

COMPARATIVE ECONOMIC EFFICIENCY OF DIFFERENT TYPES OF MECHANISED FISHING UNITS OPERATING ALONG KERALA COAST*

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ABSTRACT

Comparative economic efficiency of purse seiners, trawlers and drift gill netters operating along Kerala Coast was studied from 1982 to 1986.

The gross income and net income per unit per day of operation, rate of returns, returns to labour, fuel efficiency and pay-back period have been worked out for all the 3 types of units. These fishing units do not compete each other and their catch compositions are different. However, the evaluation of their comparative economic efficiency is essential for formulating credit policy and development plans.

Initial investment on a new unit showed considerable increase over the years for all the 3 types of fishing gears studied. The purchase price of a purse seine craft and gear amounting to about Rs. 7 lakhs in 1982 increased to Rs. 12 lakhs in 1986. Fuel cost increased due to enhancement in price as well as in utilisation level. Nevertheless, the average gross revenue per unit per day of operation of a purse seiner continuously increased from about Rs. 5000 in 1982 to about Rs. 12,000 in 1986. For trawlers it increased from Rs. 826 in 1982 to Rs. 2,250 in 1986 and with respect to drift gill nets it worked out to Rs. 606 in 1982 and Rs. 1,227 in 1986.

INTRODUCTION

THE CURRENT emphasis in our country, on development and management of the fishery sector be it artisanal or commercial fishery, focuses attention on the need to conduct research studies to provide information and analytical techniques which can contribute to the planning process, institutional development and the economic efficiency of the fishery sector. For the proper management of a fishery it is essential to assess the alternatives available for the exploitation of its resources with an eye on cost minimisation and with more emphasis, management should take into consideration the individual interest of this

harvesters that will push them in the direction of greater economic efficiency in their fishing operations. The objective of the present study is to evaluate the comparative economic efficiency of the major mechanised fishing methods in vogue along Kerala Coast viz. drift gill netters, trawlers and purse seiners. The study has been conducted at Cochin Fisheries Harbour mainly because it is the only landing Centre in Kerala where all these three types of fishing units are under operation.

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MATERIALS AND METHODS

The data on operating cost and earnings were collected from 20 to 25 sample units of each of drift gill netters, trawlers and purse seiners for 5 years from 1982 to 1986 covering all quarters in each year. All the sample units of trawlers were 32¹ with 65 H.P. The drift gill netters were 28¹ with 25 H.P. and purse seiners were 45¹ with 120 H.P.

Fixed costs such as depreciation and interest on initial investment have been worked out on the basis of the purchase price of new units in 1982.

For all the three types of fishing methods cost and earnings per unit per day of operation as well as annual averages have been worked out. To assess the comparative economic efficiency of these methods a set of key economic indicators have been computed.

RESULTS AND DISCUSSION

Cost of production

The Tables 1 to 3 give the annual average costs and earnings of drift gill netters, trawlers and purse seiners respectively. The various components of costs are classified into operating costs and fixed costs. Operating costs include all those costs which are incurred only when the vessels are under operation and fixed costs are those incurred even if there is no operation. Fuel expenditure and wages for fishing labour constitute more than 50% of the operating costs. Along the Kerala Coast sharing of the catch is the prevailing system of payment of wages for fishing labour. For drift gill net, one-third of the value of catch after deducting the auction charges and fuel cost is paid as wages to the crew. In the case of trawlers the labour share is 35% and purse seiners 25%. There has been no change in the share of labour in mechanised fishing for the last many years.

In Kerala, the wages for harvesting of paddy is paid on the basis of the quantity harvested by each labourer. During the last decade labour share has been steadily increasing mainly due to the agitations of labourers for that purpose. However, in fishing, the share of the worker remains unchanged and there has been no attempt on the part of wage earners in fishing industry, to get their share increased. This may be because the workers get higher wages each year due to the increase in revenue. This increase in revenue is mainly due to the continuing increase in fish prices in recent years. During the period from 1982 to 1986 fuel expenditure showed an increase of 36% for drift gill netters, 60% for trawlers and 47% for purse seiners. The continuous increase in fuel expenditure was partly due to increased consumption of oil resulted from the coverage of more distant fishing grounds. For gill netters and trawlers each crew will get Rs. 10 to Rs. 12 per day of operation, other than wages, as bata against food expenses. In purse seiner one worker gets Rs. 10 as bata and Rs. 5 as food expense. The annual increase in wages mainly from 1982 to 1986 for all categories was mainly resulted from the increase in annual revenue. From 1982 to 1986 operating costs recorded an increase of 71% for drift gill netters about 100% for trawlers and 83% for purse seiners. This increase in operating costs over the years had not affected net returns of the boat owners, because the major component of the operating cost in purse seiners and gill netters was wages and it was only a fixed percentage of the fishing income. Even in trawlers wages' contribution is only slightly below the fuel expenditure. The wage rate remained unchanged over the years for all types of fishing techniques. The other items included under the operating costs which are incurred in running the vessel, are repairing and maintenance, marketing expenses, ice and jetty rent. Of these the major item is maintenance and re-

repairing which primarily related to repairs to hull, engine and the renewal of the gear. Regarding the marketing cost the only expenditure incurred by the boat owner is the auction charges which is usually 5% of the sales value.

The value used for calculating depreciation is the initial new purchase value of the capital asset in 1982. The procedure adopted is the straight line method by allocating equal values every year on the basis of expected life

TABLE 1. Annual average cost and earnings of drift gill net unit during 1982 to 1986 at Cochin Fisheries Harbour

	1982	1983	1984	1985	1986
A. Initial Investment :					
Craft (Rs.)	60,000				
Gear (Rs.)	35,000				
Total	95,000				
B. Catch (Tonnes)	21.50	23.76	23.76	23.80	22.77
C. Revenue (Rs.)	1,15,140	1,58,040	1,75,860	1,85,640	2,02,455
Value realised per kg	5.36	6.65	7.40	7.80	7.89
Number of days fished	190	180	180	170	165
D. Operating Cost (Rs.)					
Fuel	27,170	27,360	30,240	30,600	32,010
Wages	27,360	40,860	46,080	48,790	53,625
Auction	5,700	7,920	8,820	9,350	10,065
Food	7,600	9,000	9,000	8,500	8,250
Ice	1,900	2,700	2,700	2,550	2,475
Repairing and Maintenance	9,500	9,720	11,160	10,880	12,375
Jetty Rent	2,850	2,700	2,700	2,550	2,475
Total operating cost (Rs.)	82,080	1,00,260	1,10,700	1,13,220	1,21,275
E. Fixed Cost (Rs.)					
Depreciation	13,000	13,000	13,000	13,000	13,000
Interest (15%)	14,250	14,250	14,250	14,250	14,250
Insurance	3,000	3,000	3,000	3,000	3,000
F. Total Cost (D+E)	1,12,330	1,30,510	1,40,950	1,43,470	1,51,552
G. Gross Returns (C-D)	33,060	57,780	65,160	72,420	81,180
H. Net Income (G-E)	2,810	27,530	34,910	42,170	50,930
Rate of Return (+)*	18	44	52	60	69
Profit to Investment ratio (%)	3	29	37	44	54

* Net income ÷ interest Initial Investment

The fixed cost include the interest of initial investment, its depreciation and insurance. Depreciation is the permanent and continuing diminution in the value of capital asset which in the case of a mechanised fishing unit comprised of hull, engine, gear and other accessories.

of each type of capital asset. Annual fixed cost for each category of fishing unit is same for all the 5 years. For the computation of average fixed cost per day of operation annual depreciation cost was divided by the number of days fished during that year.

Total costs per day of operation per unit including fixed and operating costs increased by 56% for gill netters, 84% for trawlers and 60% for purse seiners. The average annual growth rate for fuel cost per unit per day of operation was 4.5% for gill nets 7% for trawlers and 4.5% for purse seiners and growth rate of operating costs for these units were 10.5, 14 and 11% respectively.

Based on the averages of five years operating cost per kg of fish worked out to Rs. 4.60 for gill netters, Rs. 3.81 for trawlers and Rs. 1.50 for purse seiners and the total costs per kg of fish worked out to Rs. 5.90, Rs. 5.70 and Rs. 2.27 respectively.

The purchase price of a new unit of drift gill netter including craft and gear in 1986 was Rs. 2 lakhs, that of trawler Rs. 3.5 lakhs and purse seiner Rs. 12.5 lakhs as against Rs. 0.95, Rs. 1.65 and Rs. 7.7 lakhs respectively in 1982. For all these units the size of nets has been increased over the years. Regarding craft also the length and H.P. have been increased. In 1982 most of the trawlers operating off Cochin were 32 footers and in 1986 the newly introduced trawlers were 36 footers.

Catch and revenue

The annual average catch per gill net unit during 1982 to 1986 ranged from 21.5 tonnes in 1982 to 23.8 in 1985, having an average annual growth rate of 1.6 per cent (Table 1). However, the annual average revenue of Rs. 1,15,140 in 1982 increased to Rs. 2,02,455 in 1986. The major species caught in gill nets off Cochin are seerfish, pampret, tunas, shark, catfish, full-beaks and carangids. Despite a stagnancy in the annual catch during the five years the annual average revenue for a gill net unit showed an increase of 76% mainly because of the continuous increase in fish prices. It is all the more obvious from the value realised per Kg of fish given in Table 1, related to gill netters. The average value of Rs. 5.36 realised

per kg of fish caught by gill netters in 1982 increased to Rs. 8.89 in 1986 registering an increase of 66%. The increase in the price realised per kg of fish during any particular season or year of operation of a fishing unit need not be always due to the rise in fish prices. Sometimes it may happen due to the variation in catch composition. As the fishery is of multispecies in nature, the prices always vary. Hence the value realised per kg of fish will increase or decrease depending upon the high or low share of high priced species in the catch.

Over the years from 1982 to 1986 fishing returns over operating cost increased by about 2.5 times. The average annual net income of a gill net unit after deducting all costs worked out to Rs. 2,810 in 1982 increased to Rs. 50,930 in 1986. Since there has not been any considerable increase in catch during this period the steep rise in the net returns indicated that the increase in operating cost over the years especially fuel expenditure was more than compensated by the rise in fish prices. Fuel expenditure was the only major cost component other than wages and auction charges, which showed a continuous increase during these years. The increase in wages and auction charges would not affect the net income, because it is a fixed percentage of revenue. The growth rate of average value realised per kg of fish caught by gill netters during this 5 years was 14% as against the growth rate of 10.5% for operating cost and 4.5% for fuel expenditure which explained the sharp increase in gross as well as net returns.

The trawl net operation is mainly aimed at prawn catch due to its export demand and consequent high price. However as seen from Table 2 average annual prawn catch per unit of trawl showed a declining trend during 1982 to 1986. The average annual growth rate of prawn catch during this period was -10.5%. But the revenue from prawn catch showed an

TABLE 2. Annual average cost and earnings of trawler at Cochin Fisheries Harbour during 1982-'86

	1982	1983	1984	1985	1986
A. Initial Investment					
Craft	.. 1,50,000				
Gear	.. 15,000	(5 nets @ Rs. 3,000 per year)			
B. Catch					
Prawn (Tonnes)	.. 12.60	16.60	11.88	9.90	7.04
Fish ,,	.. 30.40	22.40	36.18	35.82	52.32
Total ,,	.. 43.00	39.00	48.06	45.72	59.36
C. Returns					
Prawn (Rs.)	.. 1,04,400	1,79,000	1,45,260	1,64,340	1,16,160
Fish ,,	.. 60,800	50,200	90,540	93,060	2,43,840
Total ,,	.. 1,65,200	2,29,200	2,35,800	2,57,400	3,60,000
Value realised per kg					
Prawn	.. 8.29	10.78	12.23	16.60	16.50
Fish	.. 2.00	2.24	2.50	2.60	4.66
Total	.. 3.84	5.88	4.91	5.63	6.06
No. of days fished	.. 200	200	180	180	160
D. Operating Cost (Rs.)					
Fuel	.. 73,000	79,200	75,060	86,040	93,120
Wages	.. 29,400	48,600	52,020	55,440	87,040
Auction	.. 8,200	11,400	11,880	12,960	18,000
Ice	.. 3,000	3,000	3,600	3,600	4,800
Food	.. 10,000	10,000	9,000	9,000	8,000
Jetty Rent	.. 3,000	3,000	2,700	2,700	2,400
Repairing and Maintenance	.. 12,000	14,400	15,300	16,560	17,920
Total	.. 1,38,600	1,69,600	1,69,560	1,86,300	2,31,360
E. Fixed Cost (Rs.)					
Depreciation					
Craft (10%)	.. 15,000	15,000	15,000	15,000	15,000
Net (100%)	.. 15,000	15,000	15,000	15,000	15,000
Interest (@ 15%)	.. 24,750	24,750	24,750	24,750	24,750
Insurance (Rs.)	.. 5,000	5,000	5,000	5,000	5,000
Total Fixed Cost	.. 59,750	59,750	59,750	59,750	59,750
F. Total Cost (D+E) (Rs.)	.. 2,18,350	2,29,350	2,29,310	2,46,050	2,91,110
G. Gross Returns (C-D) (Rs.)	.. 26,600	59,600	66,240	71,100	1,28,640
H. Net Returns (G-E) (Rs.)	.. 33,150	-150	6,490	11,350	68,890
Rate of Returns (%)	.. -5	15	19	22	57
Profit - investment ratio (%)	.. -20	0	4	7	42

increase of 9%. There was a considerable increase in the average annual catch of fish by trawl net unit during these years. The average unit catch of 30 t in 1982 increased to 52 t in 1986, the average annual growth rate being 20%. The catch composition and the resultant

revenue for different years indicated that there was diversification in trawl operation. The reduction in prawn catch as well as revenue over the years was compensated by the increase in fish catch and its price. The average value realised per kg of prawn at Rs. 8.29 in 1982

TABLE 3. Annual average cost and earnings of purse seiner at Cochin Fisheries Harbour During 1982 to 1986

	1982	1983	1984	1985	1986
A. Initial Investment					
Craft (Rs.)	.. 4,50,000				
Net (Rs.)	.. 3,00,000				
Other accessories	.. 20,000				
Total	.. 7,70,000				
B. Catch (Tonnes)	.. 311.25	404.60	360.45	326.40	268.00
C. Revenue (Rs.)	.. 6,47,375	8,65,900	9,37,170	11,88,120	11,86,800
Value realised per kg of fish	.. 2.08	2.14	2.60	3.64	4.43
Number of days fished	.. 125	140	135	120	100
D. Operating Cost (Rs.)					
Fuel	.. 80,500	95,200	96,390	1,01,760	94,500
Wages	.. 1,25,875	1,73,040	1,89,945	2,56,680	2,58,300
Auction	.. 32,375	43,260	46,845	59,400	59,300
Bata	.. 31,250	35,000	33,750	30,000	25,000
Food	.. 15,625	17,500	16,875	15,000	12,500
Rent for Carrier Boar	.. 50,000	56,000	54,000	60,000	50,000
Repairing and Maintenance	.. 25,000	35,000	45,900	48,000	42,500
Jetty Rent	.. 3,125	3,500	3,375	3,000	2,500
Total Operating Cost (Rs.)	.. 3,63,750	4,58,500	4,87,080	5,73,840	5,44,600
E. Fixed Costs (Rs.)					
Depreciation					
Craft (10%)	.. 45,000	45,000	45,000	45,000	45,000
Net (5%)	.. 60,000	60,000	60,000	60,000	60,000
Other accessories (100%)	.. 20,000	20,000	20,000	20,000	20,000
Interest (15%)	.. 1,15,500	1,15,500	1,15,500	1,15,500	1,15,500
Insurance (Rs.)	.. 12,000	12,000	12,000	12,000	12,000
Total Fixed Costs (Rs.)	.. 2,52,500	2,52,500	2,52,500	2,52,500	2,52,500
F. Total Costs (D+E)	.. 6,16,250	7,11,000	7,39,500	8,26,340	7,97,100
G. Gross Returns (C-D)	.. 2,83,625	4,07,400	4,50,090	6,14,280	6,42,200
H. Net Returns (G-E)	.. 31,125	1,54,900	1,97,590	3,61,780	3,89,700
Rate of Return (%)	.. 19	35	41	62	66
Profit - Investment ratio (%)	.. 4	24	26	51	70

increased to 16.50 in 1986 and that of fish caught in trawl net increased from Rs. 2 to Rs. 4.66. As seen from Table 2 the average value of fish in 1985 was only Rs. 2.60 which showed an increase of 79% over the year. It was not only due to the increase in fish price, but also due to the change in catch composition resulted by the selective fishing adopted by the trawlers. Recently trawlers at Cochin Fisheries Harbour started selective fishing using 3 types of nets. One type of net is used for fishing upto 3.3 m depth with suitable adjustments to catch column living fishes such as pomfrets, carangids, wolf herrings, etc. The 2nd type is used for beyond 3.3 m depth for threadfin breams, lizardfish, flatfish and kiddi prawn during monsoon season. The 3rd one is mainly meant for 5 m and above and used occasionally, especially for cuttlefish which has recently picked up a high export demand. The high value realised per kg of fish in 1986 as compared to earlier years might have been resulted from this type of selective fishing. As far as fishing industry is concerned it is a healthy development. Survival of any industry fully based on export demand for its product unless it is a highly essential commodity, will be always threatened by external factors. As seen from Table 2 upto 1985 the average annual revenue for a trawl unit from prawn was more than that from fish in spite of the annual decline in prawn catch. But in 1986 revenue from fish was more than double that of revenue from prawn indicating that the trawlers can survive even if there is a sudden collapse of export demand. The average annual gross returns of a trawler over the operating cost worked out to Rs. 26,000 in 1982 which increased to Rs. 1,28,640 in 1986. However, annual net returns or profit of a trawl unit after deducting the entire costs of inputs was negative in 1982 (—Rs. 33,150) and 1983 (—Rs. 150), but in subsequent years trawlers have picked-up earnings with the maximum profit of Rs. 68,890 in 1986. The increase in profit was due to the

increase in fish catch, rise in prices of prawn and fish and also due to selective fishing. The higher level of profits in later years indicated that as in the case of gill netters the increase in oil expenditure as well as operating costs has been more than compensated by the increase in fish and prawn prices and hence the total revenue.

The annual average catch of a purse seine unit showed fluctuating trend during 1982 to 1986. The average catch of 311 t in 1982 increased to 405 t in 1983 and thereafter showed declining trend reaching the low figure of 268 t in 1986. The average annual growth rate of catch during this period worked out at -2%. The average annual revenue per unit during these years showed a continuously increasing trend, but for a marginal decline in 1986. The average annual growth rate for the revenue was 15% as against the 7% growth rate of total costs and 11% that of operating costs. Gross returns over operating costs and net returns after deducting all costs from the total revenue showed a continuously increasing trend. Despite a negative annual growth rate of catch of -2% during these years, annual revenue registered an average growth rate of 15% mainly because of the increase in fish prices. As compared to trawl net and gill net catches the purse seine catch at Cochin Fisheries Harbour comprises mainly cheaper fishes like oil sardine, tunas, catfish, white baits and carangids with the only exception of mackerel. Because of its large volume of catch per unit effort its revenue per unit was much higher than that of trawlers and gill netters. Purse seiners occasionally get stray catches of high priced fishes like pomfret, seerfish and also prawns which would sometimes boost up their fishing income.

Comparative economic efficiency

Some of the key economic indicators estimated on the basis of cost and earnings data

from 1982 to 1986 pertaining to gill netters, trawlers and purse seiners at Cochin Fisheries Harbour to bring out the comparative economic efficiency of these units, have been given in Table 4.

The average catch per unit per day of operation from 1982 to 1986 was estimated at 131 kg for gillnetters, 260 kg for trawlers and 2,690 kg

duction it is minimum as compared to other two types of units. So also the operating cost as well as total costs per kg of fish is minimum for purse seiners. Fuel efficiency indicated by the quantity of fish produced per litre, was maximum for purse seiners (12 kg/ltr) and minimum for trawlers (2.3 kgs/ltr) which was all the more true in terms of value. The operating cost to produce 1 kg of fish was

TABLE 4. Key Economic Indicators

	Drift Gill Netters	Trawlers	Purse Seiners
Initial investment (Rs.)	95,000	1,65,000	7,70,000
Average catch per day of operation (kg)	131	260	2,690
Average Revenue per day (Rs.)	946	1,383	9,227
Average number of days fished in a year	177	184	125
Number of crew required for operation	4	5	25
Average value realised per kg of fish (Rs.)	7.22	5.31	3.43
Quantity of fish produced per man day (kg)	33	51	108
Quantity of fish produced per litre of fuel (kg)	3.1	2.3	12.0
Value of production per man day (Rs.)	238	271	370
Average fuel cost per day of operation (Rs.)	160	442	755
Average operating cost per day of operation (Rs.)	596	973	3,916
Average total costs per day of operation (Rs.)	767	1,320	5,952
Fuel cost per kg of fish (Rs.)	1.28	1.72	0.33
Operating cost per kg of fish (Rs.)	4.60	3.81	1.50
Total cost per kg of fish (Rs.)	5.90	5.70	2.27
Man days required to produce 1 tonne of fish (Rs.)	30	20	9
Fuel required to produce one tonne of fish (ltr.)	323	437	84
Gross returns per day of operation (Rs.)	349	383	3,867

for purse seiners. The corresponding average revenue worked out at Rs. 946, Rs. 1,383 and Rs. 9,227 respectively. The average value realised per kg of fish was maximum (Rs. 7.22) for drift gill netters and minimum for purse seiners (Rs. 3.43). The average fuel cost, operating costs and total costs per day of operation were minimum for gill netters and maximum for purse seiners. Labour productivity was much higher for purse seiners both in terms of physical quantity as well as value. Even though cost of fuel per day of operation is maximum for purse seiners, per kg of pro-

Rs. 4.6 for drift gill netters, Rs. 3.81 for trawlers and Rs. 1.50 for purse seiners.

The gross returns per day of operation *i.e.*, the total revenue after deducting the operating cost did not show much difference in the case of gill netters and trawlers despite the higher level of revenue of trawler mainly due to the higher operating costs incurred by trawlers. For purse seiners gross returns per day of operation was much higher. However, the number of days fished was minimum at 124 for purse seiners and maximum (184 days/year) for

trawlers. The purse seiners earned the maximum net returns per day of operation (Rs. 1,830) and the trawlers the minimum at Rs. 59. Though the initial investment of trawlers (Rs. 1,65,000) and revenue per day were higher as compared to gill netters, the net profit of trawler per day of operation was much lower than that of gill netters (Rs. 179/day). It is mainly because of the very poor performance of trawlers during 1982 and 1983. In 1982 the net returns were negative and in 1983 almost zero or in other words on an average trawlers were running on loss in 1982 and just managed to get through in 1983. During these years though the trawlers could earn a surplus over their operating costs, after deducting the entire fixed costs including depreciation, opportunity cost of capital investment and insurance premium, the average loss of one unit was Rs. 33,150 in 1982 and Rs. 150 in 1983. Further years they could make substantial gains. This could be very well established by the fact that during eighties no new trawler was introduced in Cochin Fisheries Harbour till 1986. During 1986-87 some new trawlers have entered into the industry that too with a comparatively higher capital investment. The new trawlers are 36 footers with 90 to 100 H.P. as against the existing 32 footers with 50 to 65 H.P. The present investment requirement of a trawler amounted to about 3.5 lakhs whereas for the earlier ones it was only 1.5 to 1.75 lakhs.

The annual rate of returns (ratio between the surplus over the all other costs except opportunity cost of capital for a particular year and the initial investment) for drift gill netters at 18% in 1982 showed a continuous increase and reached upto 69% in 1986 indicating the economic viability of gill netters if the opportunity cost of initial investment was less than 18%. In the case of trawlers, rate of return was -5% in 1982 and 15% in 1983. Further it was increased every year reaching a maximum of 57% in 1986. For purse seiners rate of returns

increased from 19% in 1982 to 66% in 1986. Profit investment ratio also showed the same trend for all the categories.

CONCLUSION

Among the three types of mechanised fishing methods the capital requirement for initial investment, based on the purchase value prevailing in the first year of the study, *i.e.*, 1982, was lowest for gill netters (Rs. 95,000), whereas for trawlers it was Rs. 1.65 lakhs and purse seiners Rs. 7.7 lakhs. The average revenue per day of operation worked out on the basis of 5 years (1982-1986) data on cost and earnings was Rs. 9,227 as compared to the revenue of Rs. 946 for drift gill netters. Though the cost of production including all variable and fixed costs per day of operation was maximum for purse seiners total cost per kg of fish was only Rs. 2.27 as against Rs. 5.90 for gill netters and Rs. 5.70 for trawlers because of its high level of production. Operating cost per kg of fish also is minimum (Rs. 1.50) for purse seiners and maximum for drift gill netters. Labour efficiency is the highest for purse seiners followed by trawlers and gill netters as indicated by physical quantity as well as value of production per man day. Fuel efficiency also is highest for purse seiners as the physical quantity of production and its value per litre of fuel are higher as compared to other units. Among trawlers and gill netters, fuel efficiency is more for gill netters as the quantity and value of fish produced per litre of fuel is higher for gill netters and fuel cost per kg of fish is less than that of trawler.

Returns to labour is highest for purse seiner and lowest for trawler. Internal rate of return estimated on cost and earnings data is almost same for gill netters and purse seiners. Pay back period, which is calculated on the basis of initial investment in 1982 and the cash flow for the successive years, is 2 years 10 months

for the gill netters, 4 years 7 months for trawlers and 3 years for purse seiners.

Based on the above analysis obviously purse seiner is economically more efficient. But its investment requirement is much higher than the other two units. Though the purse seiners were first introduced in Cochin Fisheries Harbour in 1979 with 20 units and further years expanded to 65 to 70 units this number reduced to 40 to 45 in 1986. Since purse seiner is competitive to the traditional fishing units as its catch comprise mainly the pelagic species traditionally caught by non-mechanised fishing units, it has to be met with stiff resistance from the traditional fishermen. Regarding economic efficiency of trawler and gill netter is more economically viable than trawler. The net returns per day of operation was Rs. 179 for gill netters as against Rs. 59 for trawlers. Though the average revenue per day of trawler (Rs. 1,383) was higher than that of drift gill netters (Rs. 946), because of higher capital cost and fuel expenditure in the operation of the trawler the net return reduced to a low level. Internal rate of returns, returns to capital, returns to labour, quantity as well as

value of fish produced per litre of fuel were higher for gill netters than trawlers. Pay back period calculated on the basis of actual cost and earnings from the 1982 onwards, is lower for gill netter than trawlers.

So also fuel cost per kg of fish was less for gill netter than trawler. Operating and total cost per kg of fish were normally higher for gill netter than that of trawler. But in the case of gill netters it was substantially compensated by the higher value realised per kg of fish than that of trawler.

Comparatively lesser economic efficiency of trawler as brought out by the key indicators could not be considered as a continuing phenomenon. Since the data used for this study were the averages of the 5 years from 1982 to 1986 and the first two years *i.e.* 1982 and 1983 trawlers suffered considerable losses which influenced adversely the five year averages. But in 1985 and 1986 the trawlers picked up very well due to selective fishing resulting in higher fish catches and also better unit value of fish. Probably this trend could have encouraged the industry to introduce new trawl units in subsequent years.