days	4094	1.131
X2	0.61	22.87	39,800 Ltr.	20	1.144
X3	0.05	3.62	20,600 Rs	1.15	3.148

It is obvious from Table 11 that those inputs for which ratio of MVP to acquisition is more than one can be increased from the average level. At Neendakara landing centre fishing days in a year can be increased from the average level of 193 to 204 to get maximum profit. So also the annual oil consumption can be increased to the optimum level of 54,672 litres from the average level of 39,814 litres. Maintenance & repairing expenditure had a negative MVP indicating that reducing the maintenance and repairing charges can increase gross returns.

For Cochin Fisheries Harbour, fishing days in a year can be increased from the average level of 192 to 194 to get the maximum profit. So also the annual oil consumption can be increased to the optimum level of 43,139 litres from the average level of 32,064 litres and Maintenance & repairing expenditure from Rs. 12,480 to Rs. 27,091. At this centre, trawl units are operating almost at the optimum level, so that there is no scope for further increase in number of fishing units or number of fishing days for the existing units. At Munambam, the fishing days in a year can be increased from the average level of 203 to 229 to get the maximum profit. The annual oil consumption can be increased to the optimum level of 45,524 litres from the average level of 39,800 litres and maintenance & repairing expenditure from Rs. 20,600 to Rs. 64,895.

The above analysis for the optimum level of operation of individual fishing units, shows that fishing days at all the three centres can be increased marginally from the present level. Even though the number of days fished in a year is below the optimum level for individual fishing units, it is observed that there is excessive fishing pressure as a whole due to over crowding of fishing units. Extension of fishing especially to the offshore areas in view of marginally increasing the number of fishing days and also with an additional fuel utilisation would enhance the profit of trawlers at all the centres.

CONCLUSION

The economic aspects of various craft-gear combinations, the economic loss incurred from juvenile fishing and the scope for a better input utilisation are addressed in this study. Though the study has concentrated in a limited geographic area, the inferences drawn from it encapsulates the strengths and weaknesses of the marine fishing sector. The heavy capital investments geared up throughout the coastal stretch have certainly accelerated the income earning capacity of millions of fishermen. The backward and forward linkages are as strong as any other primary sector activity. The overcrowding of boats and the subsequent pressure has elevated the landings of juveniles mainly due to intensive targeted fishing. The study revealed that the economic loss due to juvenile fishing has out-weighed the annual average revenue generated by various craft-gear combinations. In a multi-species multi-gear fisheries, although juvenile fishing is inevitable,

strict adherence of mesh size regulations as stipulated by fishery regulation Acts may go a long way to reduce the negative impact of juvenile fishing. The less than optimal level of fishing days could be effectively utilised by way of extensive offshore fishing and subsequently with additional fuel utilisation. Extending fishing operations to offshore areas will negate the overcrowding of fishing units and the ensuing pressure on marine resource exploitation.

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