Evolution of an Improved Trawl for Traditional Motorised Craft

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12.77 m two seam trawl net designed for operation from 8.40 m OAL dug out canoe with 11HP outboard engine was field tested and the results compared, with 14.00 m two seam trawl net commonly used in Valappu area of Vypeen Island. The former net brought in 31.5% more shrimp catch and 37% more revenue compared to the latter. Selective action of square meshes in cod end was also attempted.

Hornell (1938) observed that scant regard is given to fishing techniques for the capture of demersal fishes by the artisanal fishermen and their attention is entirely upon the capture of shoaling fishes. With the advent of motorization of the traditional craft, many a fishing techniques of the industrial fisheries are adopted by the traditional fishermen discarding non-profitable one. Beach (1960) reported that the use of out-board powered boats for the capture of high unit value commodities like prawn, lobster and scallop are profitable for their operators. Developing countries attach increasing emphasis on small scale fishing to provide employment and income to fishing community and experience indicate that the traditional craft fishery must not be underestimated (Gulbrandsen, 1988). Shrimp trawling from motorized crafts along the Kerala coast (Hameed *et al.*, 1988) is an attempt to emulate the most effective fishing technique in this area.

The average annual sustainable yield of shrimp is estimated to be 56,000 tonnes along the Kerala coast of which around 18,000 tonnes are distributed in 0–20 m depth (Balan *et al.*, 1989). Hitherto, seines and gillnets were used by the traditional sector and trawling by the mechanised sector for shrimp capture. This pattern has been fast changing due to motorization on a large scale of the traditional crafts with outboard engines. At present there are about 400 motorized crafts engaged in shrimp trawling along the Kerala coast, apart from that of Tamil Nadu.

The present studies were initiated with a view to evolving a suitable trawl gear and otterboard for the predominent range of dug-out canoes (8 to 10 m OAL) powered with 7 to 12 HP outboard engines. Economic viability and cost benefit analysis of the trawling operations with the gear developed in comparison with the locally used gear are presented. These observations were conducted off Valappu, a fish landing centre in Vypeen island, north of Cochin.

Materials and Methods

8.40 m OAL dugout canoe powered with 11 HP Evinrude engine was used for conducting the experiments. 12.77 m two seam net (A) designed for the purpose (Fig. 1) had an overhang, a more pronounced slanting lower jib and a comparatively shorter belly than that of the 14 m two seam net (B) (Fig. 2) which the fishermen of Valappu commonly used. 56 x 28 cm rectangular float otterboards weighing 8 kg each (Fig. 3) were rigged with the net 'A' and 60 x 30 cm rectangular flat otterboards, weighing 10 kg each were used with net 'B'. 9 Nos. of 70 x 20 cm cylindrical, foam plast floats having extra-buoyancy of 69 g each and 10 kg of 5 mm dia link chains were attached to the net 'A' while 7 floats and 8 to 10 kg of link chain were rigged with net 'B'. The towing speed ranged from 1.5 to 2.0 knots. 12 mm dia polyethlyene rope was used as trawling rope.

The experiments were conducted during January to March 1989, which is the season for shrimp trawling from motorized crafts. 27 sets of comparative hauls of 45 min duration each were made with both the nets, keeping the depth of operation, rope paid out, trawling speed, duration and direction of tow constant for each set of comparative hauls.

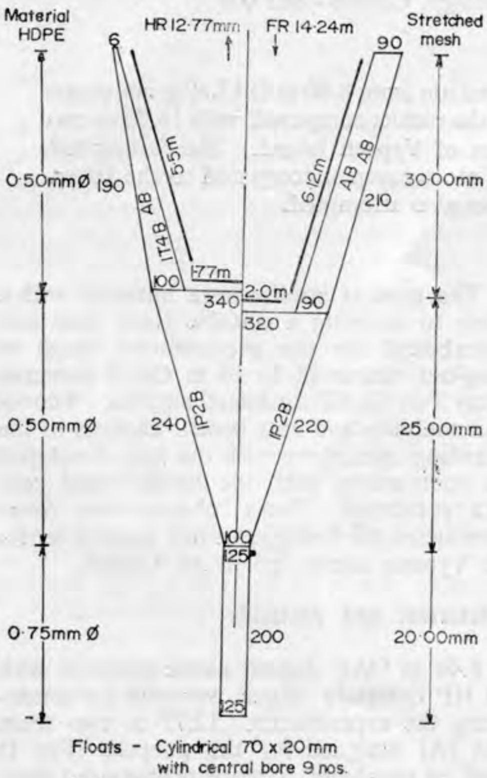

Fig. 1. 12.77 m trawl (improved design)

Results and Discussion

The operational details of 12.77 m two seam trawl net (A) and 14 m two seam trawl net (B) are given in Table 1.

The shrimp catch, consisting mainly of *P. stylifera* in net 'A' was 22.14 kg per trip as against 16.84 kg for net 'B'. The total catch per trip worked out to be 34.51 kg for net 'A' while it was only 28.32 kg in net 'B'. Hence it is inferred that the catch efficiency highly differs between the two nets and that the net 'A' is highly efficient compared to the net used by the fishermen (net B).

Table 1. *Operational details of net A and B*

	Net A	Net B
Area of operation	Off Valappu	Off Valappu
Net size (head rope length in m)	12.77	14.00
Outboard engine make/HP	Evinrude/ 11HP	Evinrude/ 11HP
Depth of operation in m	8.00	8.00
Warp paid out in m	50.00	50.00
No. of hauls per day	3	3
Duration of each haul in min	45	45
Duration of engine run for each day in h	4.0	4.0
Total No. of trips made	27	27

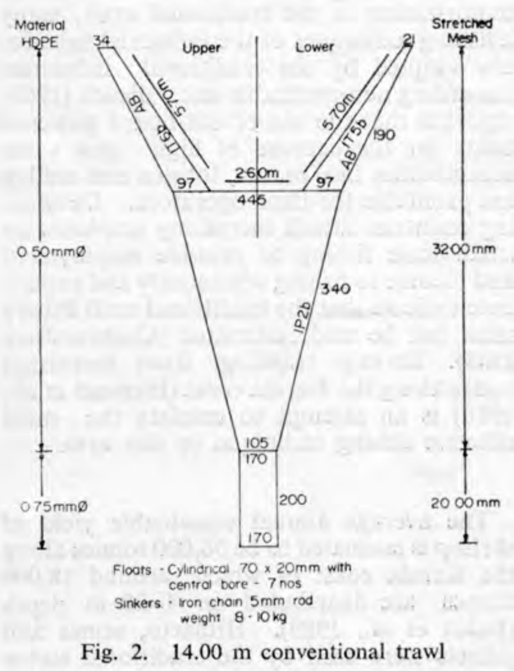

Fig. 2. 14.00 m conventional trawl

The data on catch recorded were analysed using analysis of variance technique. The results are furnished in Tables 2 and 3 for shrimp catch and total catch respectively and are indicative of the fact that variation between the two nets is highly significant ($P < 0.001$) for both shrimp and total catch.

Table 2. *Anova for shrimp catch*

Source	SS	df	MS	F
Between days	2155.87	26	82.92	7.48***
Between nets	384.00	1	384.00	34.66***
Error	1771.86	26	11.08	
Total	2828.02	53		

*** $P < 0.001$

Table 3. *Anova for total catch*

Source	SS	df	MS	F
Between days	5608.47	26	215.71	13.47***
Between nets	517.98	1	317.39	32.30***
Error	416.48	26	16.02	
Total	6592.34	53		

*** $P < 0.001$

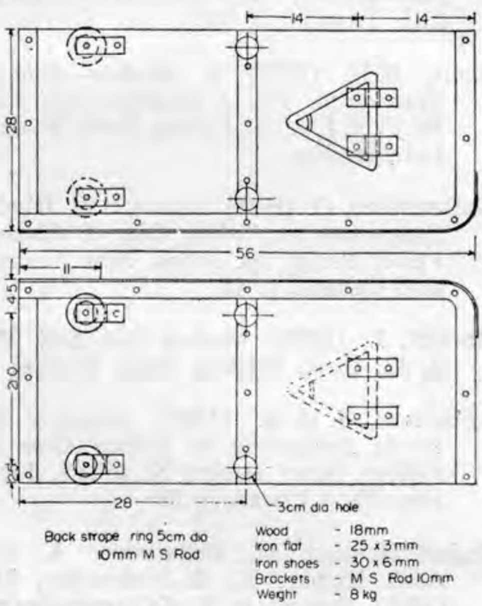

Fig. 3. 56 × 28 cm rectangular flat otterboard

In order to substantiate the effectiveness of 12.77 m trawl net (A) over the 14.00 m net (B), the catch had revenue details were collected and furnished in Table 4.

Table 4. *Catch and revenue*

	Net A	Net B
Catch/trip shrimp (kg)	22.14	16.84
Total catch (kg)	34.51	28.32
Revenue/trip Shrimp (kg)	304.00	213.33
Total catch (kg)	332.00	242.00
Profit (Rs.)/trip	177.77	123.59

It is observed that while net 'A' made a profit of Rs. 178/– per trip, net 'B' contributed only Rs. 123/60. Compared to net 'B' net 'A', brought 31.5% more shrimp catch and 37% more revenue. Cost benefit analysis for both the nets were performed and on the basis of the cost and revenue information collected, the cost of operation involved are fuel and depreciation towards the engine, craft and gear. The fuel cost in both the operation is constant as the duration of engine run is identical. The amount set apart as owner's share, which includes depreciation also, is 40% of the revenue, less fuel cost. The remaining amount is the crew's share or the profit for crew consisting of 4 members.

The profit or crew's share can be worked out on the basis of a model.

$$P = R - OS - CF - (1)$$

where P = profit in rupees; OS = owner's share which includes depreciation for engine, craft and gear = 0.4 (R-CF)–(2); R = revenue in rupees and CF = cost of fuel in rupees. Substituting (2) in (1) we get,

$$P = \frac{3}{2} \ OS \text{ or } OS = 2/3 \ P$$

The revenue accrued on the basis of total catch per trip and the corresponding profit was observed to be positively correlated and highly significant ($P < 0.01$). Hence, they are linearly related and a regression equation (both nets combined) is fitted as follows:

$$Y = -21.61 + 0.60 \ X \ ......(3)$$

where Y is the profit per trip in rupees and X is the total revenue per trip in rupees.

Given the total revenue for any trip, the corresponding profit can be worked out by substituting in equation (3). Profit per trip, worked out on the regression equation, of the net 'A' was 44% higher than that of net

'B'. A fisherman of crew 'A' gets Rs. 44.50 per trip against his counterpart crew 'B' who gets only Rs. 30.90 per trip. Hence 12.77 m net designed for the purpose is economically superior to the conventional 14.00 m trawl net.

12.77 trawl net has a shorter belly and this could have facilitated bulging out while in tow, to assume a pronounced tunnel shape enabling free flow inside the trawl, which is considered essential in effective functioning of the shrimp trawl net (Varghese *et al.*, 1968). 14 m net with a conventional long belly, with the resistance of the cod end falling on the square, would have pulled the head line back, thus giving less chance for a higher vertical opening (Binns, 1959). In the case of 12.77 m net, a more pronounced slanting lower jibs, with their larger swept area and the presence of an overhang acting effectively, could have influenced its efficiency.

Existing designs of trawl cod ends do not allow the juveniles to escape. Increase in cod and mesh size is the conventional method to improve cod end selectivity. Mesh size is not the only feature which affects the size of the fish caught in a cod end. Improvement can be achieved by selection characteristics of square mesh and cod ends with fewer number of meshes around (Robertson, 1988). To evaluare the efficiency of the square meshes in the cod end and to effectively facilitate passage of juvenile fishes, conventional diamond mesh cod end (10 mm bar) was changed over to square mesh (10 mm bar). Size composition of fish caught were made for each species of fish and shrimp, using t-tests and the mean lengths obtained are represented in Table 5.

Table 5. *Mean lengths (cm) of fish*

Species	Conventional cod end	Square mesh cod end	t-values
Sciaenids	8.60	9.32	3.31**
Cyanoglossus sp.	9.22	9.69	2.19*
P. stylifera	8.21	8.06	2.05
P. indicus	10.89	11.03	0.205
M. affinis	8.33	7.85	2.58*

* significant at 5% level; ** significant at 1% level

The mean sizes are significantly different in the case of sciaenids and *Cyanoglossus* sp. only. *P. stylifera*, the main species of shrimp caught is non-significant between the conventional and square mesh cod ends. In the case of *P. indicus* the size caught in slightly larger in square mesh cod end but the difference does not show any significance. *M. affinis* is significant at 5% level and the mean length in square mesh is less compared to conventional mesh cod end.

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