



समुद्री मात्स्यकी सूचना सेवा

MARINE FISHERIES INFORMATION SERVICE

No. 97

JULY 1989



तकनीकी एवं विस्तार अंकावली TECHNICAL AND EXTENSION SERIES

केन्द्रीय समुद्री मात्स्यकी अनुसंधान संस्थान कोचिन, भारत CENTRAL MARINE FISHERIES RESEARCH INSTITUTE COCHIN, INDIA

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INDIAN COUNCIL OF AGRICULTURAL RESEARCH

COMPARATIVE ECONOMIC EFFICIENCY OF SAIL BOATS OPERATING DIFFERENT GEARS IN TAMIL NADU

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Introduction

The present study was carried out in Tuticorin region of Tamil Nadu. The main objectives of the study were (i) to identify the present status of the utilization of wind energy for fishing operations (ii) to compare the costs and returns of traditional fishing practices and (iii) to determine how far the utilization of wind energy in nearshore trawling is economically viable as compared to other existing practices.

Data and methodology

A pilot survey was carried out in fishing villages extending from Veerapandiyanpattinam in the south to Vembar in north of Tuticorin region to find out the present status of utilization of wind energy by sail boats for fishing operations and to identify the centres for indepth study. Based on this information, two centres namely Therespuram and Tuticorin South were selected and three types of craft-gear combinations were identified for continuous observation. They were (i) plank-built sail boats operating mini trawl nets (*thallumadi*) by wind energy, (ii) plank-built boats operating gill nets (*kolavalai*) by wind energy and (iii) plank-built boats with inboard (I.B.) engines operating gill nets (*kolavalai*). Three seasons identified for the purpose of data collection and referred in text are September-December, 1986 as season I, January-April, 1987 as season II and May-August, 1987 as season III.

Craft and gear combinations along Tuticorin coast

Catamarans and plank-built boats are operating different types of nets throughout the year depending on seasonality of fish along Tuticorin coast. Gill nets, drift and bottom-set gill nets are the prominent gears used by the non-mechanised crafts. Specifically *chalaivalai* or *kolavalai*, *valavalai* or *podivalai*, *paruvalai* (gill net) *sinkiralvalai*, *thirukkaivalai* (bottom-set gill net) and *thallumadi* (disco net) are widely used by sail boats in this region.

Among the bottom-set gill nets *sinkiralvalai* and *thirukkaivalai* are widely used for fishing operations by sail boats in Tuticorin region.

The *karavalai* (shore-seines), *ralvalai* (Prawn net) and *madivalai* (Bag net) are the nets almost gone out from the field. Pallavali, Harbour point, Alangarathattu and Vembar are the prominent centres operating *karavalai*. Most of the people operating this type of net belong to Vembar.

In recent years *thallumadi* and disco net are the two fishing gears introduced by fishermen with the intention of catching more prawns in this region. *Thallumadi* is operated by the sail boats in the near shore areas within 5 m depth and disco net by boats fitted with inboard engines in deeper waters of 6 to 15 m depth range. *Thallumadi* is a modified shrimp trawl operated by mechanised boats also without otter board. It is operated throughout the year in Tuticorin area either towards north or south depending on the direction and intensity of wind. The initial cost of a *thallumadi* is about Rs. 1,500.

Disco nets are operated in Tuticorin region during the prawn season of June to September.

Operational costs and returns

Operational costs of fishing units composed of repairing and maintenance, fuel, wages, auction and other day-to-day expenses for carrying out fishing operations. The gross income of a unit is the total value received for different species of fish caught in the unit. Net operating income is obtained by subtracting operating costs from gross income.

Sail boat operating trawl net (thallumadi): The season-wise break up of operational costs and returns of a sail boat, operating trawl net (*thallumadi*) at Therespuram centre during September, 1986 to August, 1987 is given in Table 1.

The actual number of fishing days for *thallumadi* units are 93 for season I, 85 for season II and 102 for season III. The operational costs in each season range from Rs. 4,097 to 12,246. Labour cost is the major operational expenditure accounting 81% for season I, 77% for season II and 82% for season III. Sharing

Table 1. Operational costs and returns of a sail boat operating trawl net (thallumadi) at Tuticorin, 1986-'87

Items	Sep.-Dec.		Jan.-Apr.		May-Aug.		Annual	
	Total	Average per day	Total	Average per day	Total	Average per day	Total	Average per day
I. Operational costs (Rs.)								
i) Repairing & maintenance								
a) craft	560	6	340	4	510	5	1,410	5
b) gears	284	3	170	2	316	3	770	3
c) sails	185	2	90	1	200	2	475	2
ii) Wages	7,998	86	3,145	37	9,996	98	21,139	75
iii) Auction charges	651	7	260	3	918	9	1,829	7
iv) Other expenses	200	2	92	1	306	3	598	2
Total	9,878	106	4,097	48	12,246	120	26,221	94
II. Returns (Quantity caught (Q) in kg and Value realised (V) in Rs.)								
i) Penaeid prawns	Q: 595	6.4	248	2.9	581	5.7	1,424	5
	V: 11,904	128	4,633	55	16,320	160	32,857	117
ii) Crabs	Q: 150	1.6	80	1	50	0.5	280	1
	V: 670	7	330	4	230	2	1,230	4
iii) Silverbellies	Q: 190	2	187	2	40	0.4	417	2
	V: 558	6	468	6	80	1	1,106	4
iv) Others	Q: 140	1.5	147	2	60	0.6	347	1
	V: 326	4	442	5	180	2	948	4
III. Total catch (kg)	1,075	11.5	662	7.9	731	7.2	2,468	9
IV. Gross revenue (Rs.)	13,458	145	5,873	69	16,810	165	36,141	129
V. Net operating income (Rs.)	3,580	39	1,776	21	4,564	45	9,920	35

system is followed for payment to the crew. They are paid 60% of the gross revenue to be equally divided among themselves. However, the study reveals that it is not strictly followed for all seasons. Labourers are getting lesser share during the lean season (January-April). The auction charges also depend on the gross returns. The auctioneers collect 4 to 6% of the gross returns as their commission. The auction charges range from 6 to 7% of operating costs for different seasons. Repairing and maintenance charges of craft, gears and sails of *thallumadi* units range from 8 to 15% of the operational expenditure. As a whole the average daily operational cost of a *thallumadi* unit ranges from Rs. 48 for season II to Rs. 120 for season III.

Penaeid prawns, crabs, silverbellies, carangids, sciaenids and *Epinephelus* spp. are caught by *thallumadi* units. The catches of penaeid prawns constitute *Penaeus semisulcatus*, *P. indicus* and *Metapenaeus dobsoni*. Comparatively lesser quantity of penaeid prawns was caught during the season II. The catch per season varies from

0.66 to 1.07 tonnes by a *thallumadi* unit. Penaeid prawns accounted for 55% of total catch during season I, 37% in season II and 79% in season III. It may be noted that 60% of the prawn catches was comprised of *M. dobsoni* and small sizes of *P. indicus* and *P. semisulcatus*. Silverbellies contributed 6-28%, crabs 7-14% and other varieties like carangids, sciaenids, *Epinephelus* spp. and *Hilsa toli* 8-22% of catches for different seasons. As a whole the daily catch of a *thallumadi* unit ranges from 7.2 to 11.5 kg for the three seasons.

The gross revenue realised for the *thallumadi* unit during September-December, 1986 was Rs. 13,458 with an average of Rs. 145 per fishing day. The value realised from the sales of penaeid prawns alone ranged from 79 to 97% of the gross revenue for the three seasons. The non-availability of prawns during January-April period in the nearshore areas led to the decline of gross revenue to the lowest level of Rs. 5,873 with an average of Rs. 69 per day of operation. Maximum gross revenue per unit was obtained during May-August, 1987 with Rs. 16,320

Table 2. Operational costs and returns of a sail boat operating gill nets at Tuticorin, 1986-'87

Items	Sep.-Dec.		Jan.-Apr.		May-Aug.		Annual	
	Total	Average per day	Total	Average per day	Total	Average per day	Total	Average per day
I. Operational costs (Rs.)								
i) Repairing and maintenance								
a) craft	480	5	720	8	430	5	1,630	6
b) gears	670	7	685	7	600	7	1,955	7
c) sails	85	1	98	1	80	1	263	1
ii) Food	776	8	1,740	19	1,170	13	3,686	13
iii) Wages	5,722	59	10,262	112	7,644	87	23,678	86
iv) Auction charges	970	10	1,380	15	1,056	12	3,406	12
v) Other expenses	290	3	185	2	350	4	825	3
Total	9,043	93	15,070	164	11,320	129	35,443	128
II. Returns (Q - quantity caught in kg and V-Value realised in Rs.)								
i) <i>Sardinella gibbosa</i>	Q: 4,559	47	4,048	44	3,960	45	12,567	45
	V: 10,088	104	15,364	167	15,400	175	40,852	148
ii) <i>Sardinella albella</i>	Q: 194	2	—	—	176	2	370	1
	V: 291	3	—	—	352	4	643	2
iii) <i>Sardinella sirm</i>	Q: —	—	828	9	—	—	828	3
	V: —	—	4,784	52	—	—	4,784	17
iv) <i>Thryssa spp.</i>	Q: 1,067	11	2,024	22	880	10	3,971	15
	V: 1,164	12	3,036	33	1,144	13	5,344	19
v) <i>Ilisha sp.</i>	Q: 970	10	—	—	176	2	1,146	4
	V: 970	10	—	—	264	3	1,234	5
vi) Others	Q: 485	5	276	3	352	4	1,113	4
	V: 1,067	11	644	7	704	8	2,415	9
III. Total catch (kg)	7,275	75	7,176	78	5,544	63	19,995	72
IV. Gross revenue (Rs.)	13,580	140	23,828	259	17,864	203	55,272	200
V. Net operating income (Rs.)	4,537	47	8,758	95	6,544	74	19,829	72

for season as a whole and Rs. 165 per operating day. Although the catches of prawns were comparatively less than those of season I, composition of bigger sized prawns coupled with higher price led to maximum revenue during this season.

The net operating income (income after deducting operating cost from gross revenue) ranged from Rs. 21 per day during January-April to Rs. 45 per day during May-August, 1987. The number of average annual fishing days for a *thallumadi* unit was found to be 280 with daily gross earning of Rs. 129 and net operating income of Rs. 35.

Sail boat operating gill nets: The operational costs and species-wise revenue realised for a sail boat operating gill net in different seasons during 1986-'87 is given in Table 2. Number of actual fishing days for these boats are 97 for season I, 92 for season II and 88 for season III. The average operational expenditure per season ranged from Rs. 9,043 to 15,070. About 64 to 68% of the operating expenditure is incurred towards payment of wages to crew for different seasons. Normally six persons go for fishing in sail boats operating *kolavalai*. Sharing system is followed for the payment of crew wages. Expenses on food, auction charges and other day-to-day expenses are deducted

Table 3. Operational costs and returns of a sail boat with inboard engine operating gill net at Tuticorin, 1986-'87

Items	Sep.-Dec.		Jan.-Apr.		May-Aug.		Annual	
	Total	Average per day	Total	Average per day	Total	Average per day	Total	Average per day
I. Operational costs (Rs.)								
i) Repairing and maintenance								
a) craft and engine	908	9	1,070	11	864	9	2,842	10
b) gears	780	8	647	7	670	7	2,097	7
c) sails	200	2	185	2	180	2	565	2
ii) Fuel	2,522	25	1,949	20	2,390	25	6,861	23
iii) Wages	7,272	72	13,077	135	8,455	89	28,804	98
iv) Auction charges	909	9	1,843	19	1,140	12	3,892	13
v) Other expenses	505	5	582	6	380	4	1,467	5
Total	13,096	130	19,353	200	14,079	148	46,528	158
II. Returns (Quantity caught (Q) in kg and value realised (V) in Rs.)								
i) <i>Sardinella gibbosa</i>	Q: 4,848	48	3,007	31	5,700	60	13,555	46
	V: 11,312	112	10,282	106	15,105	159	36,699	125
ii) <i>Sardinella albella</i>	Q: 1,415	14	—	—	190	2	1,605	6
	V: 3,234	32	—	—	475	5	3,709	13
iii) <i>Sardinella sirm</i>	Q: —	—	2,134	22	—	—	2,134	7
	V: —	—	12,804	132	—	—	12,804	44
iv) <i>Thryssa spp.</i>	Q: 1,212	12	5,335	55	3,610	38	10,157	35
	V: 1,516	15	6,014	62	3,990	42	11,520	39
v) <i>Ilisha sp.</i>	Q: 505	5	—	—	—	—	505	2
	V: 708	7	—	—	—	—	708	2
vi) Others	Q: 605	6	388	4	475	5	1,468	5
	V: 1,311	13	776	8	1,330	14	3,417	12
III. Total catch (kg)	8,585	85	10,864	112	9,975	105	29,424	101
IV. Gross revenue (Rs.)	18,081	179	29,876	308	20,900	220	63,857	235
V. Net operating income (Rs.)	4,985	49	10,523	109	6,821	72	22,329	76

from the gross income and 50% of the remaining is paid as crew wages. Repairs and maintenance of the craft, gear and sails which range from 10 to 14% of the operational costs are entirely borne by the owner. Food expenses range from 8 to 12%, auction charges 9 to 11% and miscellaneous expenses 1 to 3%. As a whole the operating expenditure of a sail boat operating *kolavalai* ranges from Rs. 93 to 164 per day for different seasons. The wages earned by a member crew range from Rs. 10 per day during season I to Rs. 19 per day during season II.

The peak fishing season for the *kolavalai* unit is found to be January–April. Major species of fish caught in these units are *Sardinella gibbosa*, *S. albella*, *S. sirm*, *Thryssa spp.* and *Ilisha sp.* Some other varieties like barracudas and sharks also come in these units occasionally. The study reveals that the existence of the *kolavalai* unit mainly depends on the catches of *S. gibbosa*. About 63 to 72% of the quantity caught and 65 to 86% of the gross returns are contributed by this species. *S. albella* contributes about 3% of the catches in season I and III with 2% of the gross returns. *S. sirm* is caught

in considerable quantity during January–April and it accounts for about 12% of the catches and 20% of the revenue for this season. About 15 to 28% of the catch is contributed by *Thryssa* spp. and the value realised by it ranges from 6 to 13% of the gross revenue for different seasons. *Thryssa* spp. are available throughout the year, with the maximum quantity caught during January–April and minimum during May–August.

About 13% of the catches and 7% of value in season I and 3% catches and 2% value in season II have been contributed by *Ilisha* sp. As a whole the average price realised for the fish caught by the sail boats operating gill nets has been Rs. 2.78 per kg.

The gross revenue realised for a sail boat operating gill net during September–December, 1986 is Rs. 13,580 with an average of Rs. 140 per day. Although the maximum quantity of fish is caught during this season the gross revenue realised has been minimum due to comparatively lesser price for all the varieties. Maximum gross revenue of Rs. 23,828 is realised during season II (Rs. 259 per day) mainly due to the availability of *S. sirm* which fetches comparatively better price than the other species. Minimum catch of 5,544 kg is obtained in season III realising a gross revenue of Rs. 17,864, with an average of Rs. 203 per day of operation.

The net operating income per day of operation ranges from Rs. 47 to 95 for different seasons. There are about 277 fishing days during September, 1986 to August, 1987. The overall gross income realised per day works out at Rs. 200/- and net operating income Rs. 72/- per day.

Sail boat with inboard engine operating gill nets: The operational cost per day of fishing ranges from Rs. 130 to 200 for different seasons (Table 3). The average number of fishing days is 101 for season I, 97 for season II and 95 for season III. Wages to the crew is the major operating expenditure accounting for 56% in season I, 68% in season II and 60% in season III. Fuel cost ranges from 10 to 19% of the operating expenditure for the three seasons. Repairing and maintenance of the unit which is entirely borne by the owner ranges from 10 to 14% of the operating costs. Auction charges ranges from 7 to 9% and miscellaneous expenditure 2 to 4% of the operating expenses for different seasons.

The species composition and the peak season of mechanised boats are almost similar to that of the non-mechanised sail boats operating *kolavalai*. The catches of *S. gibbosa* constitute 57% of total catch in season I, 28% in season II and 57% in season III the values

realised being 63, 34 and 72% of the gross revenue respectively. The contribution of *S. gibbosa* in catch and revenue is less in season II but considerable quantity of *S. sirm*, is caught during this season. About 20% of the catches and 43% of the gross revenue are realised by this variety in season II. Similarly the abundance of *S. albella* is restricted to season I contributing 17% of the catches and 18% of the gross revenue in these units. Although *Thryssa* spp. are available throughout the year, maximum quantity has been caught during January – April season. The contribution of this variety ranges from 14 to 49% of the catch and 8 to 20% of the gross revenue for different seasons. The fish caught in mechanised sail boats realised comparatively better prices at the landing centre. The average price realised for *S. gibbosa* ranges from Rs. 2.33 to 3.41, *S. albella* Rs. 2.20 to 2.50 and *Thryssa* spp. Rs. 1.10 to 1.27 for different seasons.

As a whole the average price realised for the fish caught in mechanised sail boats operating gill nets ranges from Rs. 2.00 to 2.75 per kg for different seasons. The free mobility due to the inboard engines and non-dependence on the direction and velocity of wind by these units lead them to reach the landing centre earlier and enable them to get better prices for their catch than the non-mechanised sail boats. But the overall average price per kg of catch received by the sail boats with inboard engines are comparatively less due to the higher contribution of less priced varieties like *Ilisha* sp. and *Thryssa* spp. than the non-mechanised sail boats.

The gross revenue obtained by a mechanised sail boat operating gill net is Rs. 18,081 for season I, Rs. 29,876 for season II and Rs. 20,900 for season III. The gross revenue per day of operation ranges from Rs. 179 to Rs. 308 for the three seasons. The net operating income works out to Rs. 4,985, 10,523 and 6,821 for season I, II and III respectively. Net operating income per day of operating ranges from Rs. 49 in season I to Rs. 109 in season II. The actual number of fishing days for the whole year comes to 293 with an average daily gross income of Rs. 235 and net operating income of Rs. 76.

Comparative economics - annual income and expenditure

The average initial investment of a sail boat operating mini trawl net (*thallumadi*) comes to about Rs. 18,000 that of sail boat operating gill net (*kolavalai*) about Rs. 27,000 and sail boat with inboard engine operating the same gill nets about Rs. 42,700 (Table 4). Since most of the observed units are old ones the present value of the craft (resale values at the time of obser-

vation) has been taken as the initial investment. The life expectancy also varied from 3 to 10 years for the observed units. Hence an average life of 5 years has been considered to work out the depreciation of crafts. With regard to sails, gear and engine the life expectancy is short as it is 2, 3 and 4 years respectively.

The boats observed are 30 to 32 footers and the average initial investment worked out to Rs. 16,000 for non-mechanised sail boats operating mini trawl nets, Rs. 17,500 for same type of boat operating gill nets and Rs. 18,200 for mechanised sail boats operating gill nets. With regard to mini trawl net (*thallumadi*) the purchase price varied from Rs. 1,300 to 1,600, the average value worked out for the selected units being Rs. 1,500. For gill nets (*kolavalai*) each boat takes 15 to 22 pieces along with them, each piece costing around Rs. 500.

Average number of *kolavalai* pieces taken for fishing by a non-mechanised sail boat is 18 and a mechanised sail boat is 20, costing Rs. 9,000 and 10,000 respectively. The purchase price of sails ranges from Rs. 350 to 650, the average being worked out to Rs. 500 for all the three categories of units observed. The purchase price of a 10 H.P. inboard engine ranges from Rs. 12,500 to 15,500, the average being Rs. 14,000.

The annual fixed cost includes the depreciation of the unit and the interest for initial investment. Depreciation is worked out under straight line method by allocating equal values every year on the basis of expected life of each type of capital asset. The interest for the initial investment is worked out at the rate of 15% per annum. The annual depreciation is worked out at Rs. 3,950 for same type of boat operating gill nets and Rs. 10,723 for mechanised sail boat operating gill nets. The interest for initial investment varies from Rs. 2,700 for non-mechanised sail boats operating *thallumadi* to Rs. 6,405 for mechanised sail boats operating gill nets. The annual fixed cost for *thallumadi* units comes to about Rs. 6,650, non-mechanised sail boats Rs. 10,800 and sail boats with inboard engines Rs. 17,128. The annual total cost for *thallumadi* works out at Rs. 32,871, of which operating costs constitutes about 80%. The average catch per boat works out at 2.5 tonnes during the year realising a gross return of Rs. 36,141. With regard to non-mechanised sail boats the annual total cost comes to about Rs. 47,619 in which about 33% is incurred towards fixed cost and the rest operating expenses. The annual average catch per boat is 19.9 tonnes obtaining a gross revenue of Rs. 55,272. The annual total cost for a sail boat with IB engine comes to about Rs. 64,256 of which fixed

cost alone constitute about 27% and the rest towards operating costs. The annual catch per boat is 29.4 tonnes realising a gross revenue of Rs. 68,857. The net operating income per annum works out to Rs. 3,270, 7,653 and 4,601 for *thallumadi* units, non-mechanised sail boats and sail boats with IB engines operating gill nets respectively (Table 4).

Table 4. Annual average costs and earnings of different fishing units at Tuticorin (1986-'87)

No.	Items	Sail boats operating trawl nets (<i>thallumadi</i>)	Sail boats operating gill nets (<i>kolavalai</i>)	Sail boats with 1 B engine operating gill nets (<i>kolavalai</i>)
A. Initial investment (Rs.)				
	Craft	16,000	17,500	18,200
	Engine	—	—	14,000
	Gear	1,500	9,000	10,000
	Sails	500	500	500
	Total	18,000	27,000	42,700
B. Fixed cost (Rs.)				
Depreciation				
	Craft (20%)	3,200	3,500	3,640
	Engine (25%)	—	—	3,500
	Gear (33.3%)	500	3,000	3,333
	Sail (50%)	250	250	250
	Sub total	3,950	6,750	10,723
	Interest (15%)	2,700	4,050	6,405
	Total fixed cost	6,650	10,800	17,128
C. Operating cost (Rs.)				
		26,221	36,819	47,128
D. Total cost (Rs.) (B + C)				
		32,871	47,619	64,256
E. Catch (tonnes)				
		2.5	19.9	29.4
F. Gross revenue (Rs.)				
		36,141	55,272	68,857
G. Net operating income (F-C)				
		9,920	18,453	21,729
H. Profit of the units (G-D)				
		3,270	7,653	4,601

Key economic indicators

To highlight the comparative economic efficiency of the selected three types of units, some of the key economic indicators estimated on the basis of costs and returns data are given in Table 5.

Table 5. Economic indicators of efficiency (1986-'87)

Items	Sail boats operating trawl nets (<i>thallumadi</i>)	Sail boats operating gill nets (<i>kolavalai</i>)	Sail boats with I. B engine operating gill nets (<i>kolavalat</i>)
i) <i>Input-output efficiency</i>			
a) operating ratio	0.72	0.67	0.68
b) fixed ratio	0.18	0.19	0.25
c) gross ratio	0.90	0.86	0.93
ii) <i>Capital efficiency</i>			
a) capital turnover ratio	2.00	2.05	1.61
b) rate of return to capital (%)	70	83	66
c) pay back period (years)	2.49	1.87	2.79
iii) <i>Labour efficiency</i>			
a) No. of crew required for operation	4	6	6
b) average production per man-day (kg)	2	12	17
c) value of production per man-day (Rs.)	32	33	39
d) average wages per man-day (Rs.)	19	15	17
iv) <i>Break even analysis</i>			
a) break even production (tonnes)	2.3	17.10	27.6
b) break even price (Rs.)	13.15	2.39	2.18
c) break even revenue to cover operating expenses (Rs.)	10.49	1.85	1.60
d) average price realised per kg of fish (Rs.)	14.33	2.78	2.33
v) Average annual fishing days	280	277	293
vi) Average catch per day (kg)	59	72	101
vii) Gross revenue per day (Rs.)	129	200	235
viii) Net profit per day (Rs.)	11.68	27.63	15.70
ix) Net operating income per day (Rs.)	35	72	76
x) Net income of the owner including family labour (Rs.)	54	87	93

Input-output efficiency

The operating cost ratio indicates that 72% of the gross income for *thallumadi* units, 67% of non-mechanised *kolavalai* units and 68% of mechanised *kolavalai* units were spent towards operating expenses. Similarly the fixed ratio indicates that out of every rupee earned, 18% of gross income of *thallumadi* units, 19% of non-mechanised *kolavalai* units and 25% of the mechanised *kolavalai* units were fixed expenses. Gross ratio was 90, 86 and 93% for *thallumadi*, non-mechanised and mechanised units operating gill nets respectively. It may be noted that in terms of input-output efficiency, non-mechanised sail boats operating gill nets rank first followed by *thallumadi* units and mechanised boats operating gill nets.

Capital efficiency

Capital turn over ratio works out at 200% for *thallumadi* units, 205% for non-mechanised boats operating

gill nets and 161% for mechanised boats operating gill nets. This ratio is used to measure the rate at which income is generated by capital investment. Rate of return to capital is found to be 70% for *thallumadi* units, 83% for non-mechanised sail boats and 66% for mechanised sail boats, both operating gill nets. Considering the opportunity cost of capital as 15%, the investment on all the three types of units are found to be profitable. However, maximum advantage is observed for non-mechanised sail boats followed by *thallumadi* and minimum for mechanised units. The pay back period is 2.5 years for *thallumadi* units 1.9 years for non-mechanised boats and 2.8 years for mechanised boats, both operating gill nets.

Labour efficiency

Average production per man-day in terms of quantity is worked out at 2 kg for *thallumadi* units, 12 kg for non-mechanised boats operating gill nets and 17 kg for mechanised boats operating gill nets, the value

received being Rs. 32, 33 and 39 respectively. The average wages received per day of operation by the labourers worked out at Rs. 19, 15 and 17 for these three types of units respectively. Although a minimum of Rs. 15 is received as wages by the labourers of non-mechanised sail boats, they are getting an additional food allowance of Rs. 2 to 3 per operating day which in the case of other type of units is included in their wages.

Break even analysis

Break even production based on the prevailing market price and catch composition is worked out at 2.3 tonnes per annum for *thallumadi* units, 17.1 tonnes for non-mechanised sail boats and 27.6 tonnes for mechanised sail boats as against the actual catch of 2.5, 19.9 and 29.4 tonnes by these units respectively.

Break even cost at the existing level of production worked out at Rs. 13.2, 2.4 and 2.2 per kg for *thallumadi* units, non-mechanised sail boats and mechanised sail boats respectively, the actual price realised by these units being Rs. 14.3, 2.8 and 2.3 respectively.

In the short run the unit can operate as long as its operating costs are covered. The fixed costs have to be incurred even if fishing operations are not carried out. Hence the break even cost per kg of fish to cover operating expenses is also worked out for all the three types of units. It is found to be Rs. 10.5 per kg for *thallumadi* units, Rs. 1.8 per kg for non-mechanised sail boats and Rs. 1.6 per kg for mechanised sail boats.

The average catch per day of a *thallumadi* unit is only about 9 kg. But about 40% of the penaeid prawns caught in this net fetches good prices due to its export demand. Further the investment required for this unit is also comparatively less than the other type of units. But it is feared that more than 30% of its catches comprise juvenile prawns which do not appear to be a good trend for the shrimp fishery of this region in the long run.

Summary and conclusion

A preliminary investigation in Tuticorin region indicates that *chalavalai*, *valavalai*, *paruvai*, *thirukkai-valai*, *sinkiralvalai*, *thallumadi* and hooks and line, are the prominent gears operated by sail boats. During the last few years, the traditional gears like *madivalai* and *ralvalai* have gone completely out of operation and the utilization of shore-seines declined drastically. The emerging new gears in recent years in this area are *thallumadi* and disco nets.

The peak season for the *thallumadi* units is found to be May–August and for gill net unit January–April. About 47% of annual gross revenue of *thallumadi* unit is generated during May–August period and 43% each of non-mechanised and mechanised units operating gill nets are generated during January–April period.

There is not much variation in the actual number of fishing days between different types of units. The number of annual fishing days for *thallumadi* units is 280, for non-mechanised sail boats operating gill nets 277 and mechanised sail boats operating gill nets 293. The minimum number of fishing days is observed for *thallumadi* units during January–April and for non-mechanised and mechanised sail boats during May–August period.

The average operational expenditure per day of fishing of a *thallumadi* unit works out at Rs. 94 per day. Wages to the crew form 77 to 82% of the operational costs in different seasons. For non-mechanised sail boats operating gill nets the operational cost per day is Rs. 128 of which labour charges alone ranges from 64 to 68% for different seasons. Average operational expenditure per day for mechanised sail boats operating gill nets worked out at Rs. 158, the share of labour ranges from 56 to 68% for different seasons.

Average initial investment of a sail boat operating *thallumadi* comes about Rs. 18,000, non-mechanised sail boat operating gill net comes about Rs. 27,000 and sail boat with inboard engine operating gill nets comes about Rs. 42,700. The annual total cost comes about 32,871 for *thallumadi* units, Rs. 47,619 for non-mechanised sail boat operating gill nets and Rs. 55,272 for sail boat with inboard engine operating gill nets.

Annual average catch per *thallumadi* unit works out at 2.5 tonnes, non-mechanised sail boats operating gill nets 19.9 tonnes and sail boats with inboard engines operating gill nets 29.4 tonnes generating a gross income of Rs. 36,141, 55,272 and 64,256 respectively. The net operating income per annum works out at Rs. 9,920 for *thallumadi* units, Rs. 19,829 for non-mechanised sail boats operating gill nets and Rs. 22,329 for sail boats with inboard engines operating gill nets, the same per day being Rs. 35, 72 and 76 respectively.

Net profit earned per annum works out at Rs. 3,270 for *thallumadi* units, Rs. 7,653 for non-mechanised sail boats operating gill nets and Rs. 4,601 for sail boats with inboard engines operating gill nets, the same being Rs. 11.68, 27.63 and 15.70 per day respectively.

The study indicates that out of each rupee earned, 90 paise for *thallumadi* units, 86 paise for non-mechanised sail boats operating gill nets and 93 paise for sail boats with inboard engines operating gill nets accounted for cost of production, the share of operating expenses alone being 72, 67 and 68 paise respectively.

The capital turn over ratio for these three types of units indicated that each rupee invested generated an annual turn over of Rs. 2.00 for *thallumadi* units, Rs. 2.05 for non-mechanised sail boats operating gill nets and Rs. 1.61 for sail boats with inboard engines operating gill nets. Rate of return to capital is found to be 70, 83 and 63% for these units respectively. The pay back period is 2.5 years for *thallumadi* units, 1.9 years for non-mechanised boats operating gill nets and 2.8 years for sail boats with inboard engines operating gill nets.

Average production per man-day worked out at 2 kg for *thallumadi* units, 12 kg for non-mechanised sail boats operating gill nets and 17 kg for sail boats

with inboard engines operating gill nets, the value realised being Rs. 32, 33 and 39 respectively. The average daily wages received by these labourers are Rs. 19, 15 and 17 for these units enabling them to earn an annual income of Rs. 5,320, 4,155 and 4,981.

The cost of production per kg of fish worked out at Rs. 13.2 for *thallumadi* units, Rs. 2.4 for non-mechanised sail boats operating gill nets and Rs. 2.2 for sail boats with inboard engines operating gill nets and the average value realised per kg being Rs. 14.3, 2.8 and 2.3 for these units respectively.

Based on the key economic indicators, non-mechanised sail boats operating gill nets are found to be economically more efficient than the other two types of units. Among the non-mechanised boats operating *thallumadi* and mechanised boats operating gill nets, the former is found to be more efficient in terms of production, capital and labour efficiencies. But in terms of number of fishing days, level of income generated and net operating income of the owner, mechanised units are found to be better.

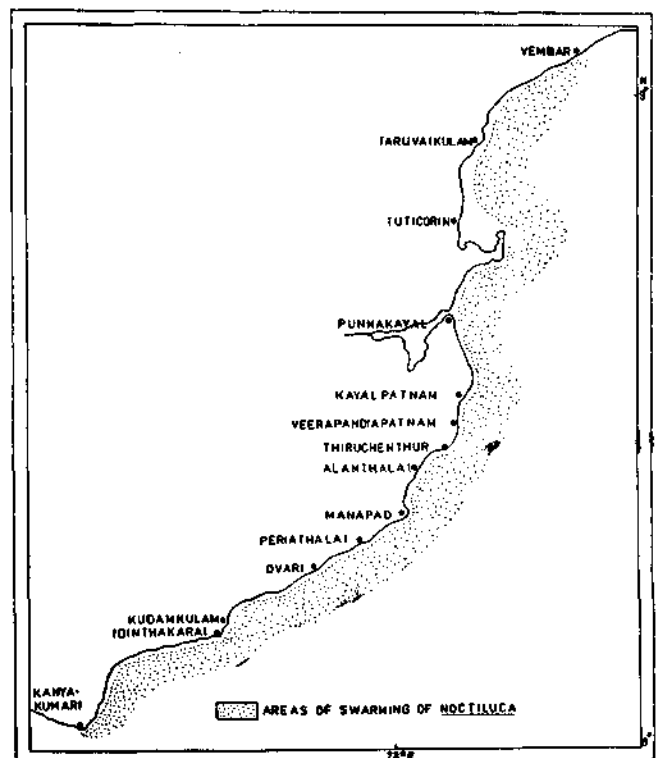


'GLOWING SEA' PHENOMENON DUE TO THE SWARMING OF *NOCTILUCA MILIARIS* ON THE SOUTHEAST COAST*

During October, 1988, a phenomenon of 'glowing sea' was observed in the night hours in the inshore area off Tuticorin and nearshore areas of Kayalpatnam, Thiruchendur, Manapad, Idinthakarai and upto Kanyakumari. The coastal people of these areas felt anxiety about this phenomenon and the 'glowing sea' condition was the talk of the villagers. Based on the newspaper reports, a visit was made to these places and collected water samples during night hours. On examination of the water samples, it was found that the dominance of the plankton, *Noctiluca miliaris* (a toxic dinoflagellate which is microscopic, balloon-like and green in colour) was responsible for the 'glowing sea' condition of the sea water. Since *Noctiluca* has the ability of producing phosphorescence or bioluminescence, the whole area became illuminated and this caused anxiety among the local people.

The blooming of *Noctiluca* is common along the coasts of India and they cause the 'red tide' in the inshore waters. However, the present observations of *Noctiluca* showed no 'red tide' since the organisms were green in

colour due to the harbouring of green flagellates on *Noctiluca*.



* Reported by C.P. Gopinathan, Pon. Siraimectan, J.X. Rodrigo and M. Selvaraj, Tuticorin Research Centre of CMFRI, Tuticorin.