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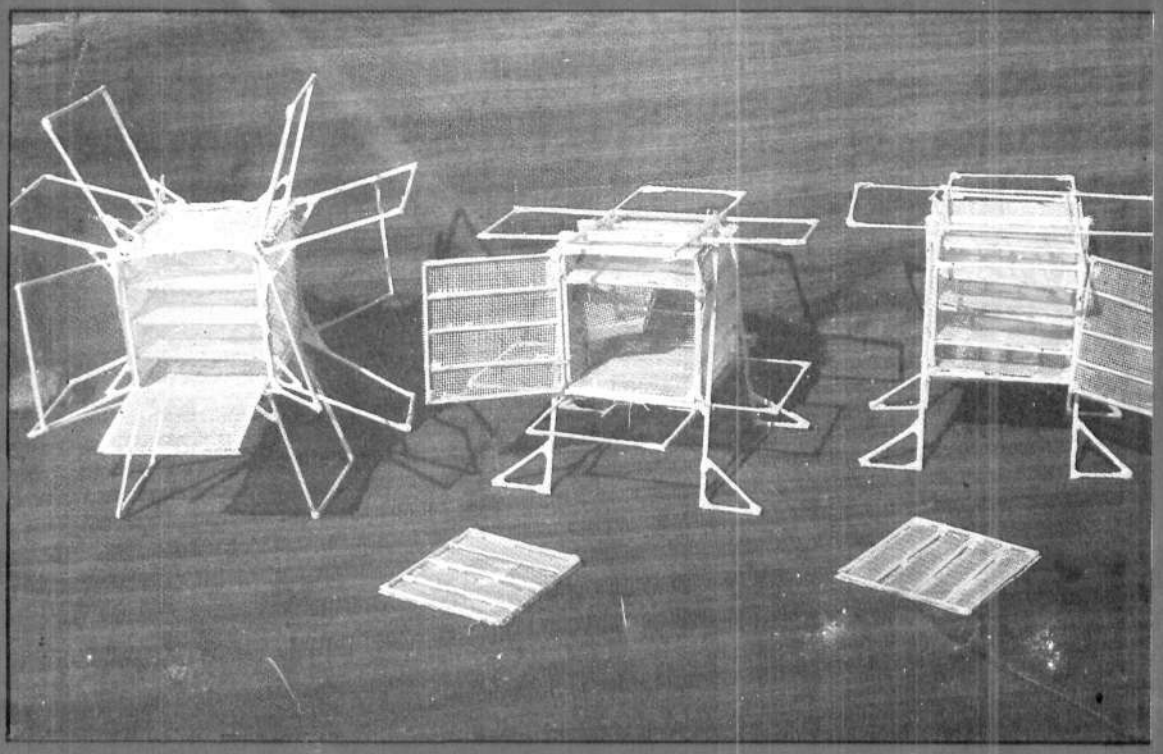

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864 ECONOMIC SUSTAINABILITY AND MANAGEMENT ISSUES OF TRAWL FISHING IN GUJARAT

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Gujarat is one of the major fish producing maritime states of India with a coast line of about 1,600 km and continental shelf area of 1.65 lakh sq.km. It provides over 2 lakh sq.km of Indian Exclusive Economic Zone. Of the ten coastal districts in the State, Junagadh, Amreli, Jamnagar, Valsad and Kutch are leading in marine fish production.

There are about 210 marine fishing villages and almost equal number of fish landing centres along the Gujarat coast. Of the total fish production of India (about 4.8 million tonnes), Gujarat accounts for about 15 %. Presently marine fish production in the State is over 6 lakh tonnes which accounts for 90 % of the total production obtained from marine and inland sectors. About 94 % of marine fish production comes from the mechanised and motorised sectors. About 300 species of marine finfish and shellfish, are available in Gujarat waters. Bombayduck, pomfret, seerfish, croakers, shark, *Coilia*, catfish, shrimps and ribbonfish are prominent marine fish resources. The marine fishable stock of Gujarat is estimated at about 7.73 lakh tonnes.

About 22,600 fishing boats are associated with marine fisheries sector along Gujarat coast. of this, 25 %, are trawlers, 14 %, gillnetters, 20 % motorised crafts, 3 % other mechanised and 38 % non-mechanised crafts. Medium and small trawlers fish within the 80 m depth contour. Marine fisheries development has led to the threat of over exploitation in the inshore waters. Catch per unit effort of trawlers has been steadily declining which is the result of increasing strength of these units and the use of small mesh size for the trawlnet especially at the cod end. Inspite of decline in catch per unit, increasing fish prices are able to maintain operational surplus at a reasonable level which lures the prospective investors to procure mechanised units and compete for the open access resources.

In comparison to the other types of units, trawlers have higher magnitude of fish landings and are reported to make greater profits. Moreover, the investment in a trawler is considerably high. The increasing number would affect the resources adversely in the long run since the increase in the number of these units does not match with the growth in fish landings in the State. The costs and earnings study of trawlers therefore, is essential to ensure proper investment in these units. The present study aims at analysing economic sustainability of trawlers in Gujarat and suggesting some management measures for judicious operations of these units.

Data collected for this study comprise both the primary and time series data. Primary data collection on economic parameters of trawl operations was confined to four major trawl landing centres in Saurashtra region namely Veraval, Mangrol, Porbandar and Okha. Five per cent of the trawl units available in a centre formed the sample. By observing units at random basis the data were collected for one full fishing season during 1994-'95. Frequency of data collection was once a week throughout the season. Besides analysing economic parameters of trawl fisheries, an attempt has been made to project its future prospects in Gujarat.

Fish landing by trawlers in Gujarat

With the increasing number of trawlers their contribution in total fish production has also increased during the recent years. Table 1 depicts the contribution of trawlers in marine fish landings in Gujarat.

The above Table shows that while contribution of all powered boats touched 96 % level of total marine fish production, the contribution of trawlers rose to 65 % during 1994-'95.

TABLE 1. *Contribution of trawlers in marine fish landings of Gujarat*

Type of unit	Fish landings (lakh tonnes)		
	1992-'93	1993-'94	1994-'95
Trawlers	3.56 (58.5)	3.70(59.7)	4.2 (65.1)
Total powered boats	5.71 (93.8)	5.81 (93.7)	6.18 (95.8)
All boats	6.09 (100)	6.20 (100)	6.45 (100)

The figures in parentheses show % contribution in annual fish production.

The Table 2 presents the number of trawlers in Gujarat and catch per unit landed in the recent years.

TABLE 2. *Declining trend of catch per trawler in Gujarat*

Particulars	1992-'93	1993-'94	1994-'95
Number of trawl units	3,456	3,941	4,634
Annual catch per unit (in tonnes)	103	94	90

As the number of trawl units increased, the catch per unit declined in Gujarat. The secondary data collected by the CMFRI also show that catch per trip of trawlers came down from 2,107 kg during 1991 to 1,811 kg during 1995.

The major catch components of trawlers are given in Table 3.

TABLE 3. *Catch components of a trawler in Gujarat*

Name of fish groups	% of total catch	
	1994	1995
Elasmobrachs	2.9	3.0
Clupeioids	4.9	5.4
Perches	7.4	6.2
Croakers	17.4	16.8
Ribbon fish	11.8	10.5
Soles	2.0	2.4
Penaeid prawns	7.5	9.3
Non-penaeid prawns	20.5	17.3
Other crustaceans	4.9	5.3
Cephalopods	8.4	6.7
Others	12.3	17.1
Total catch (lakh tonnes)	4.5	4.2

Source : CMFRI (data exclude Kutch region).

Several important species in terms of quantity and quality are available in Gujarat waters. Trawl landings comprise mainly of demersal and column species. In terms of quantity, shrimps, croakers and ribbon fishes are important.

Trawl landings in Saurashtra

Gujarat has been represented by three distinct regions namely, Saurashtra, Kutch and South Gujarat. The Gulf of Cambay and the Gulf of Kutch make Saurashtra region very productive for marine fish resources. Mainly, the coastal regions of Jamnagar, Rajkot, Bhavanagar, Amreli and Junagadh districts represent Saurashtra for marine fish production.

In Saurashtra, concentration of trawlers is found in three districts, namely Jamnagar, Amreli and Junagadh. The total number of trawlers increased from 1,202 during 1982 to 3,542 during 1994 (Table 4).

TABLE 4 *Increased trend of number of trawlers in 3 districts in Saurashtra region*

Year	Jamnagar	Amreli	Junagadh	Total for Saurashtra
1982-'83	49	120	1,033	1,202
1987-'88	87	133	1,226	1,446
1992-'93	115	167	2,183	2,468
1993-'94	116	170	2,622	2,908
1994-'95	116	176	3,250	3,542

There were about 4,630 trawlers along the Gujarat coast during 1994-'95, of which 75% was found operating in Saurashtra region alone. The high concentration of trawlers (70 % of the total number) is found in Junagadh District. (Fig. 1).

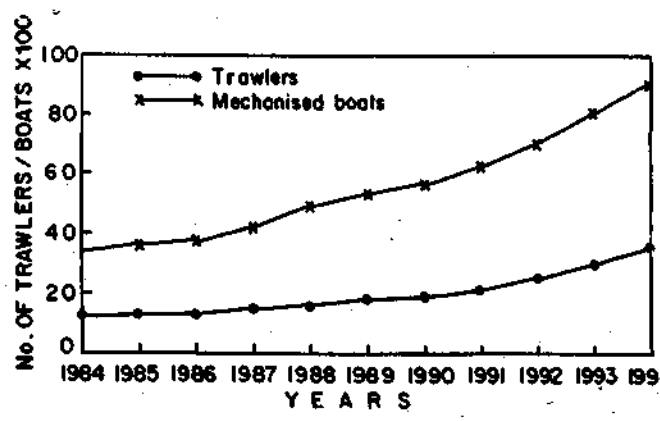

Fig. 1. Growth of mechanised boats and trawlers in Saurashtra (1984 to 1994).

The figure shows that there has been continuous increase in the number of mechanised boats as well as trawlers in Saurashtra during the recent years. Of the total number of about 9,000 mechanised boats in Saurashtra during 1994-'95, the trawlers accounted for 39 %. About 3,250 trawlers operate along the coast of Junagadh District alone.

TABEL 5. *Contribution of Saurashtra in total trawl landings of Gujarat during 1995*

Region	Landings (in tonnes)		
	Multiday trawlers	Daily trawlers	All types of units
Saurashtra	1,76,809	59,141	3,66,172
Gujarat	1,76,809	78,279	4,96,436
Landings in Saurashtra as % of those in Gujarat	100 %	76 %	74 %

Source : Central Marine Fisheries Research Institute, Cochin.

All the multiday trawlers and 76 % of the daily trawlers of Gujarat are found to operate in Saurashtra region (Table 5). Of the total marine fish catch of Saurashtra region 64 % is landed by the trawl units whereas this proportion is a little more than 50 % for the whole Gujarat landings. Thus, in Saurashtra, trawlers have a significant place in terms of number (of units) as well as their contribution to total fish production.

Economics of trawlers in Gujarat

The investment in fisheries is of low magnitude in comparison to other sectors of economy though fish is a rich source of protein and a valuable source of foreign exchange. As the fishing shifted from subsistence to commercial occupation, mechanisation of crafts got prime importance. Various promotional policies of the Central and the State governments and financial assistance from World Bank and financial institutions on liberal conditions were responsible for rapid increase in the number of mechanised units in Gujarat. The lucrative returns from fishing at the initial stages prompted entrepreneurs to invest in mechanised units, especially in trawl units. Due to addition of mechanised units in inshore waters, there developed heavy competition among different types of units as they share common inputs and fishery resources.

The high-rent resources are under the threat of over-exploitation. To make up input cost and in a bid to get higher returns on capital investment the trawlers are venturing non-conventional fishing grounds. To economise operations, the units are observing multiday fishing.

Still there is rush for catching high-rent resources like prawns and cephalopods within 70-80 m depth contour. How best trawlers perform in the competitive environment, depends on many factors such as size and condition of boat, HP of engine, number of crew, experience of the crew and the managerial capacity of the unit owners. The returns, of course, depend on catch composition and fish price which in turn, is influenced by demand and supply of fish. Operational surplus is an important income component since it is utilised for payment of rent of input resources and services used.

Investment and sunk-cost of trawlers

Traditional as well as new types of trawl nets (*Disco* trawl) are being operated off Saurashtra. The mesh size of these nets is recorded as small as 8 mm at cod end and as big as150 mm at the opening of the net. The crafts, made of Malaysian wood, *Babul* and *Shad* wood, vary from 12 to 17 m in length, 3 to 5 m in width and 2 to 3 m in depth. Ashok Leyland, Ruston and Field Marshal are some of the popular brands of inboard engines of these crafts. The power of the engine varies from 58 to 110 BHP.

The acquisition cost of a trawl unit during 1994-'95 averaged Rs. 9.7 lakhs including that of boat (Rs. 5 lakh), engine (Rs. 2.8 lakh), major and minor accessories (Rs. 1.4 lakhs) and gear (Rs. 0.50 lakh) (Table 6).

TABLE 6. *Investment (in Rs.) on a trawler (1994-'95)*

Item	Investment	Depreciation
Boat and engine	7,80,000	78,000
Gear	50,000	16,665
Major accessories	1,00,000	33,333
Miscellaneous items	40,000	20,000
Total	9,70,000	1,47,998

For calculating depreciation on various items, boat and engine were depreciated at the rate of 10 % per annum, gear and major accessories at 33.33 % and other items at 50 %. The annual depreciation amounted to Rs. 1,47,998. Other components of fixed cost, namely, opportunity cost of capital, repairs and maintenance and insurance premium worked out at Rs. 1,45,500 Rs. 40,000 and Rs. 27,000 respectively. Thus the annual fixed cost of a trawl unit averaged Rs. 3,60,498.

Operational costs and income realisation

Almost all the trawlers keep their fishing activities off during monsoon (June to August) in Saurashtra region. During this period major repairs, painting and replacement of parts of craft/gear/engine are arranged by the trawler owners. After the commencement of fishing season in September, trawlers conduct single day fishing trips for a period of about one month in the 30-50 m depth. The voyage fishing of 6-8 days a trip is carried out even in 60-80 m depth.

In a trawl unit, 5-8 persons form the crew. In most of the units, the owners of the boats do not join the crew for fishing as they find themselves engaged in management of shore-based arrangements related to input supply and marketing of fish. During the period under study, the average number of crew in a trawler was 6.7. The operational cost components of a trawl unit during 1994-'95 in Saurashtra coast are given in Table 7.

TABLE 7 *Components of annual operational cost (1994-'95)*

Items of operational cost	Annual cost/charges (Rs.)	
Labour for fishing	1,37,333	(24.4 %)
Fuel (diesel, lubricant etc.)	1,70,512	(30.4 %)
Food and *bata* (on board)	36,958	(6.6 %)
Ice, salt etc. (for preservation)	48,718	(8.7 %)
Repairs/maintenance (day-to-day)	53,758	(9.6%)
Marketing & miscellaneous (transport, L/ul etc.)	1,14,095	(20.3%)
Total	5,61,374	

The annual number of fishing days of a trawl unit in Saurashtra region averaged to 200 and annual fishing hours to 1,400. The total landings of a unit worked out at 79.4 tonnes valued at Rs. 10.31 lakhs during the fishing season (Sept. '94 to May '95). Total coast of fishing (total of operational and sunk costs) was calculated at Rs. 9.22 lakhs.

Operational surplus and net profit

Operational surplus of a trawler (gross income realised from the sale proceeds of the fish minus the cost of fishing operations) was Rs. 4.7 lakhs in Saurashtra during 1994-'95. Annual profit of a trawl unit worked out to Rs. 1.09 lakhs (Table 8).

TABLE 8. *Costs and earnings of a trawler*

Number of annual fishing days	200
Annual fishing hours	1400
Total catch (tonnes)	79.40
Gross income (Rs. lakhs)	10.31
Operational expenses (Rs. lakhs)	5.61
Sunk-cost (Rs. lakhs)	3.61
Total (annual) cost (Rs. lakhs)	9.22
Operational surplus (Rs. lakhs)	4.70
Annual profits to owner (Rs. lakhs)	1.09

Comparative economic performance of trawlers at selected centres

Major centres selected for input and output data collection from trawl units include Veraval, Magrol, Porbandar and Okha. About 55 % of total fish landings in marine sector of Gujarat come from these centres. Most of the trawlers in these centres conduct multiday fishing in 60-80 m depth zone.

The average fishing trip was the shortest for the trawlers based at Mangrol and the longest for those based at Okha. Catch per trip ranged from 2,165 to 2,829 kg and the revenue from Rs. 26,493 to Rs. 37,392. Annual operational surplus was Rs. 5.25 lakhs for 82.2 tonnes of catch at Veraval, Rs.3.74 lakhs for 73.7 tonnes at Mangrol, Rs. 4.48 lakhs for 82.0 tonnes at Porbandar and Rs. 4.83 lakhs for 78.0 tonnes at Okha (Table 9). Overall, 79.4 tonnes of annual catch valued at Rs.10.31 lakhs fetched Rs. 4.7 lakhs towards operational surplus for a trawl unit.

Important parameters of economic efficiency

Annual or aggregate economic parameters are not adequate to represent the efficiency of a particular type of unit. Other parameters of efficiency include performance per fishing hour, cost and returns per kg of fish production, rate of return to capital, payback period, returns per manhour production per litre of fuel and cost and income-related ratios.

I.	**Efficiency per fishing hour**	
a.	Catch landed (kg)	56.7
b.	Gross revenue (Rs.)	736.6
c.	Operational cost (Rs.)	401.0
d.	Total of operational & sunk-cost (Rs.)	658.5
e.	Operational surplus (Rs.)	335.6
f.	Net profit (Rs.)	78.1
II.	**Efficiency per kg of catch (Rs.)**	
a.	Gross value	13.0
b.	Crew wage/share (including food and *bata*)	2.2
c.	Fuel cost	2.2
d.	Operational cost	7.1
e.	Total cost	11.6
f.	Operational surplus	5.9
g.	Profit	1.4
III.	**Other efficiency parameters**	
a.	Fish production per manhour (Kg)	7.9
	Its value (Rs.)	102
b.	Fish production per litre of fuel (Kg)	3.7
	Its value (Rs.)	48
c.	Rate of return to capital (%)	26.3
d.	Payback period (years)	3.8
e.	Ratio of operational cost to total cost (%)	61.0
f.	Ratio of total annual cost of initial investment (%)	37.0
g.	Ratio of total annual cost to initial investment (%)	46
h.	Ratio of profit to gross revenue (%)	11.0

The above results suggest that output per fishing hour of a trawler is 56.7 kg valued at Rs. 737. An amount of Rs. 78 was added to the net profit by every hour of fishing output. A kg of fish fetched an average of Rs.13 during the study period. An operational surplus of Rs. 5.9 was obtained on 1 kg of fish which could be produced by spending an average amount of Rs. 7.1 on fishing inputs. Fish production as per man hour averaged 8 kg valued at Rs.102. Similarly, 3.7 kg of fish worth Rs. 48 could be harvested by utilising 1 litre of fuel. For any sort of institutional lending the interest rate may not exceed 20 % per annum. The calculated rate of return (to capital) of 26.3 % is therefore profitable to the trawler owners. Thus, with the given level of production and the prices of fishes and inputs, it is possible for a trawl unit to recover its capital investment in less than 4 years.

Operational costs are major components (61 %) of the total cost of fishing. The ratio of annual fishing cost to the initial investment was 37 %. Revenue side, 46 % of the gross value of catch was realised as operational surplus. The ratio of net profit to the gross revenue worked out at 11 %.

TABLE 9. *Economic performance of trawlers at selected centres of Saurashtra (1994-'95)*

Name of centre	Per trip			Per fishing hour			Annual		
	Catch (kg)	Value (Rs.)	No. of fishing hours	Catch (kg.)	Value (Rs.)	Catch (tonnes)	Value (Rs. lakhs)	Operational cost (Rs. lakhs)	Surplus (Rs. lakhs)
Veraval	2,502	33,562	42.6	58.9	788	82.2	11.04	5.79	5.25
Mangrol	2,165	26,493	41.1	52.7	645	73.7	9.02	5.28	3.74
Porbandar	2,645	33,040	45.2	58.5	731	82.0	10.24	5.76	4.48
Okha	2,829	37,392	50.6	55.9	739	78.0	10.35	5.52	4.83
Overall	2,499	32,449	44.0	56.8	737	79.4	10.31	5.61	4.70

Returns in relation to length of boat

The length of a fishing craft in general, determines its overall dimensions and approximate tonnage. Bigger the boat, higher would be the capacity (HP) of the engine fitted in it. Also, the crew size may be in proportion to the size of the boat. With higher level of input resources in bigger units, the catch and revenue are expected to higher in comparison of smaller units. To establish such a hypothesis the trawlers were divided into 3 categories based on the length of crafts namely, less than 13 m, 13-14 m and more than 14 m and accordingly the operational surplus values were calculated.

ANOVA was carried out using hierarchical classification by taking into consideration the variation between the quarters (seasonal variation) and between the centres within quarter (spatial variation within quarter). To correct for the non-addivity, the analysis was carried out by using data on log scale.

The above results reveal that quantity and value of catch per hour differ significantly between seasons and between centres within quarter.

Break-even analysis

To equate revenue with the cost of fishing in a year, the catch, number of fishing hours and price are considered. Keeping two of the variables at a constant level, the lowest limit of the third variable is calculated :

$$TR = TC$$

where, TC = annual cost (operational + fixed) of fishing and TR = annual revenue.

TABLE 10 : *Catch revenue and operational surplus in relation to length of craft*

Boat length		Av. Hp of engine	Per trip			Per man hour		
Range	Average		Catch (kg)	Fish value (Rs)	Oper. surplus (Rs)	Catch (Kg)	Fish value (Rs)	Oper. surplus (Rs)
<13	11.8	69.8	1,169	15,395	5,772	9.7	128.2	42.8
13-14	13.5	88.8	2,373	30,944	14,197	8.7	113.5	42.5
> 14	15.0	99.4	4,016	51,537	24,199	8.1	104.2	42.6

Though the amount of operational surplus per trip was higher for bigger units, its value per manhour did not differ significantly between the units. An analysis of the inputs like labour and labour in relation to catch/revenue indicated that there is scope for increasing man power on trawlers.

Seasonal variations in catch and revenue

It is well known that there are seasonal variations in availability of fish stocks which are reflected in the landings. To investigate the seasonal and spatial variations in the catches and its values the analysis of variance (ANOVA) technique was adopted Table 11. The primary data collected from different trawl operating centres have been divided based on three seasons (quarters) namely, post-monsoon (Sept.-Nov. '94), winter (Dec. 94-Feb. '95) and pre-monsoon (March-May '95). To maintain the uniformity in presentation of the data, catch and revenue have been taken on per fishing hour basis.

TABLE 11. *Analysis of variance*

Source	D.F.	S.S.	M.S.	F.Value
A. Catch per fishing hour				
Quarter	2	4.271	2.136	84.43*
Centre/Qr.	9	1.445	0.160	6.35*
Error	289	7.310	0.025	
B. Revenue per fishing hour				
Quarter	2	3.914	1.957	42.22*
Centre/Qr.	9	3.320	0.369	7.96*
Error	289	13.396	0.046	

* significant at 1% level.

The total revenue is obtained by the multiplication of catch per hour of fishing, number of hour fished and the average price of the catch (Fig. 2).

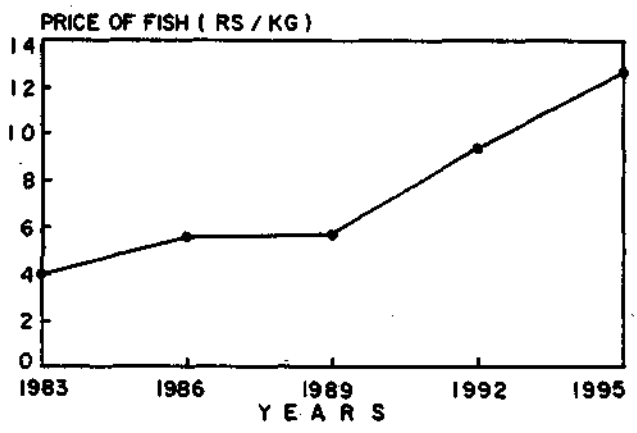

Fig.2. Components of operational cost (%) of trawlers in Gujarat during 1994-'95

The required level of each of the three parameters could be calculated by using the following equations :

a) Catch per hour = TC/ total number of fishing hours x price

b) Total no. of fishing hours = TC/ catch per hour x price

c) Price of catch = TC/ catch per hour x total no. of fishing hours

The values of the above parameters have been calculated and presented in Table 12.

TABLE 12. *Break-even level of selected parameters*

Parameters	Existing level	Break-even level
Per hour catch (kg)	56.7	45.7
Total (annual) fishing hours (nos)	1400	1128
Price of fish (Rs./kg)	13.0	10.5

To fulfill the condition of TR = TC, the required level of each of the above parameters is found to be less than that of the existing one.

Projection of trawl fleet in Gujarat by 2000 A.D.

For projecting the number of trawlers by 2000 A.D., secondary data on the number of trawl units available in Gujarat for the period from 1982 to 1994 have been used and exponential growth functions has been employed since there is exponential increase in the number of these units over the period.

Exponential Growth Function : $Y = a.b^x$ where, Y = no. of trawlers = in '000; x = year (1982 to 1994) ; and a & b are constants.

The following equation has been obtained:

$Y = 1.437 \times 1.085^x$

The projection for the number of trawlers by 2000 A.D. was worked out at 6700.

Policy implication

The above analysis shows that trawl operations, were economical during the study period. It is also established that the catch per unit has been declining during the last few years. The strength of trawlers during the last decade has doubled (Fig. 2) but the catch has not increased proportionately (Fig. 3). The question arises, as

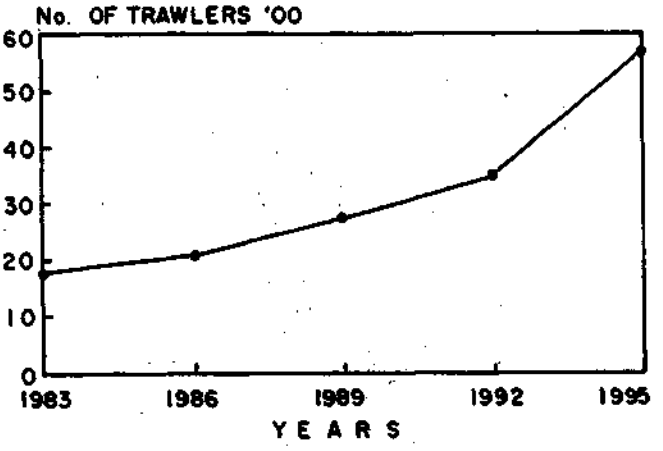

Fig.3. Growth of trawlers in Gujarat during 1983-1995.

to how the trawlers run in proft despite decline in catch. There has been increase in the price of fish during the recent years due to its increased demand in internatinonal and domestic markets.

It is due to this reason that the units still maintain moderate profits. The projection results show that, in Gujarat, the number of trawlers may go upto 6,700 by 2000 A.D.

The exploitation of high rent resources like prawns and cephalopods has been increasing, leading to a threat to these resources especially in inshore waters. Further, against the annual potential yield of 7.73 lakh tonnes off Gujarat, a production of 6.5 lakh tonnes has already been achieved during 1994-'95. To one tonne or so, efforts have to be employed mainly in deeper waters. With all these constraints, the catch per trawl unit is likely to decline further due to faster expansion of trawlers and thus it may have adverse impact on fish resources as well as on the economy of the trawl owners. It is therefore suggested that further addition of trawlers in inshore waters should be curbed.

Why there has been continuous addition to the trawl fleet?

Availability of institutional credit on liberal terms along with large amounts of subsidies and more financial institutios coming forward to finance trawlers; higher returns to capital especially in the initial stages owing to steep rise in price of fish; continuously expanding and diversifying export market for marine fish products; development of shore-based facilities; availability of fishery requisites on subsidised rate; increased employment generation; and high demand for fish in domestic markets are the major factors responsible for the expansion of trawl fishery in Gujarat.

Situation of overfishing

However, the increase in number of units is going on unchecked. The landings by trawlers in Gujarat have been showing declining CPUE from 1991 onwards suggesting that the stocks in the currently fished grounds are under the threat of overexploitation. The motive of an entrepreneur is merely to earn profit. As long as existing units continue to earn sustainable profits more and more units will be lured to join the industry. Fishermen in developing countries are inattentive to the sunk cost. Indeed, some of the units operate on "Minimum Loss Principle" hoping, in due course, to regain the operational surplus at a somewhat reasonable level.

The phenomenon observed during the recent years created such a situation where catch per unit is reduced. Under normal conditions it could have resulted in a loss to the trawlers as it would affect one of the constituents of MR which is the product of marginal physical product and the price of the fish (MR = MPP. PY), but the rapid increase in price of fishes has been compensating the reduction in catch per trawl, thereby maintaining the profits at a reasonable level.

With continuous addition to the fleet and decrease in the cod end mesh size (to exploit even small shrimps), there may be increase in total fish production but that increase is unlikely to continue indefinitely beyond the biologically sustainable levels. What is more, this is turn would also result in economic losses. If the principle of marginal cost (MC) and marginal returns (MR) is applied to the fish production, additional efforts will continue upto a level where MC=MR. At this stage there would be maximum gains to the fishing units.

If the exploitation of young fishes is not regulated the decline in catch per unit would not be compensated by increase in fish price also because of possible growth over fishing. In such a situation units will incur losses. Trawlers earning marginal profits will have to leave the industry. By that time there would be a great loss to some of the high rent resources as it has already been noted in case of lobster fishery.

Need for broader perspective

A fishing unit works on the principle of earning profits under the force of cost and revenue. The principle of marginal coast and revenue holds good in case of an individual unit, whereas the fishing industry as a whole holds the concept of average cost and revenue. The industry should

attach due importance to the total fish production, employment potential and export. It would also show interest in the development of shore-based facilities and marketing infrastructure. Interest of a fishing industry in the long run lies in conservation of fish stock and overall growth of the sector. On the other hand, profit making is the sole goal of an entrepreneur entering into the fishing industry.

How the fishing pressure can be reduced

Hundreds of trawlers are added to the fleet in Gujarat every year (Fig.1) and the catch per trawler has been declining during the recent

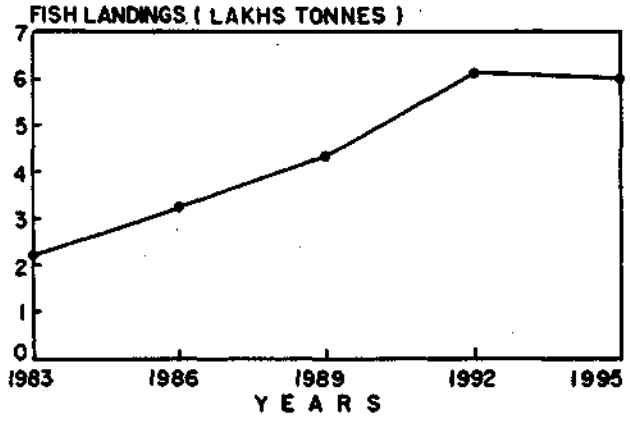

Fig.4. Trend of marine fish price in Gujarat during 1983 to 1995).

years (Table 2) resulting in reduction of the profits. To compensate for this, several trawlers are observing multiday fishing and venturing upto 80 m depth in an attempt to ensure better returns. These units are in a position to save time and fuel when compared to those observing daily trips. While this reduces pressure in inshore waters (if bigger vessels with onboard processing facilities are introduced in phases) it would be possible to harvest resources in deeper water and further reduce the pressure in the inshore waters. Adequate and reliable information on the availability of various stocks at different depths and locations would be a useful guide for such vessels. Besides, all liberal schemes of finance and subsidies for introduction of small and medium crafts in inshore waters need to be suspended for the time being.

How is optimum sustainable yield (OSY) desirable ?

MSY is based on biological considerations whereas MEY takes into account the forces of costs and returns also. The fishing efforts keep on increasing as long as the marginal cost of fishing equals marginal returns. If the level of MEY crosses that of MSY, the industry faces the problem of overexploitation. It may either be a temporary phase or prevail for a considerable length of time.

In case of continuous inflows of mechanised units like trawlers, MSY and subsequently MEY will get disturbed. It will result in losses to the units. Even operational surplus would tend to be negative. It will lead to idling of boats, block of investment capital, non-repayment of loans and decline in overall employment. Can the nation afford this sort of socio-economically undesirable situation? The basic purpose of encouraging mechanisation by the government in the initial stages was to enhance fish production on scientific lines in terms of quality and quantity. Since it has reached a level of indiscriminate harvests especially in inshore waters, there is need to discourage further addition of such units. Also, there should be regulation on mesh size of gear.

Trawlers in modern times are becoming more and more capital intensive. Our coastal population still rely on fish as their primary source of protein and also, fishing is a source of their livelihood. In the days of declining natural stocks, steps are needed to sustainably manage natural resources so that the resource gets fair chance to regenerate and thus prevent collapse. For effective management strategies, the industry needs to respect the regulations voluntarily as sufficient resources may not be there with the Government to enforce them.

Like other primary production sectors, marine fisheries must take into consideration the national objectives. Neither the approach of MSY nor that of MEY alone can solve the problem. Fisheries should aim at fulfilling social goals by making best uses of resources in the overall inte-

rest of the society. Undoubtedly the first step in this direction would be towards the development of the fishery. The second step would be to take measures at all stages to maintain the operating efficiency of the fishing units where some sort of regulations may be necessary to prevent excess pumping of money in the units.

Thus, the fishery management should create a situation of optimum sustainable yield (OSY) which comprises a set of parameters including techno-economic efficiency of fishing units; conservation of fish stocks; balance in export and domestic needs; equitable distribution of income among different strata of fishermen; development of shore-based facilities in different regions; increase in employment potential; balancing the interests of mechanised and non-mechanised sectors; rational use of input resources and protection of interest of the producers and the end users.

Conclusions and recommendations

Gujarat has reached the top rank among the maritime states in terms of marine fish production. Of about 6.5 lakh tonnes of marine fish landings, 95 % comes from mechanised and motorised sectors.

During the last one decade or so the number of fishing fleet in the State has doubled and its strength reached to 22,600 (1994-'95) which comprises 25 % trawlers, 20 % motorised units, 17 % other mechanised units and the rest non-mechanised crafts. About 65 % of total fish catch of Gujarat is landed by the small and medium trawlers. About 60 % of the total investment in fishing units is estimated to be made in trawlers alone in the State.

The major catch components of trawl landings include croakers, ribbonfish, shrimps, cephalopods and perches. The major concentration and activities of trawlers are found in Saurashtra region which comparises 3/4th of the total units available in Gujarat. In this region, trawlers account for about 40 % of the total number of mechanised units. Of the total fish production of Gujarat, 76 % comes from Saurashtra region. Also, about 50 % of total fish production of the State is contributed by the trawl landings in this region.

Various tests of economic efficiency were performed on trawl units. During 1994-'95 an average trawl unit had an investment of Rs. 9.7 lakhs which resulted in an annual fixed cost of Rs. 3.6 lakhs. For 200 days of trawl operation in a fishing season, operational cost totalled to Rs. 5.61 lakhs. Fish landings of 79.4 tonnes (Rs. 10.31 lakhs) gave an operational surplus of Rs. 4.7 lakhs and a net profit of Rs. 1.09 lakhs. There is a notable difference in the net income of trawlers between the centres.

An hour of trawl operation could fetch an operational surplus of about Rs. 336. A net profit of Rs. 1.4 could accrue from a kg of fish. Crew could generate an amount of Rs. 102 per man hour. Rate of return to capital, net annual profit and other efficiency ratios were in favour of trawlers during 1994-'95.

Bigger crafts were found to earn higher returns. The results of production–function analysis gave a signal to the trawlers to increase manpower for higher earnings. The hypotheses of seasonal and spatial variations in catch and revenue were tested and the results were found in conformity. The seasonal analysis of catch data confirmed that post-monsoon period provides higher quantity of catch and the revenue.

The break-even level of catch per hour, number of annual fishing hours and price of fish was less than the average existing value of these parameters.

A suggestion has been made here to observe OSY for judicious harvest of marine resources rather than following the principle of MSY or MEY in isolation. In other words OSY ensures the exploitation of resources in a socially optimal way where the main concern is for fish, money and people. In general, the fishery management

equilibrium could be a bio-economic equilibrium accompanied by the protection of interest of the community as a whole.

Keeping the above goals in mind a few management measures are suggested here for the sustained development of trawl fishery in Gujarat :

a) Regulation of the number of trawl units in inshore waters to reduce excessive fishing pressure.

b) Control on use of mesh size less than 35 mm for cod end of trawl net to reduce juvenile catch and prevent growth over fishing.

c) Provision of adequate subsidy to the trawl units which observe multiday fishing in deeper waters beyond 50 m.

d) Addition of bigger trawlers (to be owned by actual fishermen through fishermen co-operative societies) suitable for fishing in deep waters.

e) Creation of alteration financial system to replace the existing marketing linked credit system controlled by fish merchants.

f) Increased attention to estimation of fish landings and stock size for proper policy formulation.

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