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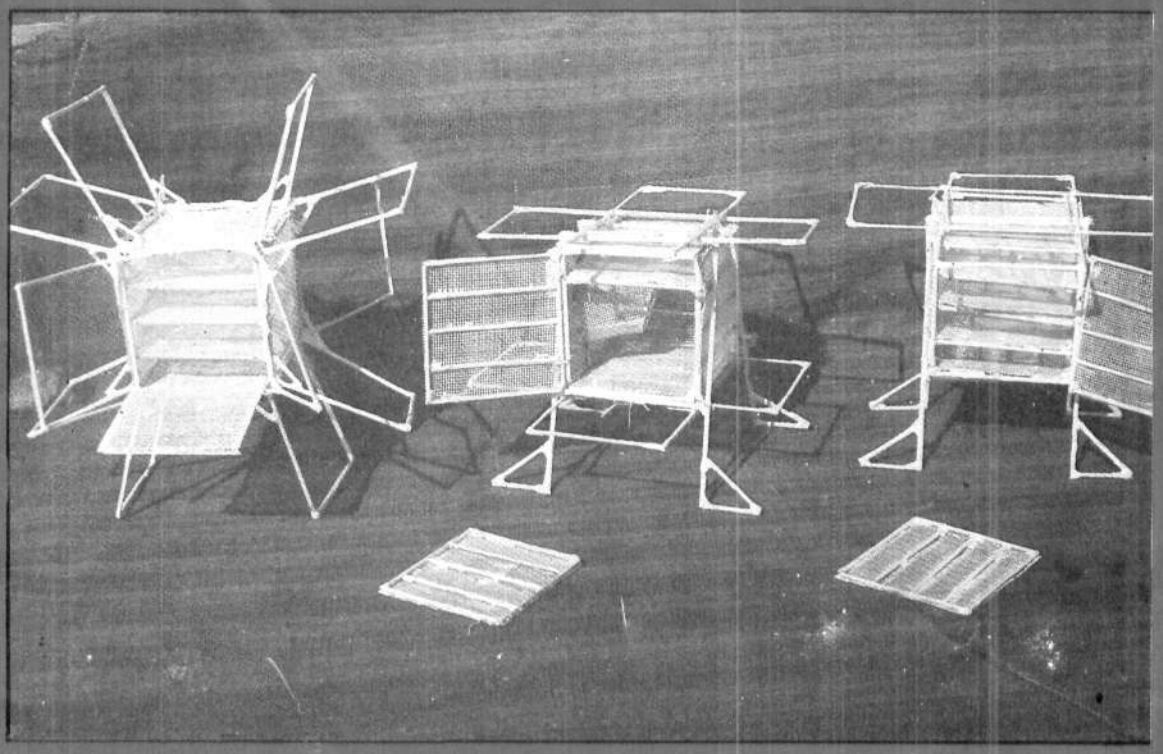

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केन्द्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान, कोचिन, भारत
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INDIAN COUNCIL OF AGRICULTURAL RESEARCH

समुद्री मात्स्यिकी सूचना सेवा : समुद्री मात्स्यिकी पर आधारित अनुसंधान परिणामों को आयोजकों, मत्स्य उद्योगों और मत्स्य पालकों के बीच प्रसार करना और तकनोलजी का प्रयोगशाला से श्रमशाला तक हस्तांतरित करना इस तकनीकी और विस्तार अंकावली का लक्ष्य है ।

THE MARINE FISHERIES INFORMATION SERVICE : Technical and Extension Series envisages dissemination of information on marine fishery resources based on research results to the planners, industry and fish farmers and transfer of technology from laboratory to field.

Abbreviation - *Mar. Fish. Infor. Serv., T & E* Ser., No. 156 : September 1998

CONTENTS अंतर्वस्तु

Front cover photo : Prototype designs of "Satellite cage" (left) two-in-one cage (centre) and high density stocking cage (right). (Ref. Article No. 866).

मुखावरण चित्र : 'साटलाइट केज' (बाएं), एक में दो पंजर (मध्य) और उच्च सांद्रता वाले संग्रहण पंजर (दाएं) के प्रोटोटाइप रूप

Back cover photo : Pearl oysters and mussels farmed at the sea bottom using the high density stocking eages (Ref. Article No. 866)

पृष्ठ आवरण चित्र : नितलस्थ समुद्र में उच्च सांद्रता वाले संग्रहण पंजर उपयुक्त करके पालन की गई मुक्ता शुक्तियों और शंवुओं का दृश्य

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).

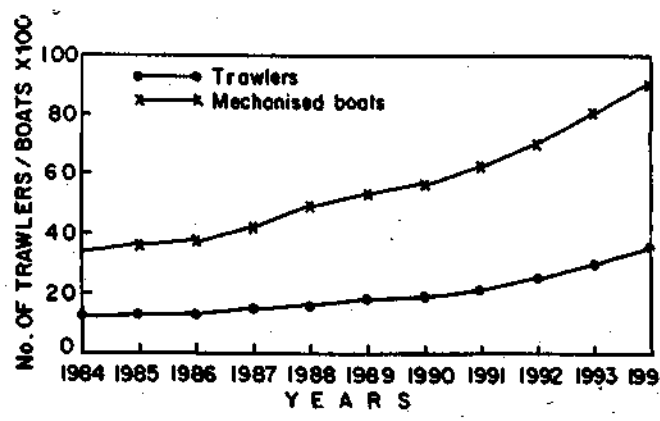

Fig. 1. Growth of mechanised boats and trawlers in Saurashtra (1984 to 1994).

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).

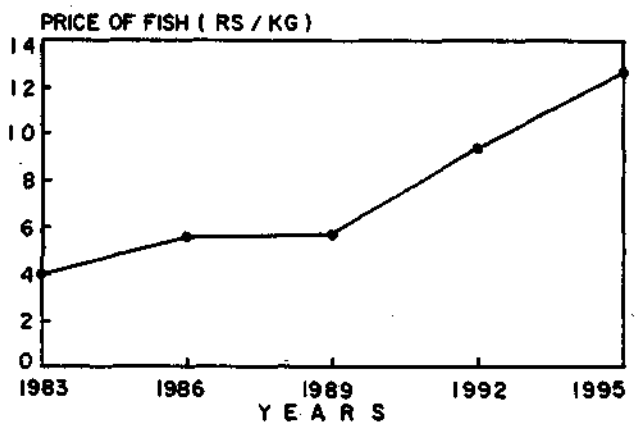

Fig.2. Components of operational cost (%) of trawlers in Gujarat during 1994-'95

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

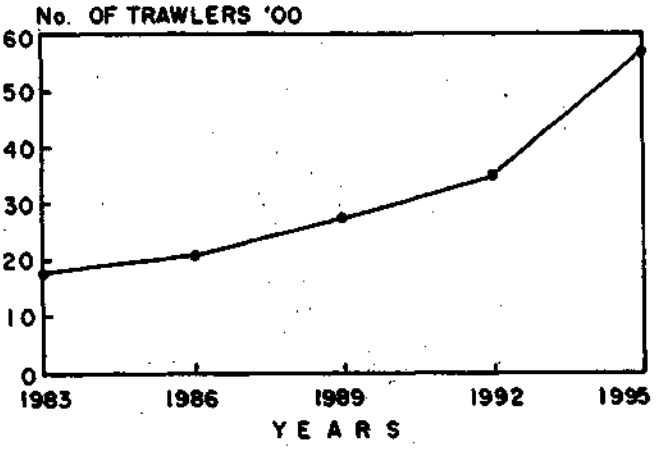

Fig.3. Growth of trawlers in Gujarat during 1983-1995.

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

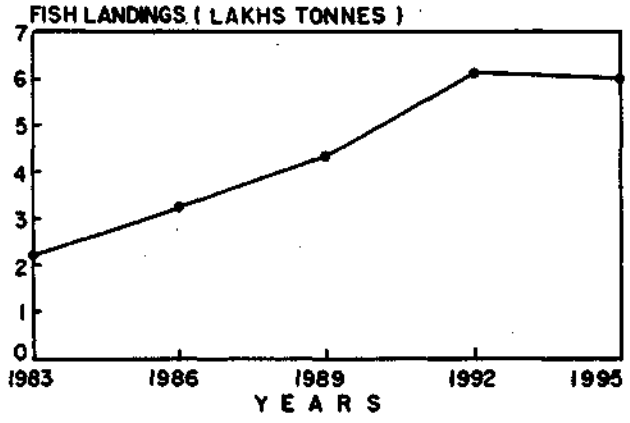

Fig.4. Trend of marine fish price in Gujarat during 1983 to 1995).

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.

Acknowledgment

I am thankful to Dr. V. Sriramachandra Murty, Head, Demersal Fisheries Division for going through the manuscript and suggesting modifications. Thanks are also due to Shri N.K. Harshan, Field Assistant, SEETT Division for his support in making charts and doing other computer work related to this paper.

865 CHANGING PATTERNS IN THE MACKEREL FISHERY OF THE MALABAR AREA

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Introduction

Radical changes have occurred in the methods of the traditional mackerel fishery of Malabar during the last four decades. From the inefficient methods as observed by Nicholson *(Bull. Madras Fish. Bureau,* **1** : 9-50, 1915) the fishery metamorphosed into dexterity by the end of 1980s with huge, small-meshed nets being operated from large and faster boats. The present study is an attempt to evaluate the consequences of this transformation in the harvesting.

Data base

Detailed data collected regularly on catch and effort in the mackerel fishery from Beypore, Vellayil, Puthiangadi and Puthiappa (important landing centres in Calicut) during 1994-'96 and data on the length-frequency distribution in the commercial catches of mackerel in these centres during the same period form the basis of this study. Occasional visits were made to different landing centres in the Malabar area (from Malappuram to Kasaragod districts) to study variations in the fishery. Data presented by the Madras Fisheries Department in the Fish Statistics of the west coast and Madras for the years from 1931-'37, the Madras Fisheries Administrative Reports for the years from 1935-'37 and by various workers on the mackerel fishery of the area were also reanalysed for comparison with the past.

Retrospect

The crafts : Until 1984 dug-out canoes with lengths varying from 6.5 to 9.8 m were used in the mackerel fishery of the area except in a small area in Malappuram Disctrict between Kootai and Vadakekadappuram where plank built boats were also in use. These crafts were being propelled by men using oars. Hence, most of the time and energy were being used for going to the fishing area, searching for shoals and return jurney, restricting the fishing operations to a distance of less than 10 miles out in the sea. In the 1984-'85 season outboard engines were used for the propulson of these dug-out canoes. The use of outboard engines revolutionised the indigenous fishery of the area. The fishermen started with an engine of 7 hp which soon became obsolete when they went for engines of 25 hp. The engines helped them to save time to go to the fishing area, search for shoals, trap the fish and return to land their catch. They could go well beyond 10 miles searching for fish. By 1987 all the country crafts were fitted with out-board engines.

In the meantime, due to the high cost of wood the dug-out canoes became very costly which resulted in the entry of plank built boats in a big way to replace them. These plank built boats had a length of 8.5 m, a width of 1.55 m and a depth of 0.8 m. They were flat bottomed and with a transom stern to fit the out board engines conveniently, but were not sturdy as the dug-outs. This problem was solved by coating the boats with fibreglass. Later the wooden planks were replaced by marine plywood.

In 1988 the ring sienes were introduced. The operation of this large net needed a crew of more than 25. Large *kettuvallam* was introduced for this purpose. *kettuvallam* is a large plank built boat with a length of upto 20 m and a width of 1.5 m. Heavy net, increased the number of crew and the large boat made the unit very cumbersome and needed more power for propulsion. This problem was solved by the use of 3 nos of 25 hp outboard engines which was later improved by 3 nos of 40 hp engines. Still the craft had no space for bringing the catch. Hence, the unit started the practice of taking one carrier boat with them to land the catch quickly as the unit continued the fishing. The carrier boat also needed an outboard engine of 25 hp. Now the fibreglass coated *kettuvallam* with a transom stern is being made using marine plywood to which the 3 outboard engines can be fitted conveniently. All these changes in the craft and gear happened in the later half of 1980s.

The gear: The change in the gear was much slower than that of the crafts. The most important gear in the mackerel fishery till the middle of 1960s were differnt kinds of boat seines made of cotton and hemp fibres, with a mesh size of above 35 mm at the mouth and wings. *Ayilakolli* was the most important boat seine. *Ayilachalavala*, a gill net with a mesh size of above 50 mm was also popular. By the middle of 1960s, when nylon fibres revolutionised net making, a new boat seine called *pattenkolli* made of nylon fibres and with much smaller mesh replaced the old *ayilakolli*. The nylon fibre was also used for making the *ayilachalavala*. These gear dominated the mackerel fishery till 1988 when ring seines with a length of 540 m and a depth of 80 m and a mesh size of 18-20 mm were introduced. The ring sienes became an instant success and soon made all the existing gear in the fishery obsolete. Only *ayilachalavala* survived with much reduced importance.

Capital : In 1984 a *pattenkolli* unit was costing around Rs.1,10,000/- and an *ayilachalavala* unit around Rs. 60,000/-. In 1989 the ring seine unit was costing around Rs.5,50,000/-. With further improvisations the cost of a ring seine unit in 1994 was as detailed below :

1	No. of *kettuvallam*	Rs. 900.00
2	Nos. of 40 hp engine	Rs. 2,10,000
1	No. of 25 hp engine	Rs. 70,000
1	No. of ring net	Rs. 2,25,000
	Total	Rs. 5,95,000
1	No.of carrier boat	Rs. 52,000
1	No. of 25 hp engine	Rs. 70,000
	Total	Rs. 1,22,000
	Grand total	Rs. 7,17,000

Fuel per one fishing trip

Kerosene	150 ltr
Petrol	30 ltr
Engine oil	15 ltr

Later, with the use of 3 nos of 40 hp engines the initial cost and running cost increased further. Besides, the repairs to engines, boats and net are very costly. All these made the indegnous mackerel fishery capital intensive.

Other facilities : Fishing harbours and jetties made the landing of catch easy and safe even during the rough monsoon season. The Puthiappa Fisheries Harbour facility made available in the beginning of 1990s increased the operation of ring seines during monsoon. Auctioning shed, gear shed and road facilities here helped the fishermen to keep their units safe and also sell the catch during this rough weather.

Trawl fishing : By early 1990s the trawl fishing spread to areas beyond the depth of 40 m in search of cephalopods. With larger boats and powerful engines the period of a single trawling trip increased to 2 to 3 days. Mackerel catch by trawls remarkably increased, especially during summer from depths beyond 35 m. In the 1994-'96 period 39.4 % of the total mackerel catch of the area was landed by trawls.

Consequences

The fishery : Table 1 gives the average annual catch of mackerel, month of peak catch and the dominant gear used during different periods. In the earlier period (1931-'37) the peak catch was in January with *ayilakollivala* as the dominant gear. In 1965-'67 when *pattenkolli* became the major gear the peak catch was in October. In 1984-'88 when outboard engines were introduced the peak catch was in September. In 1988-'92 when ring nets replaced all the earlier gear in the fishery the peak catches continued to be in September, with catch before September increasing than that after September. In the present period (1994-'96) with Puthiappa fisheries harbour facility available, the peak catch is in August with a sharp decline afterwards. The average annual catch showed a declining trend from the earliest period until the outboard engine period, from where it showed an increase. The catch data given here is collected from Vellayil which was the most important mackerel landing centre in Calicut. But, by the beginning of 1990s the harbour facility in Puthiappa was available, which provided a safe landing place for the ring net units during the rough monsoon weather. This caused an increase in the fishing activity during monsoon resulting in bumper catch of juvenile mackerel. The catch data collected in 1994-'96 includes the catch from Puthiappa also. The increasing mackerel catch by trawls landed in this harbour also is included in the total catch of this period. Hence, the annual average catch of this period is not comparable with that of the earlier periods. Vellayil lost its earlier importance as the major mackerel landing centre and comparison of the catch landed in Vellayil at present with that of the earlier period may not be justifiable. However, the annual average catch in Vellayil during the period is estimated as 497 tonnes. It can be said that, though the mackerel landings improved with the increasing efficiency of crafts and gear and better landing facilities, it is not much of an improvement over the earlier periods, when the primitive type of crafts and gear were in use. All the increase in the efficiency of fishing at a very high cost has not produced a corresponding improvement in the catch.

58.59 % of the total mackerel catch during 1994-'96 was contributed by ring nets, 39.51 % by trawls and the remaining 1.9 % by *ayilachalavala*. Fig. 1. shows the monthly percentage ccontribution by different gear. The ring nets dominated the fishery during monsoon months. In other months most of the mackerel catch was made by trawl nets.

Size groups : Another disturbing fact is that as the efficiency of fishing improves, the month of peak catch advances towards the monsoon sea

TABLE 1. *Comparison of the mackerel fishery during different periods*

Period	Average annual catch (t)	Month of peak catch	Dominant gear	Mesh size	Source
1931-'37	1,042	January	*Ayilakolli*	35mm	Madras fisheries Bulletin.
1957-'60	985	December	"		Pradhan & Reddy (*Indian J. Fish;* ***9A*** (1): 100-109, 1962)
1965-'67	339	October	*Pattenkolli*	23 mm	Venkatraman & Rao (*Indian J. Fish;* ***20*** (2): 448-475, 1973).
1984-'88	350	September	*Pattenkolli* with OBE		Yohannan & Balasubramanian (*J. Mar. biol. Ass. India,* ***33*** (182): 246-254, 1991).
1988-'92	970	September	Ring net with OBE	18 mm	Yohannan & Sivadas (*MFIS* No. 119, p. 1-3, 1993).
1994-'96	1,328	August	"		Present study

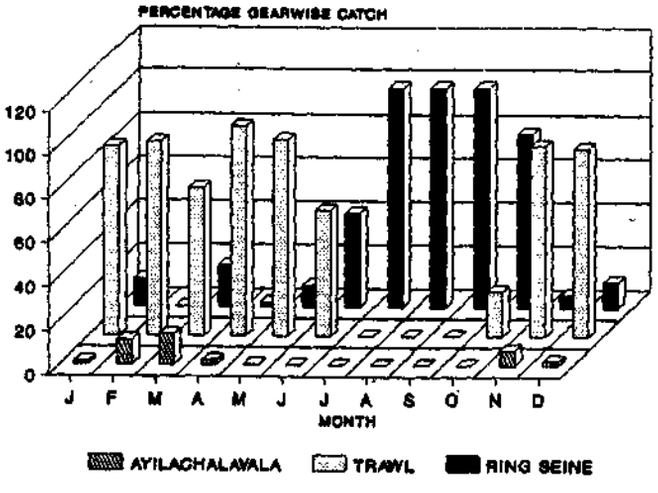

Fig 1. Average gearwise percentage catch in different months during 1994-'96

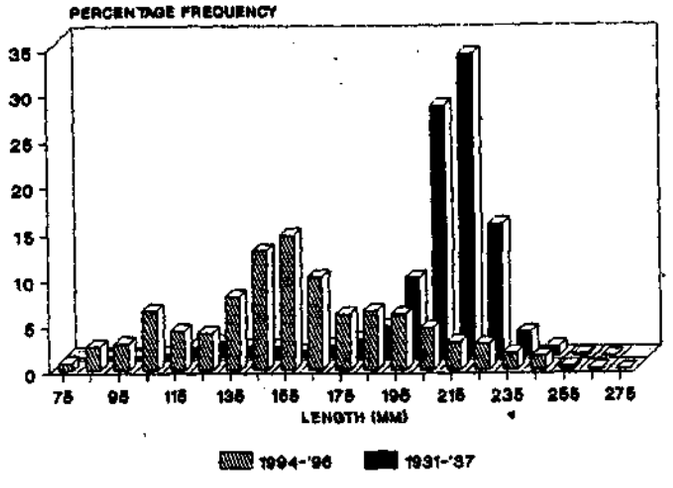

Fig. 2. Average length-frequency distribution in 1931-'37 and 1994-'96.

son and the mean length of the fish in the commercial catches decreases. Fig. 2 shows the percentage frequency of different length groups in the catches of 1931-'37 and 1994-'96. In the 1931-'37 period the peak catch was from 20-23 cm size group and mean length was 204.93 mm, whereas in 1994-'96 the dominant group was of the size from 13-16 cm, the mean size being 161.78 mm. The reason for this is evident from Fig. 3 in which the mean size of the fish caught during different months are given. In 1931-'37 the smallest size groups were caught in July. The size of the fish gradually increased from Jully and reached a peak by May, with minor ups and downs in between. In 1994-'96 period also, the smallest size group appeared in July, the mean size reaching a peak in January. From Fig. 4 it can be seen that the peak catches in 1931-'37 was in December-January when the mean size

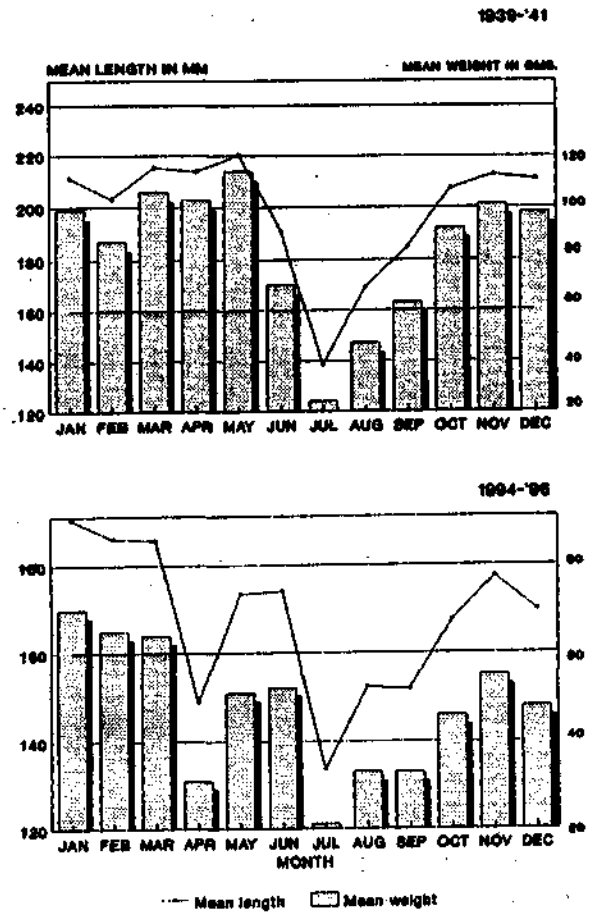

Fig. 3. Monthly mean length and weight of catch during 1931-'37 and 1994-'96.

was high. But in 1994-'96 the peak catches were in July-August when the mean size was very low. There is a gradual decline in mean size from January in 1994-'96 which is very sharp in April. The dips in the mean size in figure indicates the recruitments to the fishery. The major brood to the fishery was recruited in July in both the periods. The minor dips in the mean size from the gradual increase indicates that minor recruitments occurred in December, February and April of 1931-'37. But, in 1994-'96 recruitment is indicated in all those months as well as in September. The recruitments in this period seems more prominent, especially in April. It is perhaps not

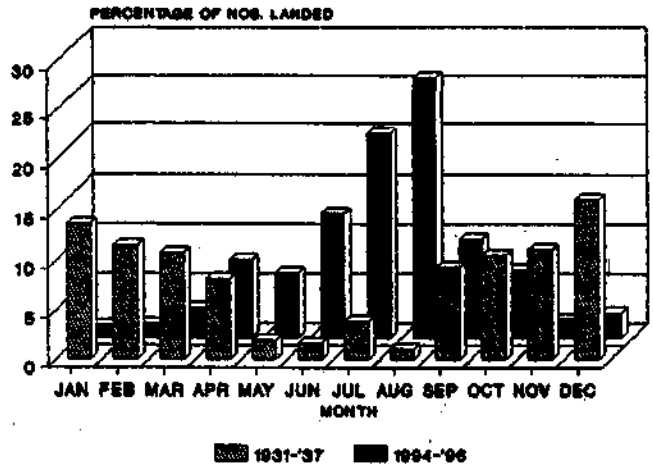

Fig. 4. The monthly percentage of catch in numbers during 1931-'37 and 1994-'96.

real but an illusion created by the increased exploitation of early juveniles due to the reduction of mesh size of the major gear employed and the increase in fishing activity during the monsoon. In 1939-'41 the major gear was boat seines with a mesh size of 35 mm at the mouth and wings avoiding the catch of smaller size groups. But in 1994-'96 major gear, ring seine, with a mesh size of 18-20 mm did not allow the escape of any small size groups. Fig. 3 also shows that in 1931-'37 the mean length and weight of the fish caught during the peak fishing period was above 200 mm and around 90 g respectively. In 1994-'96 the values came down to around 150 mm and 30 g respectively. Fig. 4 shows the monthly percentage contribution of the catch in numbers during 1931-'37. The figure shows that in 1931-'37 the fishery was active during October-March with peak catches in December-Jaunary, the period when large size groups dominate the fishery. But, in 1994-'96 the fishery was active in July-September period (monsoon months) especially in July-August when smaller size groups dominated the fishery and peak was very much prominent than in 1931-'37 period.

Summing up

The increasing efficiency of the mackerel

fishery by way of increasing size of the net and decreasing mesh size, increasing speed of the crafts, range of fishing operations and landing facilities do not seem to move in the right direction. These are used only for harvesting the stock early and fast. In the absence of proper management and the open access system the present motorised indegenous fishing fleet is bound to increase. The fall in catches after August is very sharp indicating an early decline of stocks available to the fishery. The present growth-over fishing can soon develop into recruitment overfishing and the stock would collapse. The monsoon fishery do not allow a large portion of the new recruits to grow beyond 16 cm when the size at the first maturity of the fish is above 20 cm.

In the past the rough monsoon season protected the new recruits from over-exploitation and allowed growth during its fast period. During the postmonsoon and summer, they had the protection of deeper depths. These refuges are now being violated. Observations indicated that the situation is same all along the Malabar area. The indications are ominous for the stock of the species that sustain the pelagic fishery of the area.

Acknowledgment

The first author is grateful to the Director, Central Marine Fisheries Research Institute, Cochin for granting him study leave during which period this work was carried out.

866 SHALLOW SEA BOTTOM FARMING : MULTICROP SYSTEM DEVELOPED AT VIZHINJAM *

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Introduction

Eventhough mariculture technology for various organisms like mussels, pearl oysters, lobsters and crabs has been developed during the last three decades by the CMFRI and several other institutions in India, there has been considerable practical difficulties for commercialising these programmes in Indian waters due to the rough weather conditions during the two monsoon periods as well as due to the non-availability of adequate protected bays along the Indian coasts. Mariculture technologies have been develoed by other countries, using floating structures like rafts and longline system. The rough weather condition is one of the major constraints to maintain such structures in our open sea. Considering these aspects the CMFRI has initiated a project in May 1995 at Vizhinjam for the development low cost technology for the farming of pearls and mussels. Accordingly the farming procedures were oriented to utilise shallow sea bottom, and new designs of cages which can suit to the bottom conditions were evolved so that the wave action at the surface level will not have much impact on the animals farmed in such cages.

Design and fabrication of high density stocking cages

The designs of the cages with various modifications were made by the senior author. Cages of 64 x 64 cm were fabricated with four shelves to accommodate 1,000 oysters in each shelf as a unit for high density farming. The design was made in such a way that individual unit of 64 x 64 cm was made using 10 mm M.S. rods with three supporting rods at a distance of 16 cm. The frames were covered allaround with nylon netting of required mesh size so that it was possible to stock oysters of different sizes at different stages of farming. A total of nine frames were assembled into a box type cage with four inner shelves. The oysters or other bivalves stocked in the cage were then installed at a site having favourable ecological conditions.

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The cage (Fig. 1, 2, & front cover photo) has the advantage of using for farming as well as fishing simultaneously by replacing the middle

Fig. 1. The pedestal cages operated at Vizhinjam with the stocked animals in high density.

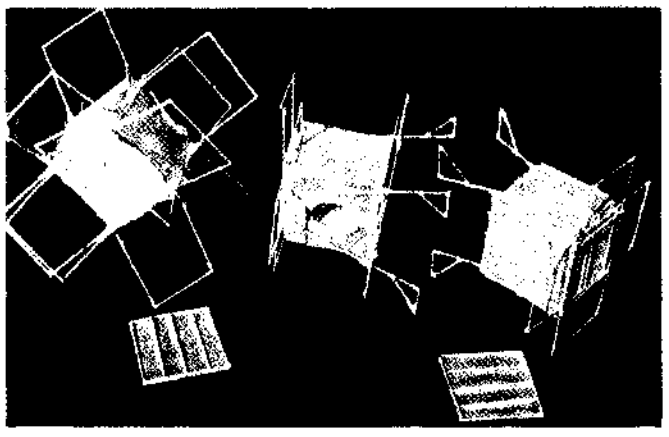

Fig. 2. The cages when remaining in the tilted condition (see the cages do not touch the bottom on any tilted position).

shelf with a lateral frame having a trap mouth to make "two-in-one" cage. (Fig. 3) Using those two-

Fig. 3. The two-in-one cage with trapmouth for fishing-cum-farming of oyster using the top and bottom shelves.

in-one cages it was possible to catch ornamental fishes, edible fishes, lobsters, mud crabs, and other marine organisms simultaneously while mussel or pearl oysters were stocked at the top and bottom shelves. These investigations are being carried out at Vizhinjam Bay near Trivandrum (Fig. 4 & 5).

To avoid the body of the cages touching the sea bottom and to prevent its organic decay by contact with bottom silt/sediments, proper pede-

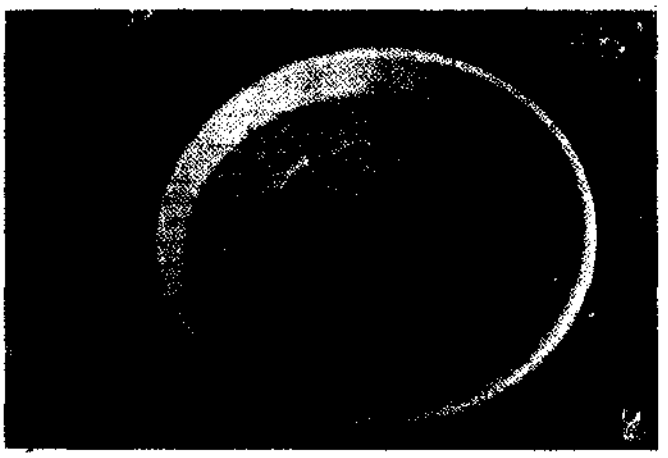

Fig. 4. Lion fish *Pterois* sp. caught in Two-in-one cage.

Fig. 5. Fishes caught in Two-in-one cage.

stals of 120 cm height with a resting space of 70 cm^2 were also fabricated using 2.5 cm M.S. rods in such a way that using two such pedestal frames the cages could be kept above the sea bottom without touching the ground (Fig.1).

However, there are possibilities of the cages tilting towards the sides due to irregular sea bottom or with wave action. However, adequate provi-

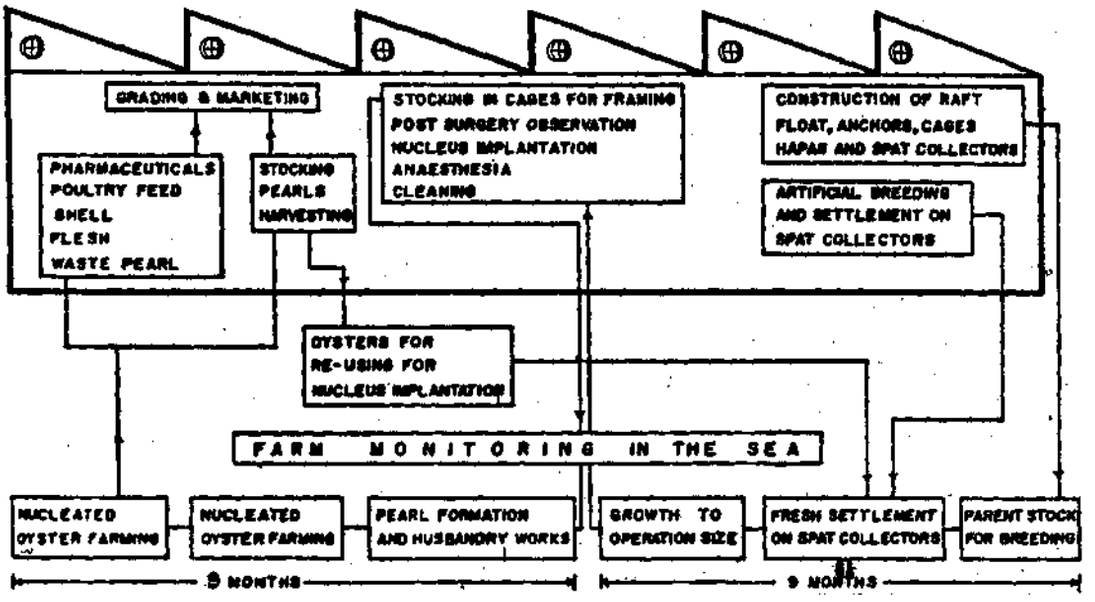

Fig. 6. Project on pearl culture (work-flow chart)

sions were given by providing extra frames at the top and bottom of the cages as shown in Fig. 2.

A prototype design without pedestals but with radial supporting frames was made in such away that if the cage was tilted in any angle, it did not touch the sea bottom. This design is currently undergoing trials at Vizhinjam. The designs described here are being patented.

These cages have been found to be highly useful for fattening lobsters, crabs and fishes and also for broodstock development, in addition to the regular farming-cum-fishing by providing additional lids for feeding. It has also been observed that by attaching nylon frills on the sides of the cages, these cages could act as spat collectors for pearl oysters and mussels and also act as fish attracting devices by providing adequate extra biomass as feed for the fishes.

The cages can be operated in shallow sea bottom from catamarans, canoes or boats by individual fisherman or by groups of fishermen using marker nylon ropes of adequate size and floats which can also be used for attaching nylon frills for attracting spats and thus to raise natural stock of pearl oyster seeds for large scale farming.

Suitable areas for farming and appropriate designs

The cages can be operated in shallow sea bottom with sandy or gravelly base as well as in lagoons of Lakshadweep and Andaman Islands, shallow areas of the Gulf of Mannar and Palk Bay region. The cages can be selected according to the depth, nature of sea bottom, currents and drifts of the area where farming is proposed to be taken up. Depending on the availability of seed, the size of the farm can be decided and accordingly the investment can be regulated.

Candidate species and farming procedure

The design of the cage is versatile and almost all marine candidate organisms suitable for farming can be grown depending on the habitat of the species. The cages could be used for fattening the juveniles of finfishes and shellfishes to marketable size by changing the mesh size of the cages and the feeding pattern of the cultivated species. It is also possible to grow most of the sedentary marine animals as well as free living ones using these cages.

Programme for marginal farmers and large scale pearl farming

The shallow sea bottom farming and the farming system using different types of cages presented here are relevant to multicrop systems as well as single species crops such as peral farming and/or mussel farming. The general methodology for any crop is the same for both marginal farmers as well as large farmers or for national programmes. Different managerial systems

would be required for large scale adoption of pearl farming, as given in the work flow chart.

a. Seed development and supply of oyster stock for implantation

Since pearl oyster is the raw material for pearl culture, adequate availability of oyster stock is to be ascertained by the organising agency before starting a major programme by adopting marginal or large scale farmers. It could be done through hatchery supply or through the supply of natural population in the natural farm. Proper training programmes for this purpose should be organised on a large scale.

b. Implantation of oysters and distribution to farmers

The trained persons can establish distribution centres for the supply of implanted oysters to the farmers. It can be a major source of income for the fishermen even without much sophisticated training. If each fisherman can start his own implantation centre depending on their personal experience, there will be wide variations in the output and the quality of pearls.

c. Husbandary work, harvest and marketing

By using the high density stocking cages as well as the two-in-one cages the fishermen farmers can collect nucleated oysters and farm them in the sea. Fouling organisms get attached on the surface of the oysters as well as on the cages and hence cleaning is essential or remove them in the case of high density stocking cages atleast once in a month. The cages are lifted, cleaned and put back into the sea. The cleaning work can be done by the members of the family of fishermen at no additional cost.

In the case of two-in-one cages since the farmer lifts the cages daily or atleast on alternate days for the collection of ornamental fishes, edible fishes, lobsters, crab etc. he can watch the intensity of fouling and attend to the cleaning work accordingly.

In the tropical conditions harvest of pearl is possible within 6 to 9 months after the implantation. So the farmer will have to maintain implanted oysters only for such a short period and the pearls can be extracted, washed in soap water and marketed directly or through an agency after sorting them into different grades. Already experiments have proved that the yield of high quality 'A' grade marketable pearls is 20 to 50 % and it is found that the economics of a unit system using high density stocking cages is very encouraging.

d. Unit system of high density stocking cages

A cage of 65 x 64 x 64 cm can hold 4,000 nucleated oysters. The details on the recurring expenses using a single cage is given in Table 1.

TABLE 1. *Recurring expenses for shallow sea bottom farming of pearls*

Particulars	Amount (Rs)
Cage with pedestal	1,060
Nylon net (2 kg)	505
Labour charges for netting	100
Nylon thread (0.5 kg)	60
Marker rope (15 m)	200
Float (1 no.)	250
Nylon frill (2 kg)	250
Cost of nucleated oysters (4,000 Nos)	16,000
Labour charges for cleaning (9 months)	1,575
Total	20,000

Total expense for fabricating the cage and launching it in the sea is Rs. 2,425/- and the cleaning charges for a single cage for nine spells is about Rs.1,575/- and including the total cost of nucleated oysters at the rate of Rs. 4/- per oyster, (Rs. 16,000/-) the total investment is Rs. 20,000/-. At the yielding rate of 25 % pearls the sale proceeds of 1,000 pearls at the rate of Rs. 50/- is Rs. 50,000/- and the net profit anticipated by the fishermen is Rs. 30,000/- as shown in the operational details in Table 2.

TABLE 2.Operational details for *low cost shallow sea bottom farming of pearls*

Particulars	Amount (Rs.)
Cost of pedestal cage, nucleated oysters * and farming expenses (Stocking density : 4,000 numbers, Duration of farming : 6-9 months Pearls production @ 25 % : 1,000 numbers),	20,000
Sale proceeds of 1,000 pearls	50,000
Net profit	30,000

(* cost of 4,000 nucleated pearl oysters = Rs 16,000 included).

Remarks

A General picture on the scope of adopting shallow water bottom farming of pearls by marginal fishermen farmers as well as by large farmers through a statewise or a national programme is dealt with in this account. We need take up this programme also for a multicrop system of farming-cum-fishing and farming-cum fattening of lobsters, crabs and fishes. The programme implementing agency has to make arrangements for seed development and supply of oysters, distribution of implanted oysters to the farmers and financial and technical support to the farmers for farming as well as marketing of pearls. The new designs of cages developed at Vizhinjam for shallow water farming could cut down the imputs on farming expenses to the minimum and it is hoped that the findings at Vizhinjam willl enable sea bottom farming on a large scale in the seas around India and elsewhere.

Acknowledgment

The authors are deeply indebted to Dr. M. Devaraj, Director, CMFRI for critically going through the manuscript and offering useful suggestions and for providing facilties to carry out this study at Vizhinjam and to Dr. K.K. Appukuttan, Head, Molluscan Fisheries Division and Dr. P.A. Thomas, for the continued support during this period of study.

867 The traditional and mechanised marine fishing units along Jamnagar and Rajkot districts, Gujarat

The coastal Jamnagar and Rajkot districts contribute a sizable share in the marine fish landings of Gujarat employing both traditional and mechanised fishing units of which the non-mechanised units comprise about 66 %. The trend in the number of non-mechanised fishing units of the two districts during the period 1987 to 1997 (Fig. 1) indicates that yearly an average of 1,000 units were operated. No drastic year to year fluctuations could be noted in the number of units, but the number was all time high in 1997.

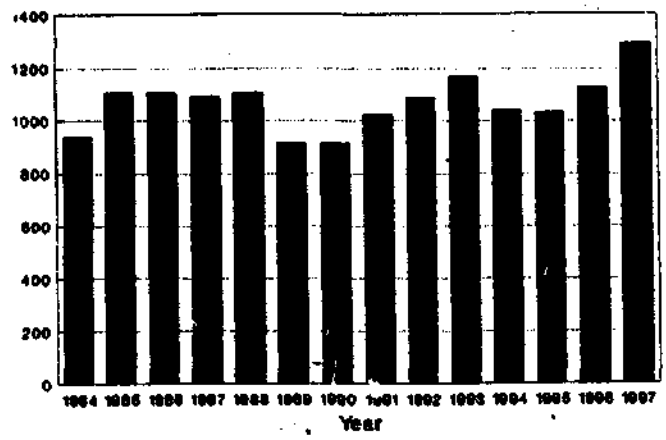

Fig. 1. Non-Mechanised units at Jamnagar and Rajkot Districts (1984-'97)

Remarkable year to year increase was noted in the case of mechanised units of the two districts during the same period (Fig. 2). More units were added especially from 1988. A total of 979 mechanised boats operated in 1997 along Jamnagar and Rajkot districts.

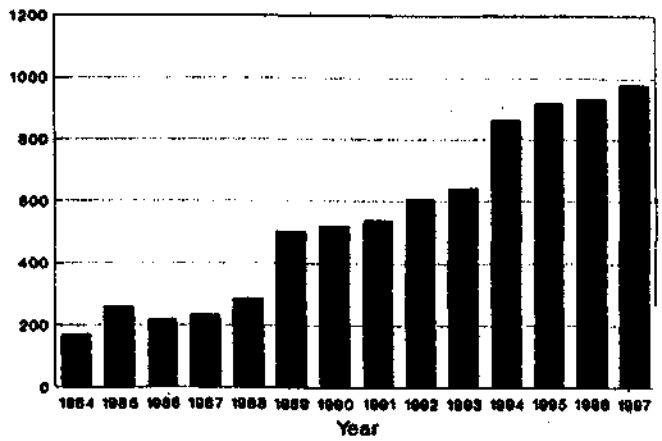

Fig. 2. Mechanised units at Jamnagar and Rajkot Districts (1984-'97)

Reported by B.V. Makadia, Jamnagar Field Centre of CMFRI, Jamnagar, India.

868 On the disposal of dried prawns *(Parapenaeopsis stylifera)* along Raigad District, Maharashtra

Along some southern centres of Raigad district, Maharashtra viz Shrivardhan, Bhardkol, Dighi, Rajpuri, Murud-Janjira, Nadgoan, Borli-Mandla, Korlai, Salavand Revdanda, there exists a traditional seasonal prawn fishery during August-December landed mainly by 'dol' netters and trawlers. Among the different species caught *Parapenaeopsis stylifera* contributed a major share with 160-175 kg per unit in 1996. Others included *Metapenaeus affinis, M. brevicornis* and *M. monoceros*.

The commercial agents who purchase prawns from the local fishermen during the season do not accept *P. stylifera* which counted less than 300 numbers per kg thus leaving behind considerable quantity of small sized prawns. But recently these prawns find a good market in dried condition.

The dried prawns of *P. stylifera* locally called *Soda-kolambi* is popular not only in nearby areas but at several places in Mumbai also. The local agents purchase the dried prawns at the wholesale price of Rs. 80-125 per kg and in turn sell them in markets at a retail price of Rs. 225-250 per kg. Murud-Janjira being a tourist spot, a brisk market of dried prawns has been observed from 1996. Hence the local fish merchants have concentrated their attention more on this thriving dry prawn market.

Reported by D.G. Jadhav, Janjiramurud Field Centre of CMFRI, Janjiramurud, Maharashtra, India

was sold at the rate of Rs. 7.50 per kg.

Reported by N. Burayya and Y.V.S. Suryanarayana, Kakinada Research Centre of CMFRI, Kakinada, India.

871 On the landing of a giant grouper at Paradeep and strandings of dead turtles along Paradeep and Puri coasts, Orissa

A giant grouper, *Epinephalus* lanceolatus (Bloch) *(Promicrops lanceolatus)* locally called 'Kaibaley' measuring 202 cm in total length was landed at Paradeep on 18-12-'97 by a trawler operated 12 km south of Paradeep (Fig.1). The fish with an approximate weight of 150 kg was sold for Rs. 400/-. Few morphometric measurements taken in cm on the specimen are given below.

Total length	–	202
Standard length	–	168
Head length	–	75.5
Body depth	–	68.0
Snout length	–	15.0
Length of upper jaw	–	33.5
Eye diameter	–	5.2
Pectoral fin length	–	36.0

Fig. 1. The giant groupers landed at Paradeep, Orissa.

Three dead olive ridely turtles, *Leipidochelys olivacea* locally known as 'Kaincha were stranded during December '97 along Puri and Paradeep coasts the particulars of which are given below.

Date of stranding	Place	Carapace length (cm)	Carapace width (cm)
11-12-'97	Puri north	64	56
17-12-'97	Paradeep	64	57
19-12-'97	Paradeep	65	55

Reported by Sukdev Bar, Puri Field Centre of CMFRI, Puri-752 002.

864 गुजरात में आनाय मत्स्यन की आर्थिक वहनीयता और प्रबन्धन

डी. बी. एस. सेहरा

केन्द्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान, कोचिन – 682 014

भारत में मछली उत्पादन करनेवाले समुद्रवर्ती राज्यों में सब से प्रमुख है गुजरात । लगभग 1600 कि मी का लंबा तट और 1.65 लाख वर्ग कि मी की महाद्वीपीय शेल्फ से युक्त गुजरात में 2 लाख वर्ग कि मी से अधिक अनन्य आर्थिक मेखला भी है । यहाँ के दस तटीय जिलाओं में जुनागढ़, अमरेली, जामनगर, वल्साद और कच मछली उत्पादन की दृष्टि से प्रमुख हैं ।

गुजरात में करीब 210 मत्स्यन गाँव और उतने ही अवतरण केन्द्र भी है । भारत के कुल मछली उत्पादन (लगभग 4.8 मिलियन टन) के 15% गुजरात से होता है । आज इस राज्य का समुद्री मछली उत्पादन 6 लाख टन से भी अधिक है, जो समुद्री और अंतःस्थलीय सेक्टरों से प्राप्त कुल उत्पादन के 90% तक है । समुद्री मछली उत्पादन के 94% यंत्रीकृत और मोटोरीकृत सेक्टरों से उपलब्ध होता है । गुजरात में समुद्री पख मछली और कवच प्राणियों की 300 जाति उपलब्ध है । बम्बिल, पॉम्फ्रेट, सुरमई, क्रोकेर्स, सुरा, *कोयिलिया,* शिंगटी, चिंगट और फीतामीन प्रमुख समुद्री मछली संपदाएं है ।

करीब 22,600 मत्स्यन नाव गुजरात तट में मात्स्यिकी सेक्टार में मत्स्यन करते है । इनमें 25%

A dead male loggerhead turtle, *Caretta caretta* with the carapace length of 70 cm and width of 62 cm was stranded at Digha beach on 7-3-'98 (Fig. 2) and the specimen weighed about 75 kg.

Reported by Swapan Kumar Kar, Contai Field Centre of CMFRI, Contai - 721 401, India

869 On a whale shark landed and a turtle stranded at Digha, Midnapur districts, West Bengal

A whale shark, *Rhiniodon typus* measuring 6.07 m in total length caught by a trawler was landed at Digha Mohana Centre on 8-2-'98 (Fig. 1). The shark with an approximate weight of 400 kg was sold for Rs.2,800.

Fig. 1. The whale shark landed at Digha West Bengal.

Fig. 2. The loggerhead turtle landed at Digha, West Bengal.

870 On the rare occurrence of *Elagatis bipinnulata* off Kakinada coast

Elagatis bipinnulata commonly called rainbow runners of the family Carangidae is a fish species found usually at or near the surface over reefs or sometimes far offshore in the Indian waters. They are caught occasionaly by hooks and line and gill nets. These fishes are reported to attain a maximum length of 120 cm with a weight of 9.5 kg. Biological information on this species along the Indian coast is lacking.

An exclusive catch of 437 specimens of the fish weighing 128 kg caught in a pelagic gill net *(Naravala)* with 6 cm mesh size was landed at the Kakinada Fisheries Harbour on 6.2.1998. The fish, not common along the Andhra coast were caught off Uppada at a depth of 16 m about 12 km away from the Kakinada Fisheries Harbour towards the northeastern side.

All the fishes caught were juveniles characterised with an elongate almost fusiform body (Fig.1). The

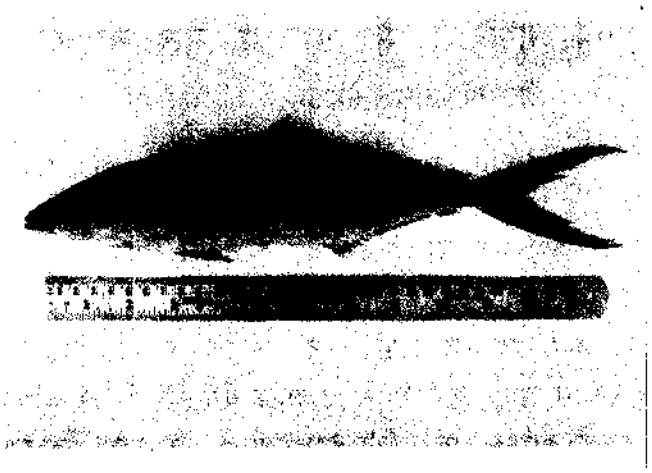

Fig. 1. *Elagatis bipinnulata* landed at Kakinada Fisheries Harbour.

anal fin possessed 2 spines with detached two rayed finlet. Caudal peduncle was devoid of scutes. Colour was dark-olive blue above and white below. Fins were dark with olive or yellowish tint. The length of fishes ranged between 32 and 42 cm with dominant size groups at 35-40 cm. The total catch weighted about 128 kg and

was sold at the rate of Rs. 7.50 per kg.

Reported by N. Burayya and Y.V.S. Suryanarayana, Kakinada Research Centre of CMFRI, Kakinada, India.

871 On the landing of a giant grouper at Paradeep and strandings of dead turtles along Paradeep and Puri coasts, Orissa

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करीब 22,600 मत्स्यन नाव गुजरात तट में मात्स्यिकी सेक्टर में मत्स्यन करते है । इनमें 25%

आनाय, 14% गिलजाल, 20% मोटोरीकृत क्राफ्ट, 3% यंत्रीकृत और 38% अयंत्रीकृत क्राफ्ट है । माध्य और छोटे आयाम के आनाय 80 मी गहराई में मत्स्यन करते है । आनायों का पकड श्रम बढाने पर भी मछली पकड कम होती जा रही है , जिसका कारण इन एककों की बढती और छोटी जालाक्षि के आनाय जालों का प्रयोग है । पकड कम हो जाने पर भी मछलियों की बढती दाम, प्रचालन जारी करने और यंत्रीकृत एककों के खरीद करने केलिए मछुआरों को लालायित करते है ।

अन्य एककों की तुलना में आनायों के प्रचालन से लाभ ज्यादा मिलता है । यह भी नहीं एक आनाय में निवेश अधिक होता है । आनायों की बढती का बुरा प्रभाव संपदाओं में ज़रूर पडेगा । इसलिए इन एककों पर ठीक निवेश केलिए आनायों की लागत और आय पर एक अध्ययन अनिवार्य है । वर्तमान अध्ययन इस लक्ष्य के साथ किया गया है और इन एककों के न्यायपूर्ण प्रचालन केलिए कुछ सुझाव भी प्रस्तुत करने का प्रयास किया गया है ।

गुजरात में आनायों द्वारा मछली अवतरण

आनायों की संख्या में हुई बढती के साथ साथ कुल मछली उत्पादन में उनके योगदान भी बढ गया। 1994-95 के दौरान यह 65% तक बढ गया । लेकिन प्रति एकक पकड कम हो गया ।

गुजरात में अच्छी मात्रा में मिलनेवाली कई गुणतायुक्त मछलियाँ उपलब्ध है । इनमें कुछेक हैं चिंगट, क्रोकेर्स और फीतामीन । इसके अलावा उपास्थिमीन, क्लूपिड्स, पेर्चेस, सोल्स, पेनिआइड झींगे, नॉन-पेनिआइड झींगे, अन्य कवच प्राणियाँ, सेफालोपोड्स और अन्य मछलियाँ भी प्राप्त होती हैं । सौराष्ट्र तट में हाल के वर्षों में यंत्रीकृत नावों और आनायों की संख्या में बढती देखी थी । कुल 9000 यंत्रीकृत नावों में 39% आनाय थे और कुल पकड का 64% आनायों का उत्पादन था। अतः एककों की संख्या और योगदान में आनाय आगे है ।

जीविका चलाने के मार्ग से मत्स्यन का कार्य वाणिज्यिक उद्योग बन जाने पर और इस उद्योग चलाने केलिए सहायिकी मिल जाने पर सौराष्ट्र तट में अधिक लाभदायी यान, माने यंत्रीकृत एकक आनायों की संख्या बढने लगी । अपरंपरागत क्षेत्रों और 70-80 मी तक की गहराई में विदोहन करने पर भी इन आनायों की प्रति एकक पकड में वांछित वृद्धि नहीं हुई ।

आनायों केलिए निवेश और वार्षिक अनुरक्षण लागत

सौराष्ट्र में परंपरागत और आधुनिक डिस्को बोटों का प्रचालन होता है । कोड अग्र में जालाक्षि का आकार 8 मि मी और जाल मुँह में 150 मि मी है । यानों का निर्माण 12 से 17 मी लंबाई और 3 से 5 मी चैडाई और 2 से 3 मी घनत्व के काठ से किया जाता है। 58 से 110 एच. पी इंजनों का उपयोग करता है ।

एक आनाय एकक का निवेश 9.7 लाख रु. है। माने बोट केलिए 5 लाख रु, इंजन केलिए 2.8 लाख रु., बडे और छोटे उपकरणों केलिए 1.4 लाख रु और गिअर केलिए 0.50 लाख रु. । एक साल केलिए आकलित मूल्य ह्रास 1,47,998 रु. है । अन्य संघटक जैसे मरम्मत व अनुरक्षण, बीमा, मूलधन को जोडकर कुल 2,12,500 रु. लागत के रूप में आकलित करने पर कुल वार्षिक नियत लागत 3,60,498 रु. निकला ।

प्रचालन व्यय और आय

सौराष्ट्र में प्रायः मानसूनोत्तर मौसम में मत्स्यन होता है । 30-40 मी गहराई में रोज़ मत्स्यन कार्य होता है तो 60-80 मी गहराई में मत्स्यन केलिए 6-8 दिवस लगना पडता है । एक आनाय में 6-7 श्रमिक होते हैं । एक आनाय का आकलित प्रचालन व्यय 5,61,374 रु. है । प्रति एकक का प्रतिशत लाभ 25 है वैसे 4 वर्षों में एक उद्यमी अपना निवेश वापस लिया जा सकता है।

आय-व्यय के अध्ययन से स्पष्ट होता है कि आय की स्थिती आशावह है । यह भी स्पष्ट हुआ कि श्रम बढाने पर पकड कम मिला है फिर भी मछली की बढती माँग के कारण दाम बढाने से कम पकड मिलने पर भी

आनाय मत्स्यन लाभप्रद था । इस कारण से गुजरात में आगामी वर्षों में ट्रोलरों की संख्या बढने की साध्यता है। पर उपतटीय क्षेत्र में मत्स्यन बढाना संपदाओं की सुरक्षा केलिए उचित नहीं है कि यहाँ की आकलित शक्य प्राप्ति के निकट पकड पहूँच गई है । यंत्रीकृत मत्स्यन के आरंभकाल में सरकार ने इसके प्रोत्साहन करते हुए कई प्रकार की सहायिकी शुरू की थी पर वर्तमान अवस्था यह सूचित करता है कि छोटी जालाक्षि के जालों और शक्तिशाली इंजनों के प्रयोग के कारण तटीय क्षेत्रों की मात्स्यिकी का अतिविदोहन हो रहा है जो भविष्य में समाज-आर्थिक पहलुएं उत्पन्न करेंगे माने पकड कम हो जाने पर उद्यमकर्ता कर्ज पर ली गई पूँजी वापस करने में असमर्थ हो जायेंगे । दूसरी बात यह है कि आनायकों के वाणिज्यिक मत्स्यन तटीय मेखला की मात्स्यिकी संपदा को खतरे में डालते है । इस पर सरकारी तौर पर कुछ नियन्त्रण लाना अनिवार्य होगा, नहीं तो औद्योगिक मत्स्यन और परंपरागत मत्स्यन करनेवालों के बीच की खाइयां बढ जाएगी ।

865 मलबार की बाँगडा मात्स्यिकी की पकड में परिवर्तन प्रवणता

श्री टी एम योहन्नान

सी एम एफ आर आई का कालिकट अनुसंधान केन्द्र, कालिकट

श्री यू. सी. अब्दुरहिमान

प्राणि विज्ञान विभाग, कालिकट विश्वविद्यालय, केरल

भूमिका

मलबार तट की बाँगडा मात्स्यिकी की पकड में पिछले चार दशकों के दौरान कई परिवर्तन दिखाये पडे हैं । यदि पकडने की रीतियाँ शुरुआत में अक्षम थी तो 1980 के दशक में जालों और यानों में लाये गये उन्नयन ने मछली संग्रहण में प्रतिकूल प्रभाव डाला जिसका अध्ययन इस लेख में किया गया है ।

यान

वर्ष 1984 तक यहाँ डांगियों (डग आउट कानास) के ज़रिए बाँगडों का मत्स्यन किया करता था । ये डांगियाँ चप्पु से चलानेवाले थे जिसके कारण मछुओं का ज्यादा तकलीफ होता था । परिणामस्वरूप 1984 के बाद इनका मोटोरीकरण किया गया । 1987 होते ही सारे देशी यानों का मोटोरीकरण हुआ था । डांगियों के निर्माण काठ से होता है । काठ कीमती हो जाने पर फलक निर्मित बोटों का उपयोग करने लगा पर ये बलिष्ठ न होने के कारण बाद में इनमें फाइबरग्लास से आवरण करने लगा ।

वर्ष 1988 में वलय संपाशों (रिंग सीन्स) का प्रयोग होने लगा । इस जाल के परिचालन केलिए 'केट्टुवल्लम' का उपयोग किया जिसका परिचालन 25 से 40 अ. श के इंजनों और 25 से अधिक श्रमिक दलों द्वारा होता था । पर प्रश्न तब भी था कि पकड को लाने में इस में जगह की कमी थी । इसलिए मत्स्यन के दौरान एक वाहक बोट भी ले जाने लगा।

संभार

1960 के पहले कप्पास और भाँग के रेशे से बनाये 'अयिलक्कोल्लि', 'अयिलच्चालावला' का इस्तेमाल होता था। 1960 के बाद जब जाल निर्माण में नाइलॉन का उपयोग शुरु हुआ उपर्युक्त दोनों जालों का निर्माण नाइलॉन से करने लगा और 1988 में जब वलय संपाश का उपयोग शुरु हुआ तो इसका प्रयोग चलता रहा ।

पूँजी निवेश

बाँगडा मत्स्यन में निवेश ज्यादा करना पडता था । उदाहरणार्थ 'पत्तेनकोल्ली एकक' का निवेश, 1,00,000/- रु 'अयलिच्चालावला' का 60,000 रु, 'वलय संपाश' का 5,50,000 रु. और नवीनतम वलयसंपाश का

7,17,000 रु. आकलित है ।

अन्य सुविधाएं

मत्स्यन पत्तन न्यास और जेट्टियों में अन्य सुविधाएं उपलब्ध थे ।

ट्राल मत्स्यन

यहाँ 1990 के शुरुआत में ट्राल मत्स्यन करने लगा। 35 मी से अधिक गहराई से ट्राल के ज़रिए बाँगडा ज्यादा मिलने लगा।

परिणाम

वर्ष 1931 से लेकर 96 तक की अवधि में मलबार की बाँगडा पकड में दिखाया पडा उतार-चढाव नीचे की सारणी में दिखाया है ।

के दौरान मिली पर छोटी मछलियाँ भी पाने लगी । जब 1931-37 के दौरान के उच्चतम पकड में मिली मछलियाँ 20-23 से मी आकार वर्ग की, और निम्नतम आकार 204.93 मि मी की थी, तब 94-96 की मछलियाँ 13-16 से मी और निम्नतम आकार 161.78 मि मी की थी। मछलियों के आकार में कमी का मूल कारण जालाक्षि में लाया गया परिवर्तन मान लिया जाना पडेगा क्यों । कि 1994-96 के जुलाई-अगस्त महीनों के दौरान सबसे अधिक पकड मिलते हुए भी मछलियाँ आकार में छोटी थी माने जालाक्षियों का आकार 35 मि मी से 18-20 मि मी अब बन पडा है जिसके कारण छोटी सी छोटी मछली भी पकडी जाती है । स्वाभाविक है आकार के साथ भार भी कम हो जाना वैसे 1931-37 के दौरान मिली 200 मि मी लंबाई की मछली का भार 90 ग्रा

अवधि	वार्षिक औसत पकड (टन में)	उच्चतम पकड मिला महीना	प्रमुख संभार	जालाक्षियों का आकार	श्रोत
1931-37	1042	जनवरी	अयिलाक्कोल्ली	35 मि मी	मद्रास फिशरिस बुलेटिन
1957-60	985	दिसंबर	-वही-	-वही-	इंडियन जर्नल ऑफ फिशरीस, 1962
1965-67	339	अक्तूबर	पत्तनकोल्ली	23 मि मी	-वही- 1973
1984-88	350	सितंबर	बाहरी इंजनयुक्त पत्तनकोल्ली	23 मि मी	-वही- 1991
1988-92	970	-वही-	बाहरी इंजनयुक्त वलयसंपाश	18 मि मी	एम एफ आइ एस - 1993
1994-96	1328	अगस्त	-वही-	18 मि मी	वर्तमान अध्ययन

उपर्युक्त सारणी से स्पष्ट होता है कि नई और क्षमतायुक्त मत्स्यन यानों और गिअरों का उपयोग करने के बावजूद भी परंपरागत पकड रीतियों की तुलना में पकड में वांछित वृद्धि नहीं हुई है । यदि वृद्धि हुई भी तो प्रचालन लागत की तुलना करने पर आय नगण्य है।

मछलियों के आकार वर्ग

अधिक क्षमतावाले मत्स्यन यानों व गिअरों के इस्तेमाल करने पर अधिक मछलियों की पकड मानसून था तो 1994-96 के दौरान मिली 150 मि मी लंबाई की मछली का भार सिर्फ 30 ग्राम था। इससे स्पष्ट होता है कि छोटी जालाक्षियों के ज़रिए मत्स्यन यानों का गतिवेग व परिचालन संख्या बढाने से सिर्फ छोटी मछलियों को पकडा जा सका है। नये मत्स्यन तरीकों के ज़रिए प्रतिकूल मौसम में भी पूर्णत: न बढी गई मछलियों का विदोहन होने से आगामी दिनों में यहाँ की बाँगडा मछली संपदा में कमी होने की संभावना है ।

866 उथला समुद्र तल कृषि : विषिंजम में विकसित बहु फसल प्रणाली

जी. पी. कुमारस्वामी आचारी, जोसेफ आन्ड्रूस और के.टी. तोमस

सी एम एफ आर आइ का विषिंजम अनुसंधान केन्द्र, विषिंजम, तिरुवनन्तपुरम

सी एम एफ आर आइ और भारत के कई अन्य संस्थाओं द्वारा पहले ही शंबु, मुक्ता शुक्ति, महाचिंगट, कर्कट आदि विभिन्न जीवों की समुद्र कृषि तकनोलजी का विकास किया गया है । पर यहाँ के मानसून और भारतीय तटों में संरक्षित खाडियों के अभाव इन तकनोलजियों के कार्यान्वयन में बाधा डालती है । प्रक्षुब्ध मौसम के कारण यहाँ खुले समुद्र में विदेशों में विकसित रैफ्ट और लंबी डोरों का प्रयोग करना मुश्किल है । इन पहलुओं पर विचार करके सी एम एफ आर आइ ने शुक्ति, शंबु आदि की कृषि केलिए मई, 1995 में विषिंजम में अल्प लागत तकनोलजी के विकास केलिए एक परियोजना का आरंभ किया । तदनुसार पालन उथला समुद्र जल में किये जाने का और इसकेलिए तलीय स्थिति को सहन किये जा सकनेवाले नए पंजरों का उपयोग करने का निश्चय किया ताकि ऊपरितल के तरंगों का प्रभाव पंजरों के जीवों पर न पड जाए ।

उच्च घनत्व संभरण के पंजरों की अभिकल्पना और संविरचना

पंजरों की अभिकल्पना श्री जी.पी.के. आचारी द्वारा किया गया है । 64 से मी × 64 से मी × 64 से मी पंजरों में 4 शेल्फ की संविरचना की गई है । प्रत्येक शेल्फ में 1000 शुक्तियों केलिए जगह है । 64 से मी × 64 से मी × 64 से मी एककों को 10 मि मी एम एम रोड से बनाया जा सकता है और 16 से मी दूर पर तीन आधार दंड भी है । इन फ्रेमों को आवश्यक जालाक्षि आयाम के नाइलॉन जाल से ओढ लेते है । इसलिए विभिन्न आयाम और पालन की विविध अवस्थाओं के शुक्तियों को इस में स्टॉक किया जा सकता है । पेटी के समान के एक पंजर में कुल नौ फ्रेम्स होते है। शुक्ति या अन्य द्विकपाटियों को इन पंजरों में संभरित करके अनुकूल पारिस्थितिक स्थितियोंवाले स्थान में रखते है ।

इन पंजरों की अभिकल्पना की विशेषता यह है कि इसके ज़रिए पालन एवं मत्स्यन एक साथ संभव है। इसकेलिए माध्य भाग के शेल्फ को ट्रापमाउथवाले एक पार्श्व फ्रेम से प्रतिस्थापित करना है । इन टू-इन-वन पंजरों से आलंकारिक मछली, खाद्य मछली, महाचिंगट, कर्कट, समुद्री ककडी और अन्य समुद्री जीवों को पकडे जाते है, जब शंबु या मुक्ता शुक्तियों को ऊपर या तलीय शेल्फों में रखे जाते है । तिरुवनन्तपुरम के निकट स्थित विषिंज़म खाडी में ये परीक्षण हो रहे हैं ।

पंजर और समुद्र जल के संपर्क रोकने और तलीय गाद, तलछट आदि से होनेवाले ज़ैवक्षय रोकने केलिए 2.5 से मी एम. एम. रोड से बनाये गये 70 से मी^{2} के रेस्टिंग स्पेस के साथ 120 से मी ऊँचाई के पेडेस्टल लगा दिया जाता है ।

यद्यपि, अनियमित समुद्र तल और तरंगों के प्रभाव से किनारे की ओर पंजरों का सिसक जाने की संभावनाएं है । ऐसी स्थिति से बचाने केलिए पंजरों का निर्माण अतिरिक्त फ्रेमों के साथ किया जाता है ।

पेडेस्टल के स्थान पर चारों तरफ फ्रेमवाला पंजर डिज़ाइन किया है जिसका गुण यह है कि पंजर किसी भी दिशा में बदल जाने पर भी पंजर और इसमें संभरित जीव समुद्र तल का स्पर्श नहीं करते है ।

महाचिंगट, कर्कट और मछलियों के पालन, ब्रूड स्टाक विकास आदि काम भी कृषि एंव मत्स्यन के अतिरिक्त इन पंजरों द्वारा किया जा सकता है । यह भी देखा गया है कि पंजरों के पार्श्वों में नाइलॉन फ्रिल्लस लगाने से शुक्ति और शंबुओं के स्पाटों का संग्रहण भी किया जा सकता है और जीवमात्रा के इकट्ठाव इस पर होने से मछलियाँ भी फॅस जाती है ।

इन पंजरों का प्रचालन उथला समुद्रतल से

कटामरीनों, कैनोस और नावों से एक मछुआ या मछुआरों द्वारा पर्याप्त आयाम और प्लवकों के मार्कर नाइलॉन रस्सियों के ज़रिए किया जा सकता है । इसमें नाइलॉन फ़िल्स भी लगाया जा सकता है जो स्पाटों को आकर्षित करता है ।

कृषि केलिए अनुयोज्य क्षेत्र और समुचित अभिकल्पना

इन पंजरों का प्रचालन रेतीला या ककंरीला उथला समुद्र तल में और लक्षद्वीप और आन्डमान द्वीप, मान्नार की खाडी के उथला क्षेत्र और पाक खाडी क्षेत्र में किया जा सकता है । समुद्र तल का स्वभाव, गहराई, प्रवाह आदि के अनुसार अनुरूप डिजाइन के पेजरों का उपयोग किया जा सकता है ।

बीज की उपलब्धता के अनुसार फार्म का निर्णय व विस्तार किया जा सकता है और तदनुसार निवेश भी नियमित किया जा सकता है ।

जाति चयन और पालन रीति

पंजर की अभिकल्पना बहुमुखी होती है । लगभग सभी समुद्र जीवों का पालन, जिनकी आवास व्यवस्था पालन केलिए अनुकूल है इन पंजरों में किया जा सकता है । मछली, फिनफिश और कवचप्राणियों को विपणन योग्य आयाम तक बढाने में इन पंजरों का उपयोग किया जा सकता है ।

मामूली कृषकों केलिए और बडे पैमाने की शुक्ति कृषि केलिए कार्यक्रम

उथला समुद्र जल कृषि और विभिन्न पंजरों के ज़रिए यहाँ व्यक्त की गई कृषि रीतियाँ विभिन्न समुद्री जातियों के पालन केलिए अनुयोज्य है । चाहे मामूली कृषक, बडे पैमाने के कृषक या राष्ट्रीय कार्यक्रम हो कृषि की तरीका सामान्य या एक ही है । इतना अंतर है कि बडे पैमाने की शुक्ति कृषि स्वीकार करने केलिए प्रबन्धकीय प्रणाली की आवश्यकता है ।

क) रोपण केलिए शुक्तियों की आपूर्ति

मोती कृषि केलिए मुक्ता शुक्तियों की पर्याप्त उपलब्धि होनी चाहिए । अतः मामूली या बडे पैमाने के कृषकों द्वारा कृषि प्रारंभ करने से पहले शुक्तियों की आपूर्ति केलिए संगठक अभिकरण को कुछ प्रबन्ध करना चाहिए ।

ख) शुक्तियों का रोपण और वितरण

प्रशिक्षित व्यक्तियों द्वारा शुक्तियों का वितरण केन्द्र चलाये जाए तो कृषक आसानी से कृषि शुरू कर सकते है । यदि प्रत्येक कृषक अपने वैयक्तिक अनुभवों के आधार पर अपना अपना रोपण केन्द्र शुरु किये जाए तो निवेश और मोती की गुणता में विविधता होगी ।

ग) कृषि, संग्रहण और विपणन

उच्च सान्द्रता के कारण संभरण पंजरों एवं टू-इन-वन पंजरों में रोपित शुक्तियों का संग्रहण करके उनको समुद्र में पालन किया जा सकता है । शुक्तियों के ऊपर और उच्च सांद्रता के संभरण पंजरों में दूषणकारी जीवों की बस्ती होने के कारण महीने में एक बार पंजरों को साफ करना अनिवार्य है । इसकेलिए पंजरों को बाहर उठाकर साफ करके वापस समुद्र में रखते है ।

टू-इन-वन पंजरों को आलंकारिक मछली, खाद्य मछली, महाचिंगट, कर्कट आदि के संग्रहण केलिए रोज़ उठाने के कारण इसकी सफाई करना आसान है ।

उष्णकटिबंधीय स्थितियों में मोतियों का संग्रहण रोपण के छे से नौ महीनों में किया जा सकता है । ऐसे रोपित शुक्तियों से मोती निकालकर, साबुन से साफ करके विभिन्न ग्रेडों में वर्गीकृत करके विपणन किया जा सकता है । परीक्षणों से यह साबित हो गया है कि 20% से 50 % तक 'ए' ग्रेड के विपणनयोग्य मोती प्राप्त होते है और उच्च सान्द्रता के संभरण पंजरों की आर्थिक शक्यता बहुत प्रोत्साहजनक है ।

उच्च सान्द्रता के संभरण पंजरों की आय स्थिति

64 से मी × 64 से मी × 64 से मी के पंजर में 4000 केंद्रकरोपित (न्यूक्लियेटड) शुक्तियों का पालन किया जा सकता है । एक पंजर बनाने और समुद्र में लंगर करने केलिए कुल लागत 2425/- रु होती है ।

एक पंजर की सफाई व नौ प्रचालन केलिए लगभग 1575/- रु खर्च करना पडता है । एक केन्द्रक रोपित शुक्ति को 4/- रु की दर में (16,000/रु) शुक्ति पालन केलिए कुल लागत 20,000/- रु आकलित किया गया है । 25% मोती मिल जाये तो 1000 मोती को 50/- रु की दर में क्रय आय 50,000/- रु आकलित किया। इसप्रकार एक मछुआ द्वारा प्रत्याशित निविल लाभ 30,000/- रु है ।

चर्चा

मामूली और बेडे पैमाने के कृषकों द्वारा पालन केलिए उथला समुद्र पालन स्वीकार करने के बारे में यहाँ व्यक्त किया गया है । मोती पालन के साथ ही साथ बहुविध मछली पालन, महाचिंगट, कर्कट और मछलियों को पालकर बढाने (फाट्टेनिंग) केलिए भी इन पंजरों का उपयोग करना चाहिए ।

बीजों का विकास, शुक्तियों की आपूर्ति, रोपित शुक्तियों का वितरण और कृषकों को मोती पालन और मोत्तियों के वितरण केलिए आवश्यक वित्तीय और तकनीकी सहायता कार्यान्वयन अभिकरणों द्वारा देना चाहिए। उथला जल कृषि केलिए विषिजम में विकसित किये पंजरें, पालन खर्च कम करने में सक्षम है । आशा की जाती है कि विषिजम में विकसित यह तरीका भारत और अन्य देशों में समुद्र तल पालन केलिए अनुयोज्य सिद्ध होगा ।

867 गुजरात के जामनगर और राजकोट जिलाओं के परंपरागत और यंत्रीकृत समुद्री मत्स्यन एकक

गुजरात के समुद्री मछली अवतरण में जामनगर और राजकोट जिलायें परंपरागत और यंत्रीकृत मत्स्यन एककों के ज़रिए मत्स्यन में अच्छा योगदान प्रदान करते रहते है । इन दो सेक्टरों के कुल समुद्री मत्स्यन एककों में 66% अयंत्रीकृत एकक है । 1987 से 1997 तक की अवधि में औसत 1000 अयंत्रीकृत एककों का प्रचालन होते हुए देखा । इस अवधि में एककों की संख्या में कहने योग्य उतार-चढाव नहीं हुआ था, लेकिन 1997 में एककों की संख्या उच्च थी ।

यंत्रीकृत एककों की संख्या में इस अवधि में काफी बढती देखी गयी थी । 1988 से अधिकाधिक एककों को जोडी गयी थी। 1997 में जामनगर और राजकोट जिलाओं से कुल 979 यंत्रीकृत नावों का प्रचालन हुआ था ।

सी एम एफ आर आइ के जामनगर क्षेत्र केन्द्र, जामनगर के बी. बी. मक्काडिया की रिपोर्ट

868 महाराष्ट्र के रेयगाड जिले से सूखे झींगे *(पारापेनियोप्सिस स्टाइलिफेरा)*

महाराष्ट्र के रेयगाड जिले के श्रीवर्धन, बारडकोल, डिगी, राजपूरी, मूरड-जंजिरा, नाड्गोन, बोरली-मण्डला, सालवन्द रेवडान्डा आदि दक्षिण केन्द्रों में अगस्त-दिसंबर की अवधि में डॉल नेट और ट्रालरों के ज़रिए झींगे पकडे जाते है। 1996 में पकडे गये झींगों में *पारापेनियोप्सिस स्टाइलिफेरा* प्रमुख था । इसके अलावा *मेटापोनियोप्सिक अफिनिस, एस. बवियोरमिस* और *एम. मोनोसिरोस* भी पकडे हुए थे ।

स्थानीय बाज़ारों में छोटे आयाम के होने के कारण *पी. स्टाइलिफेरा* की माँग कम थी । लेकिन आज सूखी हुई स्थिति में इसकी मॉग बहुत अधिक बढ गयी है ।

सोडा कोलाम्बी नाम से जाननेवाले *पी. स्टाइलिफेरा* के सूखे झींगे मुम्बाइ में भी मशहूर हो गये है । स्थानीय विपणनकर्ता इसे 80-125/- रु के थोक दाम पर खरीदकर प्रति कि ग्रा 225-250/- रु. में बेचते है । मुरड-जंजिरा एक पर्यटक केन्द्र होने के कारण 1996 से सूखे झींगों का बाज़ार जारी है । इसलिए स्थानीय मछली व्यापारियों का ध्यान इस सूखे झींगे बाज़ार की ओर केन्द्रीकृत हो गया है ।

सी एम एफ आर आई के जंजिरा मुरड क्षेत्र केन्द्र, जंजिरा मुरड के डी.जी. जादव की रिपोर्ट

869 पश्चिम बंगाल के मिड्नापुर जिले के डिग्गा अवतरण केन्द्र में एक तिमि सुरा का अवतरण और एक कच्छप का धंसन

डिग्गा मोहना अवतरण केन्द्र में 8-2-98 को एक आनाय द्वारा पकडी गयी 6.07 मी लंबाई की तिमि सुरा *रिनियोडोन टाइपस* का अवतरण किया था । 400 कि ग्रा भार के इस सुरा को 2,800/- रु में बेच दिया और कोन्टाई में प्रदर्शन केलिए रख दिया ।

एक मरा हुआ नर राजकच्छप *करेट्टा करेट्टा* 7-3-'98 को डिग्गा में धंस हुआ था । इसकी पृष्ठवर्म लंबाई 70 से मी और चौडाई 42 से मी थी । इसका भार 75 कि ग्रा था ।

सी एम एफ आर आइ के कोन्टाई क्षेत्र केन्द्र, कोन्टाई के सपन कुमार की रिपोर्ट

870 काकिनाडा तट में *एलागाटिस बिपिन्नुलाटा* की अपूर्व उपस्थिति

कैरैजिडे वंश के *एलागाटिस बिपुन्नुलाटा* वेलापवर्ती जाति के है और इन्हें रेनबॉ रन्नेर्स कहते है । साधारणतया काँटा डोर और गिलजालों द्वारा इनको पकडते है । इनकी अधिकतम लंबाई 120 से मी और भार 9.5 कि ग्रा होते है । भारत तट के इस जाति पर जैविक सूचना उपलब्ध नहीं है ।

काकिनाडा मात्स्यिकी पोताश्रय में 6-2-1998 को वेलापवर्ती गिल जाल *(नारावला)* के ज़रिए इस मछली के 437 नमूनों को पकडा था । आन्ध्रा तट में विरल इन मछलियों को काकिनाडा मात्स्यिकी पोताश्रय से 12 कि मी दूर उपस्थित उप्पाडा से 16 मी गहराई से पकडा गया था ।

पकडी गयी सारी मछलियाँ किशोरावस्था की थी । गुद पख में 2 काँटे थे पुच्छ वृन्त में प्रशल्क नहीं था । इसका उपरी भाग गहरा ओलीव नील और अधो भाग सफेद था । पख ओलीव या पीत आभा के साथ गहरे रंग के थे । 32 से मी से 42 से मी तक की लंबाई रेंच की मछलियों में 35-40 लंबाई की मछलियाँ अधिक थीं।

कुल 128 कि ग्रा पकडी गयी थी और प्रति कि ग्रा 7.50/- रु की दर में उनको बेच दिया ।

सी एम एफ आर आइ के काकिनाडा अनुसंधान केन्द्र के एन. बुरय्या और वाइ. यू. एस. सूर्यनारायण की रिपोर्ट

871 पारादीप में एक भीमाकार कलवा का अवतरण और उडीसा के पुरी तटों में मरे कच्छपों का धंसन

एक भीमाकार कलवा *एपिनेफेलस लानसियोलाटस,* जिसे 'कायबाली' कहते है, का अवतरण 18-12-'97 को पारादीप 12 कि मी दूर प्रचालित एक आनायक के ज़रिए हुआ था । इसकी कुल लंबाई 202 से मी थी । लगभग 150 कि ग्रा भार की इस मछली को 400/- रु. में बेच दिया था । इसका कुछ शारीरिक मापन से मी में निम्नप्रकार है ।

कुल लंबाई	–	202
मानक लंबाई	–	168
सिर की लंबाई	–	75.5
शरीर की गहराई	–	68
प्रोथ की लंबाई	–	15
उपरी हनु की लंबाई	–	33.5
आँख का ब्यास	–	5.2
अंस पख की लंबाई	–	36

पुरी और पारादीप तटों में दिसंबर '97 को तीन मरे हुए ओलीव राइडली कच्छप *लिपिडोचेलिस ओलिवेसिया* पाये गये थे। इनमें एक को 11-12-'97 को उत्तर पुरी में और बाकी दो 17-12-'97 और 19-12-'97 को पारादीप में देखे गये थे । उत्तर पुरी में देखे गये कच्छप की पृष्ठवर्म लंबाई और चौडाई यथाक्रम 64 और 56 से मी थी । बाकी दोनों की पृष्ठवर्म लंबाई यथाक्रम 64 और 65 से मी और चौडाई यथाक्रम 57 और 55 से मी थी ।

सी एम एफ आर आइ के पुरी क्षेत्र केन्द्र पुरी के सुकदेव बार की रिपोर्ट

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GUIDE TO CONTRIBUTORS

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

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