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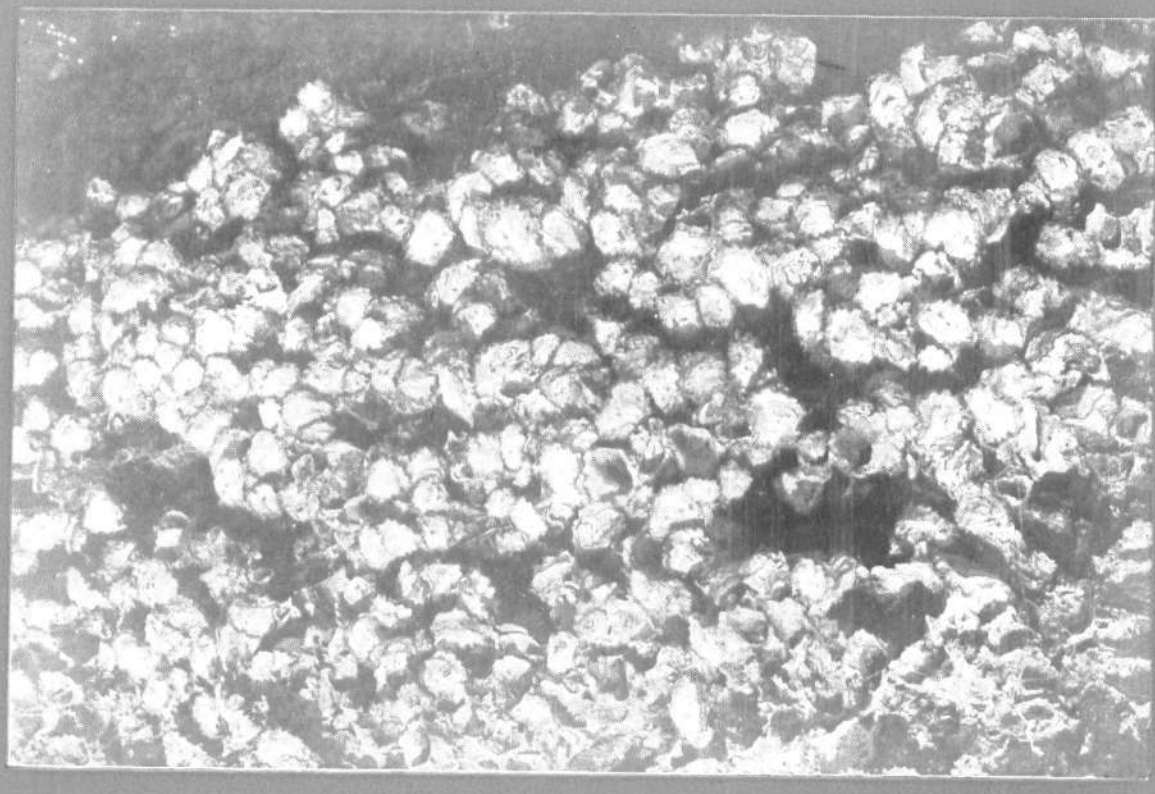

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COSTS AND EARNINGS OF TRAWLERS OPERATING AT TUTICORIN FISHERIES HARBOUR (TAMIL NADU)

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Introduction

Modernisation of indigenous crafts and introduction of mechanised fishing boats have been accorded high priority for the development of marine fishery sector from the very beginning of our National Five Year Plans. The export demand coupled with high unit value realisation of prawns added to the speed of the growth of mechanised fleets. The enhanced mobility of fishing crafts on account of motorization, led to increased exploitation of fish and induced many fishermen to shift from traditional to mechanised fishing. Mechanisation not only led to intensification of fishing but also paved the way for the growth of an organised sea food export industry and consequent increase in employment opportunities. However, the mechanised fleets were highly depending on trawl fishing and prawn catches for their sustenance. Initially the 7.6 and 9.1 metre long boats were designed and introduced for gillnetting. But the high profitability of shrimp trawling led the fishermen to use these boats also for trawling with modifications. Now a stage has come to realise that the excessive trawling in some of the regions of our coastal waters has led to over-exploitation of resources warranting regulatory measures for attaining better economic returns in the long run. The frequent clashes between the traditional and mechanised boat owners over the area of operation also emerged as a serious problem emphasising the need for fishing regulations. In this context, basic information on catch composition, costs and earnings of different craft-gear combinations is very much essential for policy decisions. The Central Marine Fisheries Research Institute has undertaken a number of micro level studies with regard to the economics of mechanised and artisanal fishing units in different regions of our country. The present study deals with the economics of trawlers of different sizes operating at Tuticorin Fisheries Harbour in Tamil Nadu. Tuticorin is one of the most important trawling centres in Tamil Nadu having a major fisheries harbour with berthing capacity of about 400 small mechanised boats and 10 deep sea trawlers with boat building yard and service centres.

Data on the initial investment of trawlers of different sizes *viz* 8.5 m (30'), 9 m (32') and 9.5 to 10 m operating at Tuticorin fisheries harbour were collected by interviewing the unit owners during July–August, 1985 in a specially designed schedule.

Most of the observed units of 9 m and 9.5 to 10 m engaged themselves in pair trawling occasionally during 1985–'86. Since two boats were involved for this type of fishing 50 per cent of the costs, species-wise catch and returns were considered as the portion of the selected unit, out of the two.

The common species of prawns caught by the trawlers at Tuticorin are *P. semisulcatus, M. dobsoni, P. stylifera* and *P. indicus. P. semiculcatus* alone contributed more than 70 per cent of the revenue realised from prawn catches. The catch and value realised by other varieties were negligible. Hence for the analysis, these 4 species were grouped together under the category penaeid prawns. Normally the trawl catches are composed of a number of varieties of fish. The number of varieties is still higher in pair trawling. In the present analysis some of the commercially important varieties of fish such as *Lethrinus* sp., silverbellies, *Thryssa* sp., threadfin breams, sciaenids, carangids, cuttle fish and white fish were recorded separately and the catch and revenue realised from them were also separately dealt with. The catch and revenue realised from the sales of all other varieties were given together.

Initial investment

The trawlers operating at Tuticorin Fisheries Harbour were mostly purchased during the period from 1973 to 1985. Due to the cost escalation of fishing boats and continuous replacements of damaged parts by the fishermen in subsequent years there was not much difference in the purchase value and the present resale value of the boats. However, the average value of the units at the time of observation was considered in working out the economics of fishing operations.

The 8.5 m trawlers (category I) were fitted with Ruston or Leyland engines having horse power ranging from 40 to 68. For most of the observed units in this category, the hull was retained with minor replacements while engines were changed in subsequent years. Each boat is having two nets; one with a length of 28 m, breadth of 12 m and mesh size of 1 to 4 cm andthe other 34 m length, 14 m breadth and the mesh size of 2 to 6 cm. The average investment of a 8.5 m trawler operating at Tuticorin was Rs. 1,00,000/- (Rs. 27,000 for hull, Rs. 65,000 for engine and Rs. 8,000 for gears).

For 9 m trawler (category 2) the h.p. of engine ranged from 54 to 88. These units possess 2 to 3 nets with mesh size of 1 to 4 cm and 2 to 6 cm. The length of the nets varies from 31 to 39 m and breadth from 11 to 14.5 m. The average investment for 9m trawler worked out at Rs. 1,20,000 (Rs. 35,000 for hull, Rs. 75,000 for engine and Rs. 10,000 for gears).

In recent years, trawlers of 9.5 to 10 m were also introduced at Tuticorin Fisheries Harbour. Most of the sample units in this category were purchased in 1984 and afterwards. They were fitted with 98 h.p. engines. These units possess 3 trawl nets with breadth of 17 m and length ranging from 36.5 to 42 m. The mesh size of the nets varied from 1 to 6 cm. The investment on these units worked out at Rs. 2,20,000 (Rs. 75,000 for hull, 1,30,000 for engine and Rs. 15,000 for gears).

Fixed cost

Depreciation of the fishing unit and interest for investment constitute the fixed cost. Depreciation is worked out on the basis of the expected life of the fishing boat and accessories and the interest is calculated at the rate of 15% per annum. The average expected life of hull and engine of the selected units was considered as 5 years and that of gears as 3 years. Depreciation was worked out on the basis of straight line method. The annual depreciation of these units worked out at Rs. 21,040 for 8.5 m, Rs. 25,300 for 9 m and Rs. 46,000 for 9.5 to 10 m. The annual interest for investment worked out at Rs. 15,000, 18,000 and Rs. 33,000/- for the three category of units respectively. The annual fixed cost came to about Rs. 36,040 for 8.5 m, Rs. 43,300/- for 9 m and Rs. 79,000 for 9.5–10 m.

Operating costs and returns

The day to day expenses incurred for the working of the boat is termed as operating expenses or variable costs. The expenses on fuel, wages and repairing & maintenance are the major components of variable cost of a mechanised boat. Generally wages are proportional to returns as sharing system is followed in these units. The cost of repairing and maintenance of the unit is entirely borne by the owner. The income after deducting operating costs such as oil expenditure, auction charges and daily bata is divided into three shares. The owner of the unit gets two shares for boat and net and the remaining is equally divided among the crew members as wages. The gross returns of a unit is the sale value of the catch landed by it.

The average operating costs and returns of a 8.5 m trawler at Tuticorin Fisheries Harbour during October 1985 to September 1986 is given in Table 1. The annual average variable cost of a unit worked out at Rs. 2,95,964 as against the gross returns of Rs. 3,90,716. The annual catch of a boat during the year was about 89.5 tonnes, of which penaeid prawns accounted for 4 %. The revenue realised by these boats were found to be minimum during October–December and maximum during July–September. Next to prawns, silverbellies contributed considerable returns (9–15%) for these units in all the seasons.

The operating cost per day worked out at Rs. 1,184 in which fuel cost alone accounted for 44 %. About 36 % of the operating expenditure was incurred for labour and 9 % for repairing and maintenance of the units. The average revenue per day of operation was Rs. 1,562. It may be seen that about 66 % of the gross revenue was realised by the bye-catch (fish) and only 34% by the contribution of penaeid prawns in the gross revenue, ranged from 33 % during January–March to 55 % during July–August.

The quarterly and daily average operating costs and returns of a 9 m trawler are given in Table 2. Annual operating cost of a boat worked out at Rs. 3,70,393 and the gross revenue realised was Rs. 4,79,811 Fuel cost alone accounted for 51 % of the operating expenses. Labour cost constituted 29 % and repairing and maintenance of the unit 10 % of the variable cost. The average annual catch of a 9 m trawler was 91 tonnes for 243 fishing days during the referred period. The penaeid prawns constituted about 4 % of total catch and 33 % of the gross revenue. Minimum gross revenue was obtained by these boats during October–December period and maximum during April–June. The average revenue realised per day of operation ranged from Rs. 1,527 to Rs. 2,475 for different seasons. The contribution of penaeid prawns in gross revenue ranged from 9 % (January–March) to 54 per cent (July–August).

Table 1. *Quarterly operating costs and returns per unit of* 8.5 *m trawlers at Tuticorin Fisheries Harbour* (1985–'86)

Items		Oct.–Dec.		Jan.–Mar.		Apr.–Jun.		Jul.–Sep.		Annual	
		Total	Per day	Total	Per day	Total	Per day	Total	Per day	Total	Per day
I. Operational costs											
Wages		8,874	153	10,230	155	21,824	341	24,800	400	65,728	263
Bata		8,062	139	9,966	151	8,768	137	9,672	156	36,468	146
Fuel		21,112	364	35,970	545	36,160	565	32,674	527	1,25,916	503
Ice		2,900	50	2,376	36	2,176	34	2,976	48	10,428	42
Auction charges		2,262	39	3,498	53	7,296	114	4,712	76	17,768	71
Jetty rent		116	2	132	2	128	2	124	2	500	2
Repairing and maintenance		9,744	168	13,068	198	6,208	97	7,688	124	36,708	147
Others		232	4	1,452	22	640	10	124	2	2,448	10
Total		53,302	919	76,692	1,162	83,200	1,300	82,770	1,335	2,95,964	1,184
II. Catch (Q-kg) and Revenue (V-Rs.)											
Penaeid prawns	Q	754	13	660	10	1,344	21	1,302	21	4050	16
	V	24,824	428	27,390	415	51,776	809	69,440	1,120	1,73,430	694
Lethrinus sp.	Q	232	4	396	6	192	3	744	12	1,564	6
	V	2,088	36	5,478	83	2,688	42	5,022	81	15,276	61
Silverbellies	Q	3,480	60	5,742	87	8,960	140	4,898	79	23,080	92
	V	7,482	129	12,210	185	17,216	269	8,990	145	45,898	183
Thryssa sp.	Q	2,784	48	3,300	50	4,160	65	1,612	26	11,856	47
	V	3,770	65	5,940	90	8,064	126	2,480	40	20,254	81
Threadfin breams	Q	2,088	36	330	5	512	8	1,364	22	4,294	17
	V	3,016	52	2,508	38	4,224	66	6,386	103	16,124	64
Sciaenids	Q	1,044	18	330	5	768	12	930	15	3,072	12
	V	5,278	91	1,980	30	3,648	57	3,534	57	14,440	58
Carangids	Q	522	9	396	6	896	14	310	5	2,124	8
	V	1,682	29	3,102	47	6,592	103	3,100	50	14,476	58
Cuttle fish	Q	232	4	198	3	128	2	186	3	744	3
	V	1,392	24	3,102	47	2,432	38	2,170	35	9,096	36
White fish	Q	—	—	—	—	384	6	186	3	570	2
	V	—	—	—	—	5,696	89	1,984	32	7,680	31
Others	Q	3,944	68	14,612	221	8,832	138	10,726	173	38,114	168
	V	11,832	204	21,384	324	18,496	289	22,320	360	74,032	296
III. Gross returns	Q	15,080	260	25,964	393	26,176	409	22,258	359	89,478	356
	V	61,364	1,058	83,094	1,259	1,20,832	1,888	1,25,426	2,023	3,90,716	1,562

Table 2. *Quarterly average operating costs and returns per unit of 9 m trawlers at Tuticorin Fisheries Harbour* (1985–'86)

Items		Oct.–Dec.		Jan.–Mar.		Apr.–Jun.		Jul.–Sep.		Annual	
		Total	Per day	Total	Per day	Total	Per day	Total	Per day	Total	Per day
I. Operational costs											
Wages		9,856	176	22,701	329	24,839	421	15,517	263	72,913	300
Bata		7,616	136	8,556	124	11,092	188	8,437	143	35,701	147
Fuel		42,784	764	49,887	723	49,855	845	45,843	777	18,369	775
Ice		2,184	39	3,588	52	3,127	53	2,773	47	11,672	48
Auction charges		3,024	54	8,211	119	6,549	111	4,897	83	22,681	93
Jetty rent		112	2	138	2	177	3	118	2	545	2
Repairing & maintenance		11,088	198	9,591	139	7,906	134	7,788	132	36,373	150
Others		672	12	759	11	531	9	177	3	2,139	9
Total		77,336	1,381	1,03,431	1,499	1,04,076	1,764	85,550	1,450	3,70,393	1,524
II. Catch (Q–kg) and Revenue (V–Rs.)											
Penaeid prawns	Q	1,120	20	276	4	1,121	19	1,416	24	3,932	16
	V	32,088	573	12,075	175	57,112	968	58,646	994	1,59,921	658
Lethrinus sp.	Q	336	6	1,104	16	531	9	1,180	20	3,151	13
	V	3,528	63	14,283	207	4,366	74	7,906	134	30,086	124
Silverbellies	Q	4,368	78	7,245	105	5,251	89	5,664	96	22,528	93
	V	10,752	192	18,147	263	13,098	222	7,906	134	49,903	205
Threadfin breams	Q	1,120	20	1,173	17	1,298	22	885	15	4,476	19
	V	2,800	50	7,245	105	7,434	126	4,602	78	22,081	91
Thryssa sp.	Q	1,568	28	4,554	66	5,782	98	2,301	39	14,205	58
	V	3,024	54	9,591	139	11,033	187	4,012	68	27,660	114
Sciaenids	Q	1,232	22	1,173	17	885	15	1,062	18	4,352	18
	V	6,160	110	5,796	84	4,897	83	3,363	57	20,216	83
Carangids	Q	560	10	621	9	885	15	531	9	2,597	11
	V	5,656	101	6,003	87	9,440	160	3,894	66	24,993	103
Cuttle fish	Q	336	6	414	6	177	3	295	5	1,222	5
	V	2,688	48	5,865	85	2,360	40	3,481	59	14,394	59
White fish	Q	672	12	759	11	531	9	649	11	2,611	11
	V	4,088	73	8,280	120	5,605	95	2,950	50	20,923	86
Others	Q	4,704	84	13,317	193	9,794	166	4,130	70	31,945	131
	V	14,728	263	51,957	753	30,680	520	12,272	208	1,09,637	451
III. Gross returns	Q	16,016	286	30,636	444	26,255	445	18,113	307	91,020	375
	V	85,512	1,527	1,39,242	2,018	1,46,025	2,475	1,09,032	1,848	4,79,811	1,974

Table 3. *Quarterly average operating costs and returns per unit of trawler* (9.5–10 m) *at Tuticorin Fisheries Harbour (1985–'86)*

Items		Oct.–Dec.		Jan.–Mar.		Apr.–Jun.		July–Sep.		Annual	
		Total	Per day	Total	Per day	Total	Per day	Total	Per day	Total	Per day
I. Operational costs											
Wages		15,344	274	21,892	421	30,394	309	37,760	590	95,390	401
Bata		11,032	197	11,388	219	16,104	244	12,288	192	50,812	214
Fuel		56,672	1,012	42,484	817	62,634	949	64,832	1,013	2,26,622	952
Ice		3,248	58	3,016	58	3,960	60	3,712	58	13,936	58
Auction charges		6,328	113	11,336	218	7,326	111	10,560	165	35,550	149
Jetty rent		112	2	104	2	198	3	128	2	542	2
Repairing & maintenance		7,056	126	10,400	200	7,590	115	11,840	185	36,886	155
Others		280	5	780	15	660	10	—	—	1,720	8
Total		1,00,072	1,787	1,01,400	1,950	1,18,866	1,801	1,41,120	2,205	4,61,458	1,939
II. Catch (Q-kg) Revenue (V-Rs.)											
Penaeid prawns	Q	1,176	21	676	13	1,118	18	2,240	35	5,280	22
	V	41,720	745	30,316	583	43,956	666	91,264	1,426	2,07,256	871
Lethrinus sp.	Q	2,240	40	1,612	31	1,518	23	2,176	34	7,546	32
	V	10,808	193	14,872	286	12,276	186	17,024	266	54,980	231
Silverbellies	Q	6,644	119	5,876	113	8,184	124	5,184	81	25,908	109
	V	11,312	202	12,844	247	15,708	238	10,688	167	50,552	212
Thryssa sp.	Q	4,928	88	4,004	77	5,610	85	1,344	21	15,886	66
	V	6,944	124	8,112	156	11,484	174	2,368	37	28,908	121
Threadfin breams	Q	1,176	21	572	11	924	14	2,944	46	5,616	24
	V	5,712	102	3,900	75	6,996	106	13,312	208	29,920	126
Sciaenids	Q	2,744	49	572	11	1,056	16	1,644	26	6,036	26
	V	10,640	190	3,536	68	4,026	61	6,208	97	24,410	102
Carangids	Q	504	9	676	13	594	9	448	7	2,222	9
	V	3,024	54	6,448	124	5,874	89	5,440	85	20,786	88
Cuttle fish	Q	448	8	1,040	20	924	14	384	6	2,796	12
	V	3,696	66	14,560	280	13,134	199	5,824	91	37,214	156
White fish	Q	—	—	312	6	330	5	320	5	962	4
	V	—	—	3,432	66	3,564	54	2,944	46	9,940	41
Others	Q	5,768	103	7,824	150	6,138	93	7,680	120	27,410	115
	V	30,128	538	36,608	704	34,914	529	50,880	795	1,52,530	642
III. Gross returns	Q	25,648	458	23,164	445	26,466	401	24,384	381	99,662	418
	V	1,23,984	2,214	1,34,628	2,589	1,51,932	2,302	2,05,952	3,218	6,16,496	2,590

The average annual opreating cost of a trawler of 9.5 to 10 m worked out at Rs. 4,61,458 realising a gross revenue of Rs. 6,16,496 (Table 3). On an average there were 238 fishing days for these boats with an annual catch of about 100 tonnes per unit. About 34 % of the gross revenue was contributed by penaeid prawns with a range of 23 % to 44 % over the four quarters. In the operating costs, fuel constituted 49 % labour 32 % repairing and maintenance of the unit 8 % and other expenses like auction charges, ice, and jetty rent 11 %. The average daily operating expenses ranged from Rs. 1,787 during October–December to Rs. 2,205 during July–September with corresponding gross revenues of Rs. 2,214 and Rs. 3,218 respectively. Silverbellies contributed towards 8 % of the gross revenue and it was available throughout the year.

Annual income and expenditure

The annual income and expenditure statement for different sizes of trawlers operating at Tuticorin fisheries harbour is given in Table 4. The total cost per annum (fixed + operating cost) was worked out at Rs. 3.32 lakhs for 8.5 m trawlers, Rs. 4.13 lakhs for 9 m trawlers and Rs. 5.40 lakhs for 9.5 to 10 m trawlers. In the total cost, the operating expenditure alone accounted for 85 to 90 % for these boats. The net operating income per annum (income over operating expenses) was worked out at Rs. 94.7 thousand for 8.5 m Rs. 1.09 lakhs for 9 m and Rs. 1.55 lakhs for 9.5 to 10 m. The annual net profit was obtained by subtracting the total of fixed and variable costs from the gross income of a unit in a year. Net profit of 8.5 m boats worked out at Rs. 58,712, 9 m Rs. 66,118 and for 9.5–10 m Rs. 76,033 during October, 1985 to September, 1986.

Revenue from prawns and other varieties

It is widely believed that the trawlers are heavily depending on the prawn catches for their sustenance. The present study indicates that about 56 % of the annual gross revenue of 8.5 m 67 % of 9 m and 66 % of 9.5 to 10 m. were derived from the catches of fin fishes. The monthwise trend of gross revenue realised per day along with the revenue from prawns alone for 8.5 m, 9 m and 9.5-10 m is given in Fig. 1, 2 and 3 respectively. The daily average revenue for each month realised by these boats from prawns and other varieties was higher with higher catches of prawns. But the revenue received from fishes was higher than that of prawns during most part of the year. The increase in price of fish in recent years in the internal market may be mainly responsible for this.

The daily gross revenue and prawn revenue were minimum during October and maximum during July for 8.5 m trawlers (Fig. 1). Even with the peak prawn catches during July, almost 37 % of the revenue was obtained from other varieties. During December about 81 % of the daily gross revenue was realised from other varieties. The higher dependance on prawn catches was explicitly known for the months of April to August and in the remaining period its contribution was comparatively less in the total revenue.

For 9 m trawlers also prawn catches contribute substantially in the gross revenue only during May–August period (Fig. 2). Even with less catch and revenue from prawns (9 %) during March each unit realised on an average about Rs. 3,100 per day of operation. During this period most of the trawlers other than 8.5 m size operated pair trawling and the quality fishes they brought fetched good prices. The gross revenue of 9.5 to 10 m trawlers was maximum during July associated with maximum prawn revenue (Fig. 3). But overall it indicates that these units were highly depending on the revenue of other varieties caught during the remaining period.

Key economic indicators

Some of the key economic indicators for the three types of units operating at Tuticorin fisheries harbour have been worked out on the basis of costs and earnings data and given in Table 5.

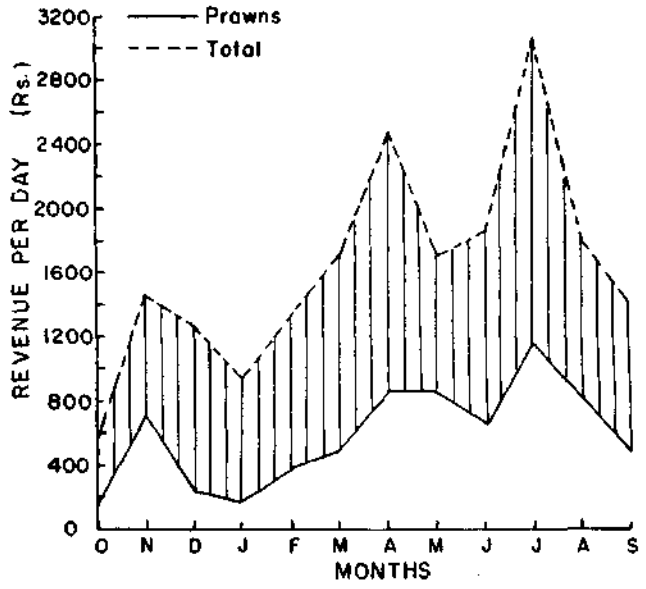

Fig. 1. Monthwise gross revenue per unit per day from prawns alone and total for 8.5 m trawlers.

Table 4. *Annual income and expenditure statement of trawlers of different size at Tuticorin Fisheries Harbour (October-September, 1986)*

Item	Trawlers		
	8.5 m	9 m	9.5–10 m
1. Initial investment (Rs.)			
a) Hull	27,000	35,000	75,000
b) Engine	65,000	75,000	1,30,000
c) Gears	8,000	10,000	15,000
Total	1,00,000	1,20,000	2,20,000
2. Annual fixed cost (Rs)			
a) Depreciation			
i) Hull & Engine (20%)	18,400	22,000	41,000
ii) Gears (33%)	2,640	3,300	5,000
b) Interest for investment (15%)	15,000	18,000	33,000
Total	36,040	43,300	79,000
3. Operating costs (Rs.)	2,95,964	3,70,393	4,61,458
4. Total costs (2 + 3)	3,32,004	4,13,693	5,40,458
5. Gross revenue (Rs.)	3,90,716	4,79,811	6,16,496
6. Net operating income (Rs.) (5–3)	94,752	1,09,418	1,55,038
7. Net profit (Rs.) (6-2)	58,712	66,118	76 038

The average number of fishing days was 250 for 8.5m, 243 for 9 m and 238 for 9.5 to 10 m trawlers during the year and average catch per day of operation worked out at 356, 375 and 418 kg respectively. The average revenue received per day was Rs. 1,562 for 8.5m, Rs. 1,974 for 9m and Rs. 2,590 for 9.5 to 10 m, the average value received per kg of fish being Rs. 4.39, Rs. 5.26 and Rs. 6.2 for these units respectively. The catch composition differs as the boats of 9 m and 9.5 to 10 m engage in pair trawling occasionally. Since the bigger size boats bring more quality fishes they receive comparatively better prices. The catch per man day varies from 59kg valued at Rs. 260/- for 8.5m to 70kg valued at Rs. 432 for 9.5 to 10 m trawlers. The quantity of fish produced per litre of fuel worked out at 3.0, 2.2 and 1.8 kg for 8.5 9 and 9.5 m boats respectively, the fuel cost per kg of fish caught being Rs. 1.41, Rs. 2.07 and Rs. 2.28 for these units respectvely.

The average total cost per day of operation worked out at Rs. 1,328 for 8.5 m, Rs. 1,702 for 9 m and Rs. 2,271 for 9.5 to 10 m trawlers during October, 1985 to September, 1986 and cost of production per kg of fish worked out at Rs. 3.73, Rs. 4.54 and Rs. 5.43 respectively.

Capital turnover ratio indicates the rate at which income was generated for each rupee investment and it was found to be Rs. 3.90 for 8.5 m, Rs. 4.00 for 9 m and Rs. 2.80 for 9.5 to 10 m. The rate of return to capital was 74, 70 and 50% respectively. Since the normal nterest rate of capital being 15 to 20%, the investments on all the three types of units were found to be profitable. The pay back period for all these three types of units was found to be less than two years. The expense income ratio is useful to measure the input-output efficiency of any business. As indicated by the total cost ratio for each rupee of gross income earned, 85 paise of 8.5 m, 86 paise of 9 m and 88 paise of 9.5 to 10 m trawlers were spent for production.

Table 5. *Key economic indicators*

Item	Size of trawlers (m)		
	8.5	9	9.5–10
Average number of days fished in a year	250	243	238
Average catch per day of operation (kg)	356	375	418
Average revenue per day (Rs.)	1,562	1,974	5,902
Average value realised per kg of fish (Rs.)	4.39	5.26	6.20
Quantity of fish produced per man-day (kg)	59.30	62.50	69.67
Value of production per man-day (Rs.)	260	329	432
Average remuneration received by a labourer per day (Rs.)	68	75	103
Quantity of fish produced per litre of fuel(kg)	2.97	2.26	1.82
Average fuel cost per day of operation (Rs.)	503	775	952
Fuel cost per kg of fish (Rs.)	1.41	2.07	2.28
Average operating cost per day of operation (Rs.)	1,184	1,524	1,939
Operating cost per kg of fish (Rs.)	3.33	4·06	4.64
Average total costs per day of operation (Rs.)	1,328	1,702	2,271
Total cost per kg of fish (Rs.)	3.73	4.54	5.43
Capital turn over ratio	3.90	4 00	2.80
Rate of return to capital %	74	70	50
Pay back period (years)	1.25	1.31	1.80
Fixed cost ratio	0.09	0.09	0.13
Operating cost ratio	0.76	0.77	0.75
Total cost ratio	0.85	0.86	0.88

Conclusion

The average initial investment of trawlers operating at Tuticorin fisheries harbour worked out at Rs. 1 lakh

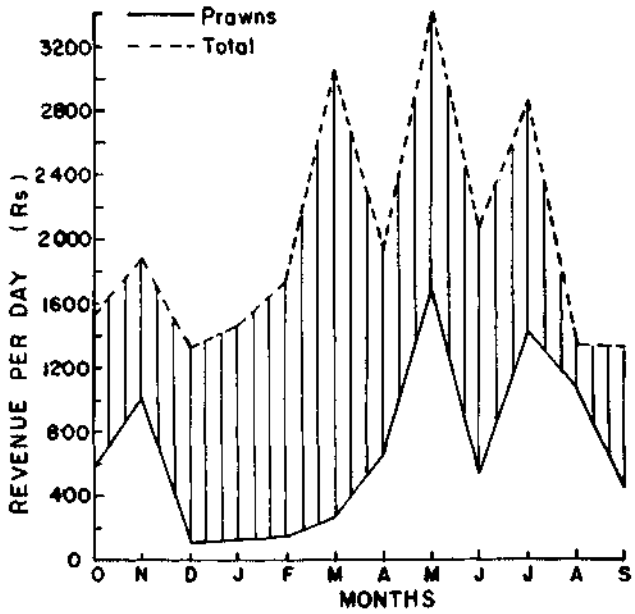

Fig. 2. Monthwise gross revenue per unit per day from prawns alone and total for 9 m trawlers.

for 8.5m, Rs. 1.2 lakhs for 9m and Rs. 2.2 lakhs for 9.5-10 m during 1985–'86. The annual number of days fished by these units were 250,243 and 238 respectively. The annual fixed expenses worked out at Rs. 36 thousand, 43.3 thousand and 79 thousand for the three categories respectively. Annual operating expenditure was Rs. 2.95 lakhs for 8.5 m, Rs. 3.70 lakhs for 9 m and 4.61 lakhs for 9.5–10 m. Gross revenue realised by these units were Rs. 3.9, 4.8 and 6.6 lakhs and the net income over operating expenses worked out at Rs. 0.95, Rs. 1.09 and Rs. 1.55 lakhs respectively. The average net profit of these units was Rs. 58.8 thousand, Rs. 66.1 thousand and Rs. 76.0 thousand respectively.

The cost of production per kg of fish worked out at Rs. 3.73 for 8.5 m, Rs. 4.54 for 9 m and Rs. 5.43 for 9.5–10 m trawlers in which the fuel cost alone constituted about Rs. 1.41, Rs. 2.07 and Rs. 2.28 respectively, the average value realised per kg of fish being Rs. 4.39, Rs. 5.26 and Rs. 6.20 respectively.

With regard to labour productivity, the quantity of fish caught per man-day worked out at 59 kg for 8.5 m, 63 kg for 9 m and 70 kg for 9.5–10 m trawlers fetching a revenue of Rs. 260, Rs. 329 and Rs. 432 respectively. The average remuneration received per man-day was Rs. 68 for 8.5 m, Rs. 75 for 9 m and Rs. 103 for 9.5–10 m.

The capital turnover ratio, rate of returns to capital and pay back period were better for smaller boats (8.5 and 9 m) as the initial investment was comparatively less. But in terms of labour productivity, wages, quantum of catch, gross revenue and net profit, the bigger size boats 9.5–10 m were comparatively efficient. The bigger size boats fitted with engines of higher horse power can operate even beyond the traditional fishing ground, easily adopt new types of fishing techniques like pair trawling and accommodate more catch in their boats. Considering the economics of operations of different sizes of trawlers it seems that investment on bigger size boats of 9.5–10 m in the Tamil Nadu coast is advisable. The study further indicates that the fishermen of this coast in future will be more inclined to introduce this type of boats.

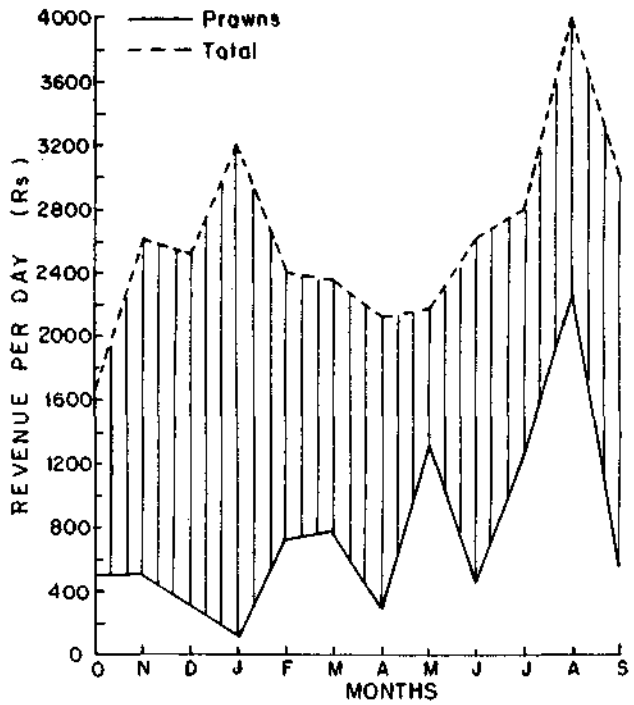

Fig. 3. Monthwise gross revenue per unit per day from prawns alone and total for 9.5–10 m trawlers.

The results revealed that the over dependence on prawn catches for the sustenance of trawlers is slowly being reduced in this region. The prawn catches contribute substantially in the revenue only during a few months of the year. It was seen that about 56 % of the annual gross revenue of 8.5 m, 67 % of 9 m and 66 % of 9.5–10 m were earned from other varieties. It has almost come to a stage that trawler can survive even without prawn catch. It is ideal to diversify the fishing techniques to reduce the fishing pressure on prawns and aim more towards catching other varieties of quality fishes. Introduction of bigger boats with longer operational range will further help to avoid the conflict between the mechanised and traditional fishermen.

THE CURRENT TREND OF THE MUSSEL FISHERY IN THE KANYAKUMARI DISTRICT OF TAMIL NADU

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The Kanyakumari district at the southern end of the Indian peninsula spans about 58 km along its western coast and 10 km on the eastern. There are massive formations of mussel beds in the coastal waters of this district and a fishery for the brown mussel *Perna indica* regularly operates during September–March at many centres where there are submerged or partially submerged rocks in the near-shore waters. Stray numbers of the green mussel *Perna viridis* are also found settled on them. The distribution of the brown mussel is limited within a coastal stretch of about 150 km, roughly between Kanyakumari and Quilon.

Though a seasonal fishery had traditionally existed here, the mussel in the district does not seem to have been fully exploited in the past. Based on the information collected during 1968, Jones and Alagarswami *(Proc. Symp. Living Resources of the seas around India,* 641-647, 1973) reported that some of the submarine rocks here have an extent of about 800 m length and 70 m width at about 7 m depth. They estimated the number of catamarans (each with a crew of 2) engaged in this fishery in the district at 270 and the annual catch at 322.4 t. Subsequently, Alagarswami *et al. (Workshop on Mussel Farming, Cent. Mar. Fish. Res. Inst.,* Madras, India, 25–27 September, 1980, mimeo.) observed increased mussel landings in this area, but, in the absence of exact catch figures, estimated a 10% increase over the figures given by Jones and Alagarswami (above cited) and envisaged scope for increasing the production to thrice the then level.

Though there had been better harvest in some years subsequently, the mussel fishery took a positively upward turn only during its 1986-'87 season and the trend improved further in the subsequent 1987–'88 season. During these two seasons, particularly in the latter, intensified mussel fishing operations were on, at a level unprecedented in this region in recent years. These fishing centres included the areas where this resource had so far been known to be exploited only at a low sustenance level. The outcome was the beaching of tonnes of mussel. The urge for this intensification was apparently an expanded market for this in the adjacent Trivandrum district of Kerala, to where about 75% of the mussels collected here was transported.

The mussel fishing centres in the district at present are – from south – Kadiapatnam, Colachel, Kodimunai, Vaniakudi, Kurumpanai, Enayam and Enayamputhenthurai. There are other rocky area having mussel settlement, namely, Chinnamuttom (the only centre in the eastern coast of the district near Kanyakumari with possibilities of mussel fishery), Kanyakumari, Kovalam (near Kanyakumari), Muttom, Melamidalam and Ramanthurai. But mussel fishing in these centres is occasional, only a few persons collecting them for their domestic use and the landings are negligible.

The following is a report on the mussel fishery in the district for the seasons beginning from 1981–'82 upto 1987–'88, with special reference to the last two seasons, based on the fishery survey statistics collected for six of the centres, Colachel, Kodimunai, Vaniakudi, Kurumpanai, Enayam and Enayamputhenthurai. Based on these data, estimated landings for the whole district consisting of 7 mussel fishing centres, Kadiapatnam being the only uncovered centre, have been worked out. Additional information gathered by personal observation and enquiries with fishermen (mussel divers and others), mussel merchants and a cross section of the consumers (coastal as well as interior) is also incorporated in the report. The part given under disposal is relevant only to the last two seasons reported here.

Exploitation

Normally, the mussel beds within a depth of 12 m are exploited. Where the rocks are very close to the shore, the fishermen swim to the spot. But in other cases, a catamaran is used usually by two persons. During peak mussel fishing season, the divers set out at about 0600 hrs and return around noon except when larger collection is required. The persons in the catamaran dive alternately.

The scalpriform tool ('uli') with a long (about 0.5m) light-weight wooden handle continues to be used to scrap the mussel directly into the net bag ('kachal') taken with the diver for the purpose. Hand-picking of mussels, which was once common, is now obsolete. A goggle ('kannadi') is used by most divers.

The mussel usually occurs in clusters and in layers, the upper layer consisting of younger ones which settled at a later date. At the beginning of the fishing season, the divers who are particular about bigger shells remove the smaller ones of the upper layer to get at the larger adult ones. At the end of a dive, the diver lets off the tool free and it darts to the surface and floats. Then follows the diver with his haul which is deposited in the catamaran. Now it is the turn of his partner to dive. Together they make normally about 30 to 50 dives per trip and collect upto 300 kg. Those who fish for lobster (whose fishery season coincides with that of the mussel) also collect some quantity of mussel, which goes to them as bycatch.

Fishery

The season-wise mussel landings and other related details for five seasons beginning from 1981–'82 are given in Table 1. A more detailed tabulation of the mussel fishery for the next two seasons, 1986–'87 and 1987–'88, *i.e.*, the period of enhanced mussel fishing operations, is separately given in Table 2.

During the first five seasons, the estimated mussel landings have ranged from as low as 182 t in 1982–'83 to 1,534 t in 1981–'82. During the same period the seasonal average quantity of mussel collected per fishing trip varied from 40 kg in 1982–'83 to 93 kg in 1984–'85.

Table 1. *Season-wise mussel landings in Kanyakumari district with other details for five seasons beginning from* 1981–'82

Seasons	Estimated landings (t)	Estimated no. of fishing trips	Range of monthly average landings per trip (kg)	Seasonal average landings per trip (kg)
1981–'82*	1,534	18,688	43–105	82
1982–'83	182	4,527	37–44	40
1983–'84	1,190	16,193	15–111	73
1984–'85*	1,320	14,210	41–155	93
1985–'86	472	6,113	55–84	77

*Data were not available for February, 1982 and December, 1985.

1986–'87 *season:* Mussel fishing for this season started from the last week of September and came to a halt by the middle of February. During this period an estimated quantity of 1,802 t was brought ashore in the district. The monthly landings had its peak in December with 857 t and were at its minimum during September and February with 49 and 19 t respectively. The monthly average quantity of mussel collected per trip ranged from 29 kg in February to 81 kg in November with a seasonal average of 63 kg. The mussel fishing trips per day per centre varied from 8 in February to 60 in December with a seasonal average of 34.

1987–'88 *season:* Commencing from October and lasting till February, this season had an estimated total landings of 8,837 t which show about a 5-fold increase from the previous season. Peak landings of 3,554 t

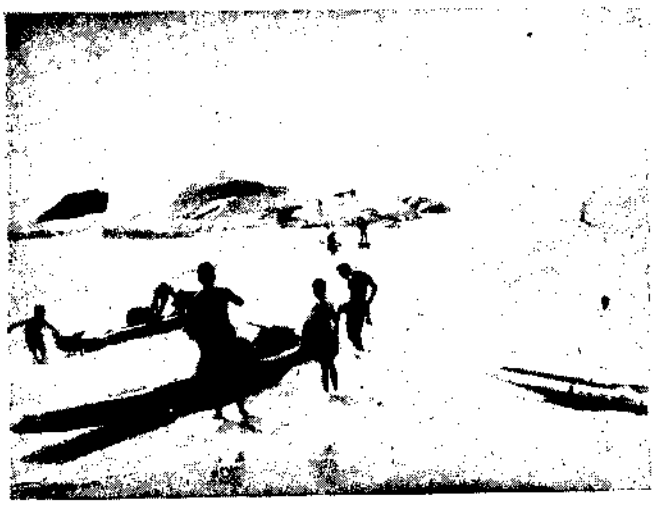

Fig. 1. Landing of mussel fishing crafts.

Fig. 2. The mussels being unloaded from catamarans.

Table 2. *Month-wise mussel landings in Kanyakumari district during the two seasons,* 1986–'87 and 1987–'88.

Seasons	Months	No. of mussel fishing days	Estimated landings (t)	Estimated no. of trips	Average collection per trip (kg)	Average no. of trips per day per centre
1986–'87	September	4	48.7	672	73	24
	October	25	180.9	2,712	67	16
	November	25	457.8	5.643	81	32
	December	27	856.7	11,416	75	60
	January	27	238.6	7,340	33	39
	February	12	19.3	672	29	8
	Total	120	1,802.0	28,455	—	—
	Seasonal Average		—	—	63	34
1987–'88	October	26	2,598.6	14,560	179	80
	November	25	3,553.8	22,400	157	128
	December	26	1,574.7	14,196	111	78
	January	26	949.2	13,680	70	75
	February	25	161.2	4,783	34	27
	Total	128	8,837.5	69,619	—	—
	Seasonal Average		—	—	127	78

were recorded in November with an average landing rate of 157 kg per trip. During the same month, an average of 128 trips were made per day per centre. At the end of the season in February, the monthly landings fell to 161 t with the month's average collection rate of 34 kg per trip and a reduction of 27 trips per day in a centre. The seasonal average quantity collected in a trip works out to 127 kg and the average number of trips per day per centre, 78.

The fluctuation in the quantity collected per trip on different days may be due to the number of dives made. Besides turbid and turbulant water and dim light impede the collection rate. The contrary factors like clear and calm water and bright sunlight are optimum conditions for mussel fishing. Tides are not considered to be a limiting factor since the tidal amplitude in this region is very low.

Disposal and marketing

Trucks of 2 tonnes capacity, having mussels to the brim, plying northward from Kanyakumari district were a common sight during the mussel fishery seasons, since the major portion (about 75%) of the landings was transported to markets in Trivandrum district

Fig. 3. Pre-selling treatment – cleaning and grading.

(which itself is a mussel fishing region in the southernmost part of Kerala) where the mussels were reportedly sold at prices lower than that of the mussels collected locally. For instance, an actual figure from a trader's record shows that from Colachel alone, 52 truck-loads were sent within 11 days during the second half of December, 1987. A truckful of mussel, already graded and cleaned of extraeneous attachments and encrusta-

tions on the shells, ranged in price from Rs. 700/- to 1,000/- during different occasions at the point of despatch.

The retail price in and around the fish landing centres varied from Rs. 2 to 4 per hundred though occasionally it went up to Rs. 7. During its season, it is a sure item fetching better selling rates in most interior fish markets in Vilavancode and Kalkulam taluks of the district.

Utilisation

The mussel, locally known as 'thodu', 'chippi' and 'kallikka', is eaten mostly cooked with condiments, though boiled mussel is also consumed without any mix. The larger ones are preferred. Though it is a much relished item of seafood in some quarters, the mussel is not in high demand in the district. That about 75% of the catch is sent out, is an indication of the attitude towards it of the local people to whom it is so easily accessible. There seem to be many reasons for this: some have a preconceived notion that it is a poor man's food capable of causing ill effects; some others hesitate to go for it for the mere reason that it invities a lot of labour in the culinary treatment, like boiling to remove the flesh from the shells and removing the byssus thread from the flesh.

So far, mussel from India has not had a promising export market. Some Arabian countries are inclined to import mussel and trial supplies are being sent. An outside market for it might arise sooner or later.

Crushed mussel is used as bait for lobster fishing. Shells are used for lime preparation. A regular business exists in one of the centres, Enayam, where many fishermen dive for the empty shells around the rocky beds, all through the year, except during monsoon months.

Fisherfolk's awareness of the fishery

Fishermen are naturalists in their own way. Experienced divers ('kuzhiyalu' in Tamil) say that during 'Panguni and Chithirai' (Tamil months corresponding to the period from March middle to May middle) a 'kara' is formed in the sea and following that attachment of 'podi chippi' (small mussels) begins. This process repeats, according to them, after a few months. Studies have shown that mussels spawn over an extended period with a peak from June to August and a secondary spurt in October and November (Jones, 1950, *Bombay nat. Hist. Soc.*, **49** (3): 519-528) and that spawning of *Perna indica* in the Vizhinjam (near Trivandrum region commences by May and lasts till September (Appukuttan and Prabhakaran Nair, 1980, Mussel Farming, *CMFRI Bull.*, **29**: 5-9). Though 'kara' is a term fishermen generally use to describe a bloom (usually of plankton), here what the divers call as 'kara' during that period may be the brick-red eggs released in millions, followed by early larval stages of the mussels, and the formation of 'podi chippi', the spat settlement.

Fig. 4. Packing for transporting to markets.

Local fishermen believe that there are mussel-scalps beyond the conventional grounds. Scientifically this can be ascertained only after conducting surveys. But, the feasibility of exploiting them commercially from beds deeper than the skin-divers' reach, would require new viable fishing methods to collect them economically.

Future prospects

At the end of the 1986-'87 season, the fishermen were sceptical about the chances of another successful mussel fishery here during the ensuing season. Because, they had made a thorough sweep of the mussel beds within the exploited depth range. But they were astonished by the multifold increase in the fishery when the feared season prevailed. Further, the 1987-'88 season was deemed as closed not because of lack of mussel on the rocks, but due to the fact that the available larger mussels had their meat shrunken and were not easily mastecateable, the characteristics perhaps of spawned individuals. So, towards the end of this season, some divers started collecting smaller shells also. All this points towards a reasonable understanding that, at the present level of exploitation, the beds are not likely to be depleted, unless by some unusual predation or some

Fig. 5. The mussels being loaded into the truck.

calamitous environmental change resulting in the destruction of the larvae, failure of spat settlement and their growth.

To encourage the consumption of this protein-rich food, all false apprehensions among the people about eating mussels must be dispelled and the fact stressed that mussels are highly nutritious food which, like any other good food, causes no ill-effect when consumed uncontaminated and in reasonable quantities. This can be achieved by extension work by governmental agencies as well as socio-economic organisations of the region.

As the observations were in progress in January, 1988, a press report stated about the Indian Council of Agricultural Research having sanctioned a Rs. 3.25 lakh project for the Kerala University on product development from bivalve meat. This project is reportedly aimed at developing edible products from bivalve meat and fixing biochemical and microbiological standards for such products. If sea-mussels also figure in the study and the results lead to better utilisation of the same, Kanyakumari district has the scope to contribute raw material to an appreciable extent by gearing up production in the presently unexploited centres also. Naturally, when mussel fishing becomes more profitable than now, more fishermen will get engaged in this fishery.

Fig. 6. An innovative method to transport mussels to short distances in meshed bags.

SIZE AND WEIGHT REDUCTION IN *HOLOTHURIA SCABRA* PROCESSED AS *BECHE-DE-MER*

*BECHE-DE-MER**

Along the Tamil Nadu coast *Holothuria scabra* is fished for *beche-de-mer* preparatiosn. The fishing for this species extends from Rameswaram to Kottaipattinam in the Palk Bay and from Pamban to Tuticorin in the Gulf of Mannar in shallow waters. Fishing for holothurian is highly seasonal being restricted to March to October in the Palk Bay and October to March in the Gulf of Mannar. Nearly 1,000 divers are seasonally engaged in this fishing activity. Throughout the area both adult and juvenile specimens are collected by the divers.

*Prepared by B. K. Bhaskar and P. S. B. R. James CMFRI Cochin.

Growing demand for *beche-de-mer* in the marine export market has naturally led to considerable debate among fishery biologists in our country on the problem of irrational exploitation of the natural stock. One important aspect currently discussed is about the minimum size of the live animal that may be safely exploited. The process in the preparation of *beche-de-mer* results in considerable shrinkage from the initial size of the animal and the export control standard prescribed in the country stipulates that *beche-de-mer* below 75 mm (3") should not be exported. The exporters feel that this decision needs revision and that they should be allowed to export *beche-de-mer* above 50 mm size since good percentage of material is below 75 mm and also material of this size has some demand in foreign markets.

The Central Marine Fisheries Research Institute as the nodal institute to give expert opinion on such matters affecting the exploitation of the natural stock, had an indepth discussion on various aspects connected with the *beche-de-mer* industry during the recent National Workshop on *Beche-de-mer* (1989) held at Mandapam and explained the rationale behind the export size stipulation. At the end it was agreed, amongst other things, that the Institute should undertake investigations to throw more light on:

i) The extent of shrinkage or size reduction of *H. scabra* from the fresh to the dried product.

ii) The weight loss of fresh animal to the dried condition and

iii) The size ranges of *H. scabra* entering the commercial catches.

The details presented in this report are the results of the follow-up studies made on the above lines during April-May, 1989.

For the study purpose fresh material was collected from Rameswaram, Devipattinam and Tirupalakudi and processed. The results emerged from the study are presented in Tables 1–3. It has been found that:

i) The size groups of *H. scabra* fall within a range of 130-340 mm. 61.81% of the specimens are in the size range of below 230 mm. This shows that in the commercial catches there is a preponderance of individuals which are maturing (16.37%, 130–170 mm, 24.35%, 171–200 mm) and those about to spawn (21.09%, 201–230 mm). Studies on the size at first maturity of *H. scabra* undertaken by the authors, reported elsewhere, have indicated that the spawning size is 201–230 mm (average 220 mm).

ii) *H. scabra* in the size group 201–230 mm after processing attains a reduced size of 73–80 mm (average shrinkage 76 mm).

Table 1. *Changes in length and weight during processing of the sand fish* Holothuria scabra *at Rameswaram (sample size:* 128*)*

Size group (mm)	Nos.	Initial state		I Boiling		II Boiling		Drying (72 hrs)	
		Length (mm)	Weight (g)	Length (mm)	Weight (g)	Length (mm)	Weight (g)	Length (mm)	Weight (g)
130-170	12	160	218	130	75	90	35	60	6.3
171-200	8	185	255	140	90	98	44	63	8.0
201-230	8	220	320	140	80	130	60	80	18.0
231-260	16	253	440	190	217	178	134	132	51.5
261-300	56	278	487	184	200	172	134	131	52.5
301-340	28	323	548	194	214	186	140	146	60.0
Total	128	1,419	2,268	978	876	854	547	612	196.3
Mean		236.5	378	163	146	142.3	91.16	102	32.72
% of shrinkage		100.0		68.9		60.18		43.13	
% of weight			100		38.6		24.12		8.66
% of weight loss			100		61.4		75.88		91.34

iii) The weight loss is considerable amounting to 91.34–91.79%.

iv) A perusal of Tables–1–3, indicates that the final reduction in length of the dried product constitutes 43.13% at Rameswaram, 42.65% at Devipattinam and 42.9% at Tirupalakudi. So far as the weight loss is concerned, it was 91.34% at Rameswaram, 91.79% at Devipattinam and 91.73% at Tirupalakudi. Thus it is evident that specimens collected from different places show only negligible variation in size reduction on conversion to *beche-de-mer*.

Table 2. *Changes in length and weight during processing of the sand fish* Holothuria scabra *at Devipattinam (sample size: 56)*

Size group (mm)	Nos.	Initial state		I Boiling		II Boiling		Drying (72 hrs)	
		Length (mm)	Weight (g)	Length (mm)	Weight (g)	Length (mm)	Weight (g)	Length (mm)	Weight (g)
130–170	12	162	233	121	85	84	26	65	14
171–200	15	192	294	125	91	85	28	65	14
201–230	17	215	346	140	108	96	35	73	18
231–260	8	247	454	192	221	169	134	132	52
261–300	4	272	487	184	197	167	134	129	51
301–340	—	—	—	—	—	—	—	—	—
Total	56	1,088	1,814	762	702	601	357	464	149
Mean		217.6	362.8	152.4	140.4	120.2	71.4	92.8	29.8
% of shrinkage		100		70.04		55.24		42.65	
% of weight			100		38.7		19.68		8.21
% of weight loss			100		61.3		80.32		91.79

Table 3. *Changes in length and weight during processing of the sand fish,* Holothuria scabra *at Tirupalakudi (sample size: 120)*

Size group (mm)	Nos.	Initial state		I Boiling		II Boiling		Drying (72 hrs)	
		Length (mm)	Weight (g)	Length (mm)	Weight (g)	Length (mm)	Weight (g)	Length (mm)	Weight (g)
130–170	22	162	236	121	86	85	27	66	14
171–200	48	191	294	126	92	85	28	66	15
201–230	32	217	354	141	109	97	37	74	18
231–260	10	247	455	192	222	170	134	132	52
261–300	8	274	487	184	198	168	134	130	52
301–340	—	—	—	—	—	—	—	—	—
Total	120	1,091	1,826	764	707	605	360	468	151
Mean		218.2	365.2	152.8	141.4	121	72	93.6	30.2
% of shrinkage		100		70.03		55.45		42.9	
% of weight			100		38.72		19.72		8.27
% of weight loss			100		61.28		80.28		91.73

From the foregoing account there appears to be no need to reconsider the earlier decision banning export of *beche-de-mer* less than 75 mm (3" size) individually since such a step would mean allowing animals of range below 201–230 mm to be fished and processed. As is evident from the data collected now juveniles are indiscriminately removed along with adults since divers maintain that it is not possible to differentiate the size under water. A practical way of overcoming this problem is to adopt the principle of 'closed season' each year. Thus revival of the natural stock can take place and this would help in encountering specimens beyond the size of 75 mm in length. The fishermen need to be educated on these points so that indiscriminate exploitation can be brought under control. However, more studies are required on the biology of holothurians to determine precisely the period of maturity and spawning in different species in a year.

Summary:

i) The fishing of holothurian *Holothuria scabra* extends from Rameswaram to Kottaipattinam in the Palk Bay and from Pamban to Tuticorin in the Gulf of Mannar in shallow waters.

ii) In commercial catches the size groups of *H. scabra* from different places fall within a range of 130–340 mm and maximum percentage (61.81%) fall below 230 mm.

iii) Studies on the size at first maturity undertaken by the authors indicated that the spawning size is 201–230 mm (average 220 mm) and this size group after processing attains a reduced size of 73–80 mm (average shrinkage 76 mm).

iv) The size and weight reduction of *H. scabra* from fresh to *beche-de-mer* from different places show only negligible variation (size: 42.65–43.13%; weight: 91.34-91.79%).

v) There is no justification to reconsider the earlier decision banning export of *beche-de-mer* less than 75 mm (3" size) individually. Also it is advisable to observe a 'closed season' each year to conserve the holothurian resources.

टूटिकोरिन के मात्स्यिकी बंदरगाह में ट्रालर आनायन - एक आर्थिक अवलोकन*

प्रस्तावना

गार्हिक यानों का नवनीकरण और यंत्रीकृत मत्स्यन देश के समुद्री उत्पादन में बड़ी वृद्धि लाये हैं। यंत्रीकरण से अति मत्स्य ग्रहण ने मछुओं को परंपरागत मत्स्यन तरीके छोड़ने केलिए प्रेरणा दी है। मत्स्यन क्षेत्र में प्राप्त इस वृद्धि ने मछुओं को मत्स्यन उद्योग और निर्यात की ओर उन्मुख की है। यद्यपि पहले पहल यन्त्रीकरण ट्राल मत्स्यन में और झींगे पकड़ में लाया गया तथापि बाद में गिल नेटिंग में भी यह लाया गया है। इसका नतीजा यह हुआ है कि कई क्षेत्रों में ट्राल आनायन से अतिमत्स्य ग्रहण हो रहा है। यह अतिमत्स्य ग्रहण और परंपरागत व यंत्रीकृत मछुओं के बीच होनेवाले संघर्ष मत्स्यन विनियम की आवश्यकता पर ज़ोर देता है। यह अध्ययन टूटिकोरिन फिशरीज़ हार्बर में उपयोग किये जानेवाले विविध प्रकार के ट्रालरों की आर्थिक स्थिति की ओर प्रकाश डालता है।

टूटिकोरिन तमिलनाडु के मुख्य ट्रालिंग केन्द्रों में एक है। यहाँ के फिशरीज़ हार्बर में करीब 400 छोटे यंत्रीकृत बोटें और 10 अगाध जल ट्रालरें लंगर डालने की सुविधा है।

टूटिकोरिन में परिचालित किये जानेवाले अधिकांश ट्रालरें 1973 से 1985 तक के दौरान खरीदे हैं।

यहाँ 3 कैटगरी के ट्रालरों का प्रचालन होता है पहला कैटगरी 1, 8.5 मीटरवाला, ट्रालर है। इसका औसत निवेश 100,000 रु. है। कैटगरी 2 के ट्रालर 9 मीटर का है इसका औसत निवेश 1,20,000 रु. है। हाल ही में 9.5 से 10 मीटर के ट्रालरें भी टूटिकोरिन में प्रचालन में लाये है। इनका औसत निवेश 2,20,000 रु. आँका गया है।

स्थिर मूल्य

मत्स्यन एकक का अवमूल्यन और लगाया हुआ धन का ब्याज मिलाने पर स्थिर मूल्य मिलता है। मत्स्यन बोट और उसके विविध

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संघटकों को जोडकर, प्रत्याशित उपयोगावधि के आधार पर निर्धारित करता है जबकि ब्याज प्रतिवर्ष 15% के क्रम में निर्धारित करता है। उपयुक्त एककों का अवमूल्यन यथाक्रम 21,040 रु., 25,300 रु. और 46,000 रु. प्राक्कलित किया गया है।

परिचालन व्यय और लाभ

बोट के परिचालन केलिये रोज़ इंधन, वेतन, मरम्मत और अनुरक्षण पर किये जानेवाले खर्च को परिचालन व्यय कहता है। यह व्यय मालिक द्वारा वहन किया जाता है। कुल आय से परिचालन व्यय घटाने पर मिलनेवाला आय को 3 भागों में बॉटता है। इसके दो भाग मालिक को मिलता है। एक भाग कर्मचारियों के बीच बॉटा जाता है।

अक्तूबर 1985 से सितंबर 1986 के दौरान 8.5 मीटरवाले बोट के वार्षिक औसत व्यय 2,95,964 रु. और प्राप्त आय 3,90,716 रु. प्राक्कलित किया गया। 9 मीटर ट्रालर का वार्षिक औसत व्यय 3,70,392 रु. और आय 4,79,811 रु. आँका गया। 9.5 से 10 मीटर ट्रालर का व्यय 4,61,458 रु. और आय 6,16,496 रु. आँका गया। इस प्रकार 8.5 मीटर ट्रालर का वार्षिक कुल व्यय 3.32 लाख रु., 9 मीटर ट्रालर का 4.13 लाख रु. और 9.5 मीटर से 10 मीटर ट्रालर का 5.40 लाख रुपये हैं। इस से प्राप्त कुल परिचालन आय यथाक्रम 94.7 हज़ार (8.5 मीटर) 1.09 लाख (9 मीटर) और 1.55 लाख (9.5 से 10 मी.) रुपये हैं। प्रत्येक एकक से प्राप्त कुल लाभ यथाक्रम 58,712 (8.5 मी) 66,188 (9 मी.) और 76,038 (9.5 से 10 मी.) है।

झींगे और अन्य मछलियों से आय

यह मान लिया जाता है कि ट्राल मत्स्यन मूलत: झींगों की पकड पर निर्भर है। वर्तमान अध्ययन के अनुसार 8.5 मीटर वाले ट्रालरों का 50% 9 मी. वाले ट्रालरों का 67% 9.5 से 10 मीटरवाले ट्रालरों का 66% वार्षिक राजस्व फिन फिशों से प्राप्त हुआ है। अत: मछलियों से प्राप्त वार्षिक आय झींगों से प्राप्त वार्षिक राजस्व से अधिक है। इसका कारण घरेलू बाज़ार में मछलियों के दाम में हुई बढती है।

मुख्य आर्थिक सूचक

कुल मिला कर कहा जाये तो टूटिकोरिन फिशरीज़ हार्बर में परिचालित किये जाने वाले उपयुक्त तीन ट्रालरों की मुख्य आर्थिक स्थिति नीचे के अनुसार है।

8.5, 9 व 9-10 मीटरवाले ट्रालरों का औसत मत्स्यन दिवस यथाक्रम 250, 243 और 238 है। प्रतिदिन की औसत पकड यथाक्रम 356 कि. ग्राम 375 कि. ग्राम और 418 कि. ग्राम है। इस से प्राप्त औसत प्रतिदिन राजस्व यथाक्रम 1,562 रु. 1,974 रु. और 2,590 रु है। प्रति दिन में प्राप्त औसत मूल्य में ट्रालरों के आकार के अनुसार अन्तर देखा गया। इसका कारण बडे ट्रालरों से पकडनेवाले बडे दाम की मछलियाँ है।

8.5, 9, व 9.5 से 10 मीटरवाले ट्रालरों का औसत प्रतिदिन व्यय यथाक्रम 1,328 रु. 1,702 रु. और 2,271 रु. देखा गया। ट्रालर अनायन से प्राप्त वापसी आय यथाक्रम 74%. 70%, और 50% आँका गया। अत: इन तीनों प्रकार के ट्रालरों के ज़रिये आनायन लाभप्रद देखा गया।

निर्णय

8 व 9.5 मीटरवाले ट्रालरों का प्रारंभ निवेश कम होने कारण उसे से प्राप्त वापसी आय अच्छा देखा गया। लेकिन उत्पादकता, पकड की अधिकता और कुल राजस्व की पृष्टि से बडे ट्रालर माने 9.5-10 मीटरवाला ट्रालर अधिक लाभप्रद देखा गया। ट्रालर आनायन के प्रारंभ में मूलत: झींगों की पकड केलिये यह अधिक उपयोगप्रद निकला था लेकिन अब ऐसी स्थिति आ गई है कि झींगें की पकड के बिना भी ट्रालर आनायन लाभप्रद है। मत्स्यन तकनीकों के विविधीकरण द्वारा अन्य मछलियों की पकड की ओर ध्यान विकेन्द्रीकरण भी प्रत्येक वर्ग की मछलियों की अतिजीविता केलिये अनिवार्य है। इस दृष्टि से बडे बोटों का और लंबे प्रचालन तकनीकों के उपयोग से मत्स्यन क्षेत्र में अधिकाधिक वृद्धि ला सकती है।

तमिलनाडु के कन्याकुमारी जिले में मसल मात्स्यिकी का वर्तमान ट्रेन्ड*

कन्याकुमारी जिले के तटीय जलों में मसल संस्तरों की प्रचुरता है। सितंबर-मार्च के दौरान विविध केन्द्रों में, जहाँ निमग्न या भागिक रूप में निमग्न चट्टान है, वहाँ ब्राउन मसल पेरना इन्डिका का नियमित मत्स्यन होता है। इस प्रकार के निमग्न चट्टानों में कहीं-कहीं हरित मसल पेरना विरडिस भी दिखायी पडती है। ब्राउन मसल कन्याकुमारी और क्वयिलोन के बीच 150 कि. मी. के सीमित क्षेत्र में दिखायी पडती है। इस क्षेत्र में इस प्रत्येक स्पीशीज़ की बढती कोई पारिस्थितिक प्रचाल से होता है, ऐसा मान लिया जाता है।

इस जिले में एक ऋतुनिष्ठ मात्स्यिकी परंपरा होते हुए भी गतकाल में मसलों का उचित समुपयोजन नहीं हुआ है। अलगरस्वामी और साथियों ने 1980 में केन्द्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान, मद्रास में मसल कृषि पर चलायी कार्यशाला में इस क्षेत्र के मसल के स्थलन के

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बारे में डाटा प्रस्तुत की। इसके अलावा मसल उत्पादन में तीन गुनी बढती करने के बारे में लेख प्रस्तुत किया।

मसल मात्स्यिकी में 1986-87 के दौरान भारी बढती महसूस हुई और 1987-88 में यह और भी बढ गयी। उक्त दोनों वर्षों में मसल मत्स्यन प्रचालन तीव्र था। इसके फल स्वरूप भारी पकड प्राप्त हुई। पकडे गये मसल का 75% केरल के त्रिवान्ड्रम जिले में बेच दिया गया।

इस जिले के वर्तमान प्रमुख मसल मत्स्यन केन्द्र हैं, कादियापट्टनम, कोलच्चाल, कोडिमुनै, वनियकुडि, कुरुमपानै, एनायम और एनायमपुत्तनतुरै आदि। इसके अलावा चिन्नमट्टम, कन्याकुमारी, कोवलम, मट्टम, मेलामिदलम और रामनतुरै में भी मसल युक्त चट्टानें हैं। लेकिन इन केन्द्रों में मत्स्यन हमेशा नहीं होता है।

समुपयोजन

साधारणतया 12 मी. गहराई के अन्तर के मसल संस्तरों का समुपयोजन करते है। यदि चट्टान तट के निकट है तो धीवरें तैर करके वहाँ जाते है। नही तो कट्टामरैन का उपयोग करके मसल का मत्स्यन करता है। कट्टामरैन दो मनुष्य द्वारा परिचालित किया जाता है। कट्टामरैन के व्यक्तियाँ एक के बाद एक डुब करके गहराई में जाकर मसल का संग्रहण करते हैं। मसलों के संग्रहण पहले हाथ से किया करते थे। अब संग्रहण केलिये "उलि" नामक एक उपकरण है। इसका लंबा (लगभाग-1/2 मी.) और हल्का सा काष्ठ है। इससे मसल खरच कर सीधे नेट बैग (काच्चल) में डालते हैं। अब मसल पकडने केलिये जानेवाले लोग ऐनक का उपयोग करते हैं।

मसल साधारणतया झुण्डों और स्तरणों में रहते हैं। ऊपर के स्तरणों में छोटे मसल और भीतर बडे मसल रहते है। पकडने केलिए जानेवाले निमज्जक बडे मसलें पकडने केलिये ऊपर के संस्तरों के छोटे मसलों को निकालते हैं। निमज्जन के बाद वे पकडने का उपकरण छोडते है। यह पानी में प्लवित होकर ऊपर आता है। इसके पीछे निमज्जक अपनी पकड के साथ बाहर आता है। अब उसका साथी निमज्जन करता है। इस प्रकार लगभग 30 से 50 निमज्जन करके 300 कि. ग्रा. तक का मसल पकडता है।

मात्स्यिकी: प्राक्कलित मसल मात्स्यिकी 1981-82 के पहले पाँच ऋतुओं में 1534 टन था। 1982-83 में यह 182 टन हो गया। उपर्युक्त अवधि में प्रति मत्स्यन ट्रिप में प्राप्त मसल की मात्रा 1982-83 में 40 कि. ग्रा. और 1984-85 में 93 कि. ग्रा. थे।

1986-87 मौसम: मत्स्यन सितंबर के अंतिम हफ्ते में शुरू होकर फरवरी के मध्य में खतम हो गया। इस अवधि की प्राक्कलित मात्रा 1802 टन थी। मासिक स्थलन में दिसंबर में सब से अधिक स्थलन हुआ। इस महीने का स्थलन 857 टन था।

1987-88 मौसम: अक्तूबर से फरवरी तक की अवधि में प्राक्कलित कुल स्थलन 8837 टन था। यह पिछले मौसम के स्थलन से कहीं 5 गुना अधिक था। स्थलन का शृंग काल नवंबर था। इस महीने का औसत स्थलन दर प्रति ट्रिप 157 कि. ग्रा. था। फरवरी के अंत में मासिक स्थलन घटकर 161 टन हो गया।

पकड मात्रा में उतार-चढाव का कारण निमज्जन की संख्या, मैला और विक्षुब्ध पानी आदि होता है। स्पष्ट और शांत जल और सूर्यप्रकाश मसल मत्स्यन केलिये उचित स्थिति विशेष है।

निपटान और विपणन

स्थलन के 75% ट्रिवेन्ड्रम के बाज़ारों में ले जाते थे। एक टूक ग्रेडड और शुद्ध मसल का दाम 700 से 1000 रुपये तक आता है। स्थलन केन्द्र में 100 मसल का दाम दो से चार रुपये तक होता है और कभी कभी यह 7 रुपये तक बढ जाता है।

उपयोग

मसल, "तोडु", चिप्पी" और "कक्कल्लिक्का" आदि स्थानीय नामों से जाने जाते है। इसे मसाला लगाकर पकाते है। कथित मसल बिना मसाला से भी उपयोग करते है। स्वादिष्ट वस्तु होते हुए भी जिले में इसका अधिक माँग नही है। पकड के 75% बाहर की ओर भेज देता है। इसका एक कारण यह है कि कुछ लोग उसे गरीबों का आहार मानते है। दूसरा कारण इसे पकाने में होने वाली कठिनाइयाँ है।

कुचला हुआ मसल महाचिंगटों के मत्स्यन में चारे के रूप में उपयोग करते हैं। इसकी सीपी से चूना बनाती है।

मात्स्यिकी के बारे में धीवरों की जानकारी

अनुभवी निमज्जकों का कहना है कि "पंगुनी" "चित्तिरै" (मार्च मध्य से मई मध्य तक) के दौरान समुद्र में एक "कारा" उत्पन्न होता है। और इसके अनुवर्ती के रूप में "पोडि चिप्पि" आ जाता है। अध्ययन के अनुसार मसल का प्रजनन जून से अगस्त की अवधि में होता है जो इसका शृंग काल होता है, इसका द्वितीय प्रजनन अक्तूबर से नवंबर तक होता है।

भविष्य: धीवरों ने 1986-87 में मसल संस्तरों का बडा समुपयोजन किया था। इसलिए वे इस अवधि के अन्त में सफल मसल मात्स्यिकी की लभ्यता के बारे में संशयी थे। लेकिन उनके संदेह के विपरीत इनकी दुगुनी बढती दिखायी पडी। लेकिन 1987-88 में बडे मसलों के मांस सिकुड जाने के कारण चर्वण में काफी कठिनाई हुई, इसलिए मनुष्यों ने छोटे मसलों को पकडने लगा।

इस प्रोटीन युक्त खाद्य के बारे में लोगों के बीच के गलत विचारें दूर करना है। यह सरकार और समाज आर्थिक संगठनों के विस्तार काम से प्राप्त कर सकता है।

मसल सम्बन्धी निरीक्षणों के प्रगामी दशा के बारे में जनवरी, 1988 में एक प्रेस रिपोर्ट में कहा था कि भारतीय कृषि अनुसंधान परिषद ने बाइवालव मांस के उत्पादन के विकास केलिये 3.25 लाख रु की परियोजनायें शुरु करने को केरल विश्वविध्यालय को मंज़ूरी दी है। इस परियोजना का मुख्य लक्ष्य खाद्य उत्पादों का विकास करना है। यदि मसल भी इसके साथ शामिल किया जायें तो अच्छा फल निकलेगा और इसकेलिए असंस्कृत पदार्थ कन्याकुमारी जिले से अवश्य मिलेगा। मसल मत्स्यन लाभदायक हो जाने पर धीवरें भी इस मात्स्यिकी में अधिक रुचि दिखाने लगेंगे।

बेश-द-मेर के रूप में संसाधित करने पर होलोथूरिया स्काब्रा के आकार और भार में होनेवाली घटती*

तमिलनाडु में बेश-द-मेर की तैयारी केलिए होलोथूरिया स्काब्रा पकडा जाता है। इस स्पीशीज़ का मत्स्यन पाक खाडी में रामेश्वरम से कोट्टैपट्टनम तक और मान्नार खाडी में पम्बान से टूटिकोरिन तक उथला जल में होता। इसका मत्स्यन पाक खाडी में मार्च से अक्तूबर तक और मान्नार खाडी में अक्तूबर से मार्च तक होता है। यहाँ के लग-भग 1000 निमज्जक इस मत्स्यन कार्यकलाप में लगे रहते हैं। यहाँ से वयस्क एवं किशोर नमूनों का संग्रहण भी होता है।

समुद्री निर्यात मार्केट में बेश-द-मेर की माँग बढती जा रही है। इस सन्दर्भ में देश के मत्स्य जीव-विज्ञानियों के बीच होलोथूरया के प्राकृतिक स्टॉक के युक्तिहीन शोषण पर्याप्त वाद-विवाद का विषय बन चुका है। मुख्य विवादास्पद विषय जीवित होलोथूरियनों का समुपयोजन साध्य सब से छोटा आकार है। बेश-द-मेर के संसाधन के वक्त उसके आकार में संकोच होता है। निर्यात केलिए निर्धारित स्तर के अनुसार 75 मि.मी. से कम आकारवाले बेश-द-मेर निर्यात योग्य नही है। निर्यातक इस निर्णय का पुनरीक्षण करके 50 मि. मी. के ऊपर के आकारवाले होलोथूरियनों को निर्यातयोग्य बनाना चाहते है। क्योंकि साधारणत: बेश-द-मेर का आकार 75 मि. मी. से कम है और विदेश मर्केट में इसकी अच्छी माँग भी है। सी. एम. एफ. आर. आइ मात्स्यिकी के समुपयोजन और आरक्षण से सम्बन्धित मामलों पर विशेषज्ञ मत देने केलिए संस्थापित हैं। इसलिए मण्डपम कैम्प में 1989 में बेश-द-मेर पर चलायी गयी राष्ट्रीय कार्यशाला में बेश-द-मेर-उद्योग से संबन्धित विविध पहलुओं पर विचार किया गया। चर्चा में बेश-द-मेर के निर्यात आकार शर्त के पीछे निहित युक्तिहीनता पर परामर्श किया गया। चर्चा के अन्त में इस विवाद पर एक वस्तुनिष्ठ निर्णय लेने केलिए संस्थान ने नीचे प्रस्तुत विषयों पर अनुसंधान करने का निर्णय लिया।

1. होलोथूरिया स्काब्रा को सुखाने पर होनेवाला संकोच या आकार की घटती की सीमा
2. सुखाने पर भार नष्ट
3. वाणिज्यक पकडों में महत्वपूर्ण एच. स्काब्रा का आकार रेंच।

उपयुक्त अध्ययन केलिए होलोथूरियनों को रामेश्वरम, देविपट्टिनम और तिरुपालकुडी से संकलन करके, संसाधित किया गया। अध्ययन के बाद यह देखा गया कि

1. एच. स्काब्रा का साइज ग्रूप 130-340 मि. मी. के आकार रेंज में है। 61.81% नमूनों का आकार 230 मि. मी. के नीचे हैं। 230 मि. मी. से कम आकारवाले होलोथूरिया न तो प्रौढावस्था में प्रवेश करनेवाले या अंडजनन करने वाले हैं।
2. संसाधन के बाद 201-230 मि. मी. साइज़ ग्रूप के एच. स्काब्रा 73-80 मि. मी. तक सिकुड जाता है।

   (औसत सिकुडन 76 मि.मी.)
3. भार में 91.79% तक की भारी घटती होती है।
4. लंबाई में सूखी उत्पन्न की अंतिम घटती रामेश्वरम देवीपट्टिनम और तिरुपालकुडि में यथाक्रम 43.13%, 42.65% और 42.9 % दिखायी पडी और भार नष्ट रामेश्वरम में 91.34%, देवीपट्टिनम में 91.79% और तिरुपालकुडी में 91.73% था। अत: विविध स्थानों से संग्रहीत नमूनों के आकार ह्रास में छोटा सा अन्तर है।

संस्थान द्वारा प्रस्तुत इन विवरणों से यह स्पष्ट है कि 75 मि. मी. से कम आकार वाले नमूनों का निर्यात रोकने के निर्णय पर पुनर्विचार की आवश्यकता नहीं है, क्यों कि रोक नहीं लगाने पर 201-230 मि. मी. से कम आकार रेंज के होलोथूरिया का मत्स्यन और संसाधन हो सकता है।

होलोथूरिया के विवेचनहीन समुपयोजन का एक कारण इन्हें पकडने की रीति है। निमज्जक प्रौढों के साथ किशोरों को भी पकडते हैं, क्योंकि अंतर्जल में प्रौढ और किशोर का पहचान संभव नहीं है। इस समस्या को दूर करने केलिए एक प्रायोगिक रीति अपनाना आवश्यक है। हर एक साल में "बंद मौसम" तत्व का प्रयोग करके प्राकृतिक स्टॉक की रक्षा कर सकती है। धीवरों को आवश्यक शिक्षा देकर अव्यवस्थित शोषण नियन्त्रित कर सकता है। जो भी हो होलोथूरियनों के विविध स्पीशीज़ों के प्रौढावस्था काल अंडजनन आदि का स्पष्ट ज्ञान प्राप्त करने केलिए इनके जीव-विज्ञान पर आधिकाधिक अध्ययन आवश्यक है।

*बी. के. भास्कर और पी. एस. बी. आर. जेम्स, सी. एम. एफ. आर. आइ., कोचिन।

GUIDE TO CONTRIBUTORS

The articles intended for publication in the MFIS should be based on actual research findings on long-term or short-term projects of the CMFRI and should be in a language comprehensible to the layman. Elaborate perspectives, material and methods, taxonomy, keys to species and genera, statistical methods and models, elaborate tables, references and such, being only useful to specialists, are to be avoided. Field keys that may be of help to fishermen or industry are acceptable. Self-speaking photographs may be profusely included, but histograms should be carefully selected for easy understanding to the non-technical eye. The write-up should not be in the format of a scientific paper. Unlike in journals, suggestions and advices based on tested research results intended for fishing industry, fishery managers and planners can be given in definitive terms. Whereas only cost benefit ratios and indices worked out based on observed costs and values are acceptable in a journal, the observed costs and values, inspite of their transitionality, are more appropriate for MFIS. Any article intended for MFIS should not exceed 15 pages typed in double space on foolscap paper.

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