

# High-Opening Bottom Trawling in Tamil Nadu, Gujarat and Orissa : A Summary of Effort and Impact



SWEDISH INTERNATIONAL DEVELOPMENT AUTHORITY



FOOD AND AGRICULTURE ORGANIZATION  
OF THE UNITED NATIONS

**HIGH-OPENING BOTTOM TRAWLING IN  
TAMIL NADU, GUJARAT AND ORISSA, INDIA:  
A SUMMARY OF EFFORT AND IMPACT**

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**Executing Agency:**  
**Food and Agriculture Organization  
of the United Nations**

**Funding Agency:**  
**Swedish International  
Development Authority**

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**Development of Small-Scale Fisheries in the Bay of Bengal.  
Madras, India, February 1987.  
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Between 1980 and 1985, the small-scale fisheries project of the Bay of Bengal Programme (BOBP) demonstrated fishing techniques with various types of high-opening bottom trawls in Tamil Nadu and Orissa, in cooperation with the fisheries departments of these states. New deck equipment and machinery and simple trawl rigging accessories for standard Indian coastal trawlers were also locally developed, demonstrated and introduced.

In Gujarat, training and experimental fishing in high-opening bottom trawling were conducted early 1983 by CIFNET (Central Institute of Fisheries Nautical and Engineering Training). BOBP provided technical and material support to the CIFNET effort.

It was hoped that high-opening bottom trawls would help relieve fishing pressure on prawn resources, put idle prawn trawlers to gainful use during the off season and help tap underexploited food fish resources. The innovations with deck equipment and gear accessories were intended to make trawling effort safer, more efficient and more comfortable.

This paper summarizes the results of the high-opening bottom trawl demonstrations and the response to them in the three states. It also sums up the impact of trawling effort following BOBP demonstrations on fishery resources; and discusses the present status of gear designs and of deck equipment. Future prospects concerning high-opening bottom trawling are also discussed.

The paper's comments on the impact of high-opening bottom trawling are based on a study of socio-economic impact by John Kurien of the Centre for Development Studies, Trivandrum, early 1984; and on studies conducted by the author, B.T. Antony Raja, in Tamil Nadu and Gujarat during February-April 1984 and August-September 1986. During the first trip, biological consequences in the Palk Bay-Gulf of Mannar area were studied; during the second trip, an overall appraisal was attempted. The author also met officials of the CMFRI (Central Marine Fisheries Research Institute, Cochin), and of the three state governments, besides fishermen, fish merchants and boat owners.

Earlier papers on high-opening bottom trawling in Tamil Nadu and Orissa published by the BOBP are BOBP/WP/10, BOBP/WP/20, BOBP/WP/21 and BOBP/WP/48.

The small-scale fisheries project of the Bay of Bengal Programme is funded jointly by DANIDA (Danish International Development Agency), and SIDA (Swedish International Development Agency) and executed by the FAO (Food and Agriculture Organization of the United Nations). It seeks to help improve the conditions of marine small-scale fisher-folk in member-countries; the immediate object is to develop, demonstrate and promote, through pilot activities, technologies and methodologies by which such betterment can be attained. The project is multi-disciplinary, and is active in extension work among marine fishing communities, fishing technology and aquaculture. The project covers seven countries bordering the Bay of Bengal — Bangladesh, India, Malaysia, Sri Lanka, Thailand, Indonesia and Maldives.

The present project began in 1987 for a duration of 5 years, and succeeds a similar project funded by SIDA that began in 1979 and terminated in 1986. It covered five countries—those listed above except Indonesia and Maldives.

This document is a technical report and has not been officially cleared either by the Government concerned or by the FAO.

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## SUMMARY

The Bay of Bengal Programme (BOBP) introduced new trawling techniques in Tamil Nadu during 1980/81, principally through the two-boat high-opening bottom fish trawl (TF), two-boat midwater trawl (TMW), one boat high-opening bottom fish trawl (OF) and one-boat high-opening bottom fish-cum-shrimp trawl (OSF). The fishing trials with the trawls were carried out from Mandapam, Mallipatnam, Tuticorin and Madras.

The main objectives were to investigate the technical feasibility and the economic viability of these techniques; to identify and develop possible improvements to the fishing boats for more efficient, comfortable and safer fishing operations and trawl handling; and to train counterparts, fishermen and net-makers in the design, construction and use of the fishing gear, equipment and methods.

The BOBP hoped that this experimental fishing project would reveal whether fishing pressure on the prawn resources could be relieved to some extent, whether the idling prawn trawlers could be gainfully engaged during the off-season and whether a part of the fishing effort could be re-deployed to harvest under-exploited food fishes.

After the fishing trials became popular, the technology was demonstrated by CIFNET (Central Institute of Fisheries Nautical and Engineering Training), Cochin, on the coast of Gujarat in 1983. Subsequently, BOBP carried out a demonstration in Orissa in 1984/85.

While there was no doubt about the technical feasibility of the designs, the fishing trials in Tamil Nadu indicated that TMW might not be economically viable; TF appeared to suggest the possibility of economic returns in commercially oriented operations seasonally at some places; OF and OFS experiments clearly demonstrated that they could be accepted for commercial operations. They also proved to be better than the conventional shrimp trawl (CS) for higher production of food fishes. The commercial operations which started thereafter yielded bumper crops from TF in 1982, followed by some reduced returns in 1983, in the Palk Bay. The same was the case in Tuticorin (Gulf of Mannar) where however OFS was more popular. In 1984, the enthusiasm generated during the previous two seasons was absent because of an extended prawn season.

An impact study\* on the biological consequences of introducing these trawling techniques in the Palk Bay and the Gulf of Mannar showed no evidence of negative impact on the exploited and exploitable resources of the Palk Bay; the continued success of TF depends on the availability of shoals of valuable food fish which, however, appear to occur only occasionally. It would therefore appear doubtful whether there will be any expansion at all of this technique in this area. OFS operation at Tuticorin appeared to have increased the fishing pressure on the anchovy, *Thryssa*, which was also exploited by the artisanal sector. Although the level of this resource declined drastically, it has recovered reasonably well of late.

The present position in Tamil Nadu is that at many places, the trawl operators employ mainly CS and OSF but have reduced the cod-end mesh size to 10-15 mm. The CS has dispensed with the 4 seam design; now only the 2-seam design is in evidence. The demand for HDPE as gear material has increased because of OSF, also because HDPE has replaced nylon for CS.

There has been a significant increase in Tamil Nadu's total marine fish production as well as in important centres landing trawler catches since 1981. However, there was a decline in 1984/85. It is not possible to say to what extent the high opening trawls have contributed to augmentation of the total catch. However, it would appear that there is no negative effect on the returns

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\* Antony Raja, B.T., 1984, An impact study on the biological consequences of introduction of improved trawling techniques in the Palk Bay/Gulf of Mannar, Tamil Nadu, India, 22 p. (Manuscript).

of the traditional sector by the introduction of improved trawling methods. Because of the small meshed cod-end, there has been a significant increase in the quantity of inedible varieties such as stomatopods, empty shells, gastropods and bivalves besides juveniles of some food fish, crabs and cephalopods at almost all places except Tuticorin. While the small prawns and *Stolephorus* are the target species for fabricating such cod-ends, the high incidental catch of trash fish which goes for fish meal is a matter of concern although it might improve the economics of the operation.

Of the OF designs, that with 120 mm mesh size at the front part of the belly is more popular.

There are about 150 TF, a number of which existed in 1882/83, but only half of them are being operated during the season (January to April) and still less during the whole year. Even these are in operation only at Nagapattinam, Rameswaram and Tuticorin.

In Gujarat, soon after the training-cum-demonstration programme, OF became popular with commercial operators, who named them as 'disco trawls'. The off-take at HDPE webbings also increased and the Government distributed nearly 170 readymade nets. There was an increase of about 38% in the total production, most of which was due to the trawlers. It could be surmised that this improvement was largely the result of high-opening bottom trawls. A study by a Government agency showed that the catch of OFS was 26% higher than that of CS and the value was 20% more.

It is rather strange and puzzling that despite the perceived advantages of OF, there has recently been a tendency to change the design and go in for a smaller circumference at the mouth and a smaller cod-end mesh size.

The results of fishing trials in Orissa indicated that OSF was distinctively superior to CS with an earning 30% higher than CS and with more high value fish and prawn; OF and OFS were also found promising for harvesting fish or fish and large prawns according to the seasons. An improved type of trawler capable of conducting 2-3 days of off-shore fishing voyages should further improve the feasibility of trawling with these designs.

Of the various deck machinery/equipment and trawl accessories developed, the new design of otter boards, gantry, tiltable drum winch and split links has been found acceptable with some of the Tamil Nadu operators and has prospects for the future. In Gujarat, the advantages of the gantry and tiltable drum winch are yet to be convincingly demonstrated to operators.

In Tamil Nadu, any expansion in the number of TF seems unlikely. In Gujarat too the prospects are remote, the most important reason in both areas being the general opposition from fishing units, especially the gillnet operators. In Orissa, experimentation is required further off-shore.

Of all the high opening trawl designs, that of the shrimp-cum-fish trawl is likely to become more acceptable in all the three states, the main advantage being that it can be operated during the off-season for prawns for economic returns. However, with smaller mesh size at the cod-end, the fishing pressure will increase further on prawn stocks, which are already reported to be under the threat of over-exploitation in almost all areas; in addition, juveniles of fishes, some of which may be valuable food fishes, are being destroyed.

Before such a practice gets out of control, mesh-size regulation is strongly recommended. The cod-end mesh size should be a minimum of 40 mm in all the trawls.

The existing industry no doubt will be affected. But this will pave the way for re-deployment of effort not only to develop driftnet/longline off-shore fishery for large pelagics but also to promote a healthier trawl fishery for prawns and fishes.

It is likely that the operation of the shrimp-cum-fish trawl may extend to Kerala and Maharashtra in the near future and probably to Andhra Pradesh in due course.

It is recommended that the State Governments set up a well-organized unit to monitor the activities and conduct effective extension programmes to promote the principal objectives with which the new trawl designs and other machinery and accessories were developed and demonstrated.

The next generation of mechanized boats should be slightly larger so that they may endure two or three days on the sea.

## 1. INTRODUCTION

The rapid development of mechanization in India's fisheries sector was oriented, by and large, towards prawn fishery through the introduction of small coastal trawlers, mostly 9-10 m in length. As the fleet strength increased, the net revenue per boat started to decline and the profitability began to diminish because of increased operating costs. Almost all along the Indian coast, the in-shore prawn fishery for small boats has reached the point of maximum sustainable yield with indication of over-exploitation in some areas.

Since the prawn season differs from place to place, these small trawlers have either to keep migrating to other fishing grounds, some which are far from the home base, or keep their boats idle during the off-season.

It was considered desirable to relieve fishing pressure on prawn resources, yet keep idle prawn trawlers productively engaged during the off-season, by tapping under-exploited food fishes. Consequently, the BOBP launched an experimental fishing project to:

- Investigate the technical feasibility and economic viability of high-opening bottom trawls and mid-water trawls employed by boats of the existing type-single and in pairs.
- Identify and develop possible improvements to the fishing boats for more efficient, comfortable and safer fishing operations and trawl handling.
- Train counterparts, fishermen and net makers in the design, construction and use of the new fishing gear, equipment and methods.

The activities were initiated in Tamil Nadu in 1980 and continued through 1981 with Mandapam, Mallapatnam, Tuticorin and Madras as bases; the outcome of these activities is reported in BOBP/WP/10, BOBP/WP/20 and BOBP/WP 21.

Sensing the economic viability of employing the improved trawling techniques during the off-season for prawn, some operators of small shrimp trawlers started commercial operation with two-boat and one-boat fish-cum-shrimp trawls in Mandapam, Rameswaram (Palk Bay) and Tuticorin (Gulf of Mannar) in 1981/82. The successful operations in 1982 and 1983 not only encouraged some operators in other important centres in Tamil Nadu like Nagapattinam and Madras, but also aroused interest in Gujarat, the northernmost maritime State of India on the west coast. The Government of Gujarat desired that the technology be demonstrated and developed. This extension work was undertaken by the Government of India's Central Institute of Fisheries Nautical and Engineering Training (CIFNET) in February 1983 at Porbander, Gujarat.

Demonstration of high-opening trawls was also taken up off the coast of Balasore, Orissa in 1983-85 by BOBP. The results have been published in BOBP/WP/48. The places where trial fishing was conducted and those which figure in the text are shown in Fig. 1.

Improved deck machinery and layout and gear-handling devices for conducting the new trawling techniques from the small coastal trawlers were also developed, details of which are available in BOBP/WP/21.



## 2. RECORD AND RESULTS OF ACTIVITIES

The record of activities in chronological order was as follows:

S.No.	Activity	Places	Period	Technology Tried out
1.	Fishing trials	Mandapam	Mar.-Jul. 1980	OF&TF
2.	Fishing trials	Tuticorin	Jul. 1980-Jan. 1981 Aug. 1980-Jan. 1981 Apr.-May 1981	TF TMW OFS
		Mandapam	Oct.-Nov. 1980	TF & OF
		Madras	Jan.-Mar. 1981	TF
		Mallipatnam	Mar.-May 1981	TF, TMW, OF
3.	Fishing trials	Madras	Aug.-Nov. 1981 Oct. 1981	OFS OF
		Tuticorin	Oct.-Nov. 1981	OFS
4.	Development of improved deck machinery, equipment and accessories	Madras & Tuticorin	July 1980 to May 1981	Otter board, gantry Net drum on gantry Net drum on deck Three drum winch, split links Cod-end clips
5.	Extension and demonstration	Mandapam Rameswaram Tuticorin	1982-I 1983	TF, OF, OFS Deck equipment, trawl handling devices and accessories
6.	Support to CIFNET	Porbander	Jan.-May 1983	OF, TF, OFS
7.	Fishing trials	Balasore	Nov. 1984-Mar. 1985	OF, OFS, OSF

OF — One-boat high-opening bottom fish trawl; OFS -One-boat high-opening bottom fish-cum-shrimp trawl ; OSF — One-boat high-opening bottom shrimp-cum-fish trawl ; TF -Two-boat high-opening bottom fish trawl; TMW -Two-boat mid-water trawl.

### 2.1 Fishing trials

#### 2.1.1 Tamil Nadu

As may be seen from the above summary, four types of trawl designs were experimented with i.e., OF, OFS, TF and TMW. The different types of trawl vary basically in the size of mouth opening and in the mesh sizes in the main parts of the net (Table 1).

The four bases where trials were conducted represented three distinct parts of the Tamil Nadu coast in terms of fishing season, species-mix, slope of the continental shelf and sea bed configuration. They were the Coromandel Coast (Madras), Palk Bay (Mandapam and Mallipatnam) and the Gulf of Mannar (Tuticorin).

A summary of data obtained during the trials is given in Table 2. From the standpoint of economic viability: if, on a rough estimate, the daily operating costs of one boat were taken to be Rs. 500,

**Table 1**  
**Broad specifications of trawl designs**

	Conventional Shrimp Trawl (CS)	Fish-cum- Shrimp Trawl (OFS)	Shrimp cum-Fish Trawl (OSF)	One-boat Fish Trawl (OF)	Two- boat Fish Trawl (TF)	Two-boat mid-water Trawl (TMW)
Mouth opening Height (m)	1	3	2.5	4	6	6
Mesh size (mm)						
Cod-end	15	30/40	40	30	25	25
Wings	40	80/1	60 80	200	200	200
Mouth	40	60/1	20 60	160	160	200
Number of meshes						
Mouth	1100	700/484/370	620/550	320	480	228

**Table 2**  
**Summary data of fishing trials with  
high-opening bottom trawls in Tamil Nadu**

(TF=Two boat fish trawl; OF=One-boat fish trawl; OFS=One-boat fish-cum-shrimp trawl; TMW=Two-boat mid water trawl)

Base	Madras				Mallipatnam		Mandapam			Tuticorin	
	TF	OF*	OFS*	TMW	TF	OF	TF	OF	TF	TMW	OFS**
Fishing days	11	13	34	26	29	11	91	40	75	32	26
Fishing time (h)	70	69	181	110	112	51	558	318	273	81	147
Total catch (t)	6.6	13.8	16.0	11.7	12.7	1.9	143.5	45.4	27.5	15.3	16.1
Catch value ('000 Rs.)	11.0	10.7	25.4	12.3	16.1	1.8	88.8	28.5	62.3	13.3	31.2
Average price (Rs./kg)	1.68	1.29	1.59	1.06	1.27	0.94	0.62	0.63	2.26	0.87	1.94
Catch rate (kg/h)	94	200	89	106	113	38	257	143	101	189	110
Gross earnings (Rs./day)	998	825	748	473	556	164	976	713	830	415	1201

Source: BOBP/WP/10; BOBP/WP/20

\*Unpublished data;

\*\*Includes some unpublished data.

then TMW was not viable at any place; the same was the case with OF and TF at Mallipatnam. At the other two centres, Mandapam and Tuticorin, the results from TF appeared to suggest the possibility of economic returns in commercially oriented operations. The results from OF and OFS experiments clearly demonstrated that they may be acceptable commercially.

The results of the fishing trials also indicated the following features:

- There are opportunities in some places at some seasons for increased exploitation of less heavily fished food fishes
- High-opening bottom trawls are better than the conventional shrimp trawl (CS) for capturing food fishes.
- In addition to CS, more than one type of trawl would be necessary for the best results.
- Re-deployment of the prawn trawling fleet into a food fish fishery is possible only to some extent. General acceptance of the new technique would depend on higher financial returns than those derived from the existing shrimp fishery. Otherwise the introduction of high-opening trawling will be supplementary to shrimp trawling and will have little effect on the reduction of fishing effort on the prawn resources.

By 1982 end, as a result of extension and demonstration at Mandapam and Tuticorin, more than 100 boats took up TF and OFS on seasonal basis,

The commercial operations of about 25 TF in the Mandapam-Rameswaram area from February to April 1982 showed more than one tonne of fish as catch per unit, with silver pomfret and rainbow sardine forming 30% each, croakers and catfish 18% and 9% respectively, and the rest shared by ponyfishes, rays, other clupeids and carangids. Because of this bumper crop, the number of units operating high-opening bottom trawls nearly doubled in 1983, but the catches reported were less than the previous season; nonetheless an average of about 100-200 kg of pomfret was landed by each unit with occasional heavy catches of catfish,

In 1984 however, the enthusiasm generated during the previous two years was absent mainly for two reasons (1) continuance of prawn season during January to April due to unseasonal rains and (2) apprehension caused due to seizure of Indian boats by Sri Lankan patrol boats.

At Tuticorin, in the Gulf of Mannar area, the peak activity was in 1982 and 1983 with 20 TF units and 50-60 OFS units in operation. In 1984, only 50% of the invested capacity was used, the reason again being the prolonged fishing for prawns when operation of CS was found to be more remunerative.

An impact study on the biological consequences of introduction of improved fishing technologies in Palk Bay and Gulf of Mannar came to the following conclusions:

- While there was no evidence to suggest a negative impact on the exploited or the exploitable resources of the Palk Bay, the TF operations had contributed towards exploitation of certain untapped food fishes. But the continued success of the same depended on the availability of shoals of valuable food fishes which appear to occur only occasionally.
- OFS operations at Tuticorin appeared to have increased fishing pressure on the Thyrssa resource which is also exploited by the artisanal sector.
- TF is a highly effective fishing operation but the experiences over the three year period would appear to cast doubts whether there will be any expansion at all of this particular technique in the area. The main reasons are the ability and tenacity required to withstand financial strain; seasonality of operations; and general opposition from other fishing sectors.

A survey of seven boats at Madras employing the OFS trawl during September-November 1983 showed that the average total catch per boat was a little over 52,000 kg, realizing a value of about Rs. 136,500 during an average period of 73 days. Thus the daily average catch was about 720 kg and daily gross earnings Rs. 1,870.

### 2.1.2 Gujarat

In Gujarat, the training-cum-demonstration programme undertaken by CIFNET in collaboration with the Department of Fisheries, Government of Gujarat, received the support of BOBP in the form of supply of three OFs, two OFSs and three TFs to facilitate initiation and uninterrupted functioning of the programme. BOBP also made available the services of a counterpart who was earlier associated with the fishing trials and demonstrations in Tamil Nadu. The designs of the trawl nets were the same as those experimented with in Tamil Nadu:

TF	:	480 meshes x 160 mm
OF	:	320 meshes x 160 mm
OFS	:	700 meshes x 60 mm

In the Government training boats on which one-day fishing trips were conducted, the performance during February-March 1983 was as follows (Monthly Progress Reports on "Training in Diversified Fishing for Artisanal Fishermen" by CIFNET and Department of Fisheries, Government of Gujarat) :

	TF	OF	OFS
Fishing days	23	19	18
Fishing hours	94	93	86
Total catch (kg)	9561	7779	5608
Catch (kg/hr)	102	84	65
Catch (kg/day)	416	409	312

Considering the limitations — operation by Government boats, with inexperienced crew not acquainted with the new trawls—the results were quite encouraging; it was reported that the catch rates despite the limitations were higher than those of other local commercial fishing boats.

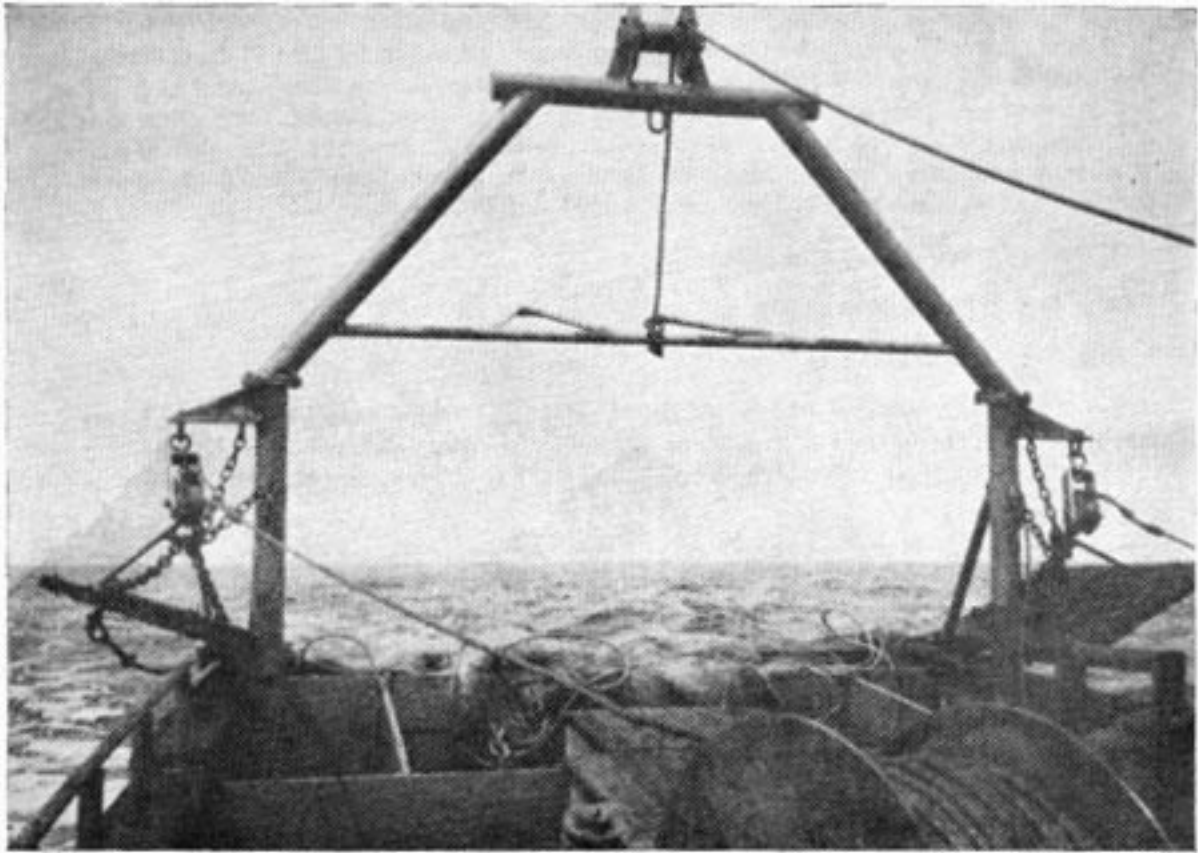
How the commercial operators could get interested with such moderate rates of return can be seen from Table 3 which details data from four commercial boats which operated the three types of trawls. Their catch rates were 889 kg/h for TF, 206 kg/h for OF and 216 kg/h for OFS. It was therefore no surprise that there was heavy demand for such nets immediately thereafter. The Government of Gujarat, through the fish net making plant of the Gujarat Fisheries Central Cooperative Association (GFCCA), arranged for fabrication of 60 nets, 40 OF and 20 OFS, and distributed them early 1984 to the fishermen of Veraval and Porbander.

The catch consisted of quality fish like pomfrets, big croakers, Spanish mackerels, *Lactarius lactarius*, catfish and squids, besides large quantities of hairtails, clupeoids such as *Pellona*, *Ilisha*, *Thryssa* and *Opisthoptenus **tardoore*** and small croakers.

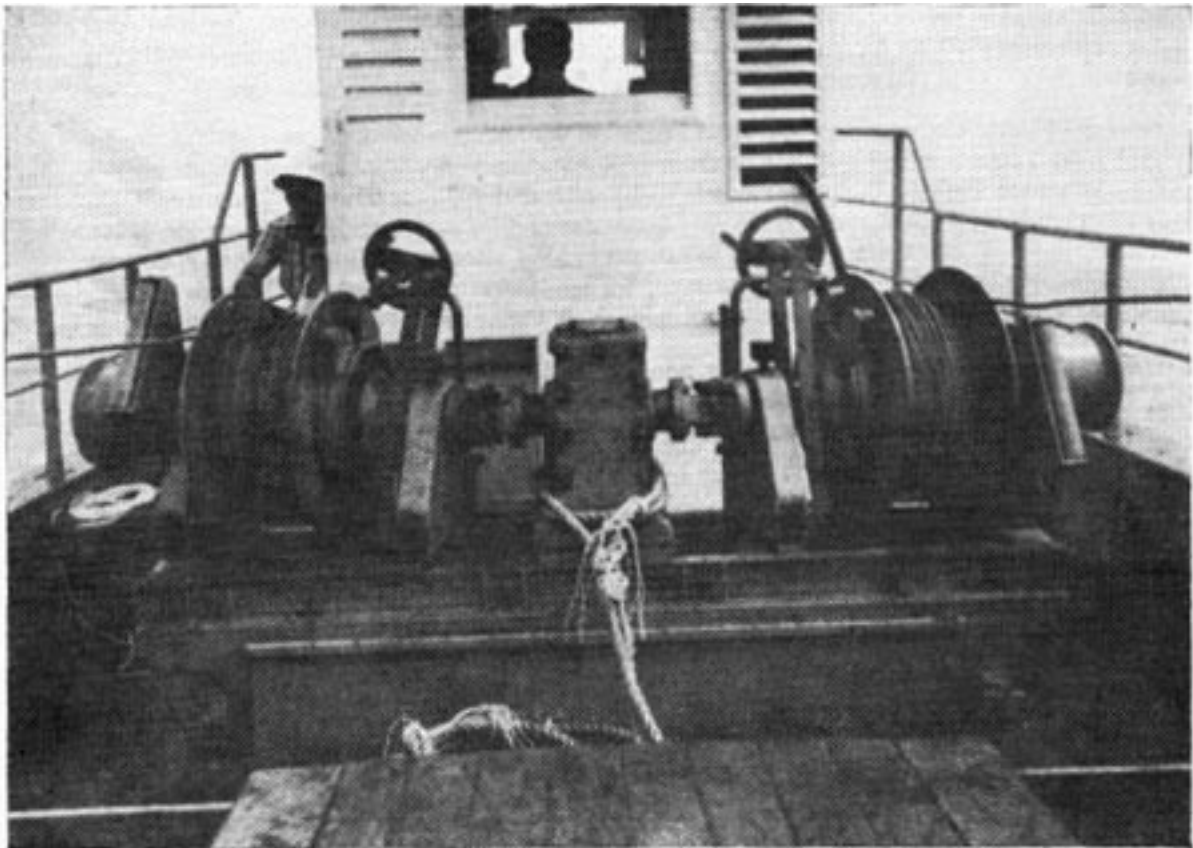
### 2.1.3 Orissa

Five designs of trawi for one-boat operation were tried off Balasore in 1984/85. They were :

- (1) OF .. .. 320 meshes of 160 mm
- (2) OFS .. .. 370 meshes of 120 mm
- (3) OFS .. .. 484 meshes of 80 mm
- (4) OSF .. .. 620 meshes of 60 mm
- (5) OSF (LW (long wing) . . 550 meshes of 60 mm



*Deck layout innovations introduced by BOBP to trawlers.  
Gantry (above). Winch with tillable drums (below).*



For comparison, fishing was also conducted with the conventional shrimp trawl (CS).

Details of the results of demonstration trials extending from November 1984 to March 1985 are set out in BOBP/WP/48. A summary record of results is presented in Table 4. Briefly the results indicated that :

- OSF of 620 meshes of 60 mm was distinctly superior to CS with an earning 30% higher than CS and with a higher quantity of high-value fish and shrimp.
- OF of 320 meshes of 160 mm and OFS of 370 meshes of 120 mm proved to be appropriate trawls for harvesting fish or fish and large shrimp according to the fishing season.
- Further introduction of these three types is desirable; a successful trawling operation would require the use of these different types as the situation demands.
- An improved type of trawler capable of conducting 2-3 days offshore fishing voyages can improve the feasibility of trawling with these designs.

## **2.2 Deck machinery/equipment and trawl accessories**

### **2.2.1 Otter boards**

The new trawls called for a revised otter board design, which was prepared and introduced. The new otter boards enable the trawl to spread to the maximum possible extent. They are simpler to construct than conventional otter boards, and the bracket chain is easier to adjust. They are also suitable for other types of trawl, with a slight adjustment on the bracket chain.

### **2.2.2 Gantry**

The gantry designed and introduced by BOBP was well received by the fishermen who were convinced of its merits -especially those of safety, comfort, easiness, and reduced time for trawl handling.

### **2.2.3 Net drums and three-drum winch**

The advantages are that these are labour-saving and time-saving devices: besides, the boat can be kept in the forward motion while hauling the gear, thus driving the fish **to the** cod-end and reducing the risk of the net getting fouled with the propeller.

Their introduction implies the use of trawls made of heavier netting and more resistant PVC floats which are not readily available.

### **2.2.4 Tiltable drum winch**

By shifting the winch forward by about 2 m from the original position aft of the engine room hatch, more free working space on the deck was obtained; also, the need for a transmission shaft and connected plumber blocks and beams in the traditional layout was eliminated. Another advantage is that the winch has a self-winding system and the wires get uniformly wound on the drums, since the angle of the tiltable drum is in line with the gallow-pulley. The trawl warp also lasts longer, in as much as it is not subjected to stress and strain resulting from sharp curves or bends obtained in the existing shrimp trawlers.

### **2.2.5 Split links**

This component was introduced in order to save time and make it easier to rig a trawl without any tool, especially when a net is damaged or has to be replaced by another. These items were also found to be cheaper and more durable than the shackles in the conventional trawlers. The fishermen were quick to adopt and use these gadgets for rigging all types of trawls.

### **2.2.6 Cod-end clip**

The cod-end of a trawl is normally closed by passing a cord through the meshes and by using slip-knots in the cord. Sometimes, when the cod-end is full, it is difficult to release the cord as

**Table 3**  
**Summary record of catches by four**  
**commercial boats off Gujarat in March, 1983**

	OF	TF	OFS
Fishing days	15	4	4
Fishing time (h)	67	20	20
Catch — Quantity (t)	13.8	17.8	4.3
Value ('000 Rs.)	49.2	22.3	10.7
Price (Rs./kg)	3.56	1.26	2.48
Catch rate (kg/h)	206	889	216
Gross revenue (Rs./day)	3281	5586	2679

Source: Monthly Progress Report (No. 2) ; Training in Diversified Fishing for Artisanal Fishermen. Published by CIFNET, Govt. of India and Department of Fisheries, Govt. of Gujarat.

**Table 4**  
**Summary record of catches by high-opening bottom trawls as**  
**compared to conventional shrimp trawls in Orissa, 1984/85**

	OSF(LW)	OSF	CS
Fishing days	62	65	63
Fishing time (h)	348	361	378
Catch — Quantity (t)	44.5	48.1	43.1
Value ('000 Rs.)	168.1	183.3	148.0
Price (Rs./kg)	3.74	3.80	3.43
Catch rate (kg/h)	129	133	114
Gross revenue (Rs./day)	2711	2820	2350

Source: BOBP/WP/48

the knot gets jammed. To remedy this shortcoming and save time, a cod-end clip was fabricated locally and demonstrated to the fishermen. An endless rope of 14 mm is passed through the slot in the clip and the clip is jammed on the deck when the cod-end is to be closed. When the bag is hauled up, a small rope 6-8 mm connected to the clip is just pulled to open the bag. Most of the boat operators of Tuticorin and Rameswaram reportedly adopted this clip in their trawlers after the demonstration but probably discontinued its use later.

### 3. LANDINGS, EFFECTS AND IMPACT

#### 3.1 Tamil Nadu

##### 3.1.1 Production

There has been a significant increase in the total fish production in the State since 1981, both in the mechanized sector and the non-mechanized sector, each of which makes roughly an equal contribution. However, in 1984/85 due to a sizeable fall in the trawlers' catch, the contribution of the non-mechanized sector was distinctively higher (56%) than the mechanized sector (Table 5). The contribution from the mechanized sector is almost exclusively from the small trawlers; a small portion — 1 or 2% of the production from mechanized fleet — comes from power-propelled units mainly operating gill/drift nets.

**Table 5**  
Estimated marine fish landings in Tamil Nadu, 1981-85  
(In tonnes, with percentage of grand total in parenthesis)

	1981*	1982/83	1983/84	1984/85
Trawlers	104445 (47)	115284 (49)	140313 (51)	96099 (41)
Others	2219	4994	2250	5793
Total from mechanized boats	106664 (48)	120278 (51)	142563 (52)	101892 (44)
Total from non-mechanized boats	114632 (52)	115675 (49)	134471 (49)	130706 (56)
Grand Total	221296	235953	277034	232598
Effort of Trawlers (No. of Operations)	443818	497137	526404	429337
Catch rate of trawlers (kg)	235	232	267	224
Penaeid prawn from trawlers	11612	11415	12610	10292
Penaeid prawn from non-mechanized boats	1930	1634	2419	2275
Prawn catch rate of trawlers (kg)	26	23	24	24

Source: CMFRI

\* January to December; Data for other years relate to April to March period.

Note: Effort and catch rate are in relation to the number of operations of all units.



It would appear from the data in Table 5 that both the sectors were more or less equally responsible for the average increase in fish production during the last three years. Thus no clear evidence could be derived from the total annual catch of the State, that introduction/adoption of improved trawling techniques through OF and OFS has either increased production or hit the share of the artisanal non-mechanized sector. In fact the trawl fishery suffered a setback in 1984/85, but the non-mechanized sector did not.

CMFRI data for four years from 1981 in respect of six important trawler centres in Tamil Nadu are summarized in Table 6. It is seen that the share of these centres in the State's total trawler catch has been increasing from 47% in 1981 to 67% in 1984/85. In absolute values the total catch of these centres recorded a significant increase after 1981, except for some decrease in 1984/85; the latter was a feature in the State's total landing also.

This 'rise and fall' picture held good for four of the six centres, the exceptions being Mandapam and Tuticorin where the rising trend was maintained in 1984/85 also. It may be indicated here that while at Mandapam it is the conventional shrimp trawl that was mostly employed, at Tuticorin all four types are used — CS, OF, OFS, TF. In the absence of corresponding data from the non-mechanized sector it is not possible to see the impact of one on the other. Thus here again it is not possible to say to what extent the high-opening trawls have helped augment the total catch of the respective landing centres. However, the following additional features emerge from an analysis of these data :

- (i) Effort has been more or less increasing at all places, except at Rameswaram and Cuddalore where there was a decline in 1984/85.
- (ii) The best catch rates were obtained at Tuticorin and the lowest at Mandapam.
- (iii) Generally the catch rates increased in 1982/83 and 1983/84 but declined in 1984/85.
- (iv) The catch rate of prawns was declining rapidly at Madras; it appears to be on the increase at Cuddalore and Rameswaram; and at the other three centres it seems to be at the point of stabilization.
- (v) Crab contribution has been increasing at all centres.
- (vi) The returns from ponyfishes (silver bellies) have been declining steadily at Madras and Mandapam; their reduction in 1984/85 at other places except at Tuticorin, appears to reflect the overall reduction in the landing for that year; at Tuticorin there has been a sizeable increase during the past three years.

A specific study of the impact of high-opening trawls on the resources and on the traditional sector was attempted with the data available at Tuticorin. Since the peak operations with the new trawling gear are from January to March, when it is the off-season for prawns, the data relating to this period (from the records of the State Government) are presented in Table 7.

Although a personal check-up indicated that both the catch and the effort are being underestimated, since the error of estimate is presumed to be carried over the years, importance is given only to the trend and not to the absolute values.

A study of Table 7 indicates the following salient features:

- (i) After the boom in 1982 and partly in 1983, the total catch has dropped to a level below that of 1981, the year prior to commercial induction of high-opening trawls. The increase was seen mostly due to increased returns from the anchovy *Thyssa*. With its disappearance from the catches in 1984 and 1985, the catches also declined.

In the meantime quite a large quantity of 'others' has appeared in 1984 and 1985, which included sizeable amounts of goatfishes, *Upeneus* spp. When *Thyssa* reappeared in 1986, *Upeneus* was considerably reduced.

- (ii) In 1984 and 1985, prawns continued to yield good returns during the off-season, perhaps because of the favourable ecological conditions provided by unseasonal rains.

Table 6  
Estimated trawler landings (tonnes) at some important centres in Tamil Nadu

Group	Madras				Cuddalore				Nagapattinam				Mandapam				Rameswaram				Tuticorin			
	1981	1982-83	1983-84	1984-85	1981	1982-83	1983-84	1984-85	1981	1982-83	1983-84	1984-85	1981	1982-83	1983-84	1984-85	1981	1982-83	1983-84	1984-85	1981	1982-83	1983-84	1984-R
Elasmobranchs	312	137	83	560	—	3		1	163	325	605	402	290	236	209	332	3453	2330	3249	2861	603	893	327	11
Clupeoids	228	56	130	313	40	22	207	234	732	1254	2567	1451	176	188	156	161	116	438	637	839	1920	2628	1481	3839
Perches	1152	2259	1954	1298	126	385	404	249	360	806	1068	556	83	116	133	159	55	103	332	516	39	624	159	365
Croakers	507	224	405	335	73	142	99	269	560	866	1566	1058	280	319	348	348	2126	2754	2533	1544	704	753	438	420
Carangids	41	229	434	631	16	—	—	44	142	233	328	297	35	41	39	80	17	103	60	187	3	109	793	944
Pomfists	1577	1336	1532	1218	334	826	1440	831	756	967	3025	1772	3194	3659	2910	2419	10310	12373	14029	10012	1714	2144	2783	4672
Penaeid prawns	1023	1181	770	410	104	234	296	363	349	748	1543	1073	803	681	794	1031	2101	1905	2429	2552	3431	730	1014	2061
Crabs	—	30	68	130	31	197	64	102	91	202	402	450	232	198	272	732	640	696	1016	868	42	16	—	5
Others	1361	3639	3923	3999	280	527	814	537	720	1761	1750	1806	366	925	2135	2048	1760	2111	2808	2116	3913	1544	6095	3174
Total	6201	9091	9299	8894	1004	2336	3384	2630	3873	6982	12854	8865	5459	6363	6996	7310	20578	22813	27093	21495	12369	9441	13090	15491
Effort (No. of operations)	26671	34567	29897	36864	8043	9232	11239	9218	15827	21614	33447	41029	47840	45392	54074	59563	101449	94627	98060	75317	31846	24702	40449	51852
Total landings/effort (kg)	232	263	311	241	125	253	301	285	245	323	384	216	114	140	129	123	203	241	276	285	388	382	324	299
Prawn landings/effort (kg)	38	34	26	11	13	25	26	39	22	35	46	26	17	15	15	17	21	20	25	34	108	30	25	40

Source: CMFRI

**Table 7**  
**Summary of catch and effort data at Tuticorin, 1981-86**

(In tonnes with kg/boat-day in parenthesis)

	1981	1982	1983	1984	1985	1986
Trawlers (boat-day)	4573	6203	6202	4639	4842	5024
Total Catch	976(213)	1491 (241)	1132(183)	805 (174)	771 (159)	808 (161)
Prawns	26 (6)	34 (6)	37 (6)	64(14)	56 (12)	22 (4)
Thryssa	215(47)	615 (99)	445 (72)	0	0	157 (31)
Croakers	246 (54)	280 (45)	248 (40)	113(34)	93 (19)	125 (25)
Ponyfishes	172(38)	232 (37)	152 (25)	117(25)	97 (20)	117 (23)
Rays	125 (27)	122 (20)	141 (23)	61 (13)	29 (6)	94 (19)
Others	192 (42)	209(18)	109(18)	450(97)	496 (102)	293(58)
Traditional Boats (Kola Valai) boat-day	7422	9884	9478	9633	9180	6454
Total Catch	512 (69)	529 (54)	582 (61)	507 (53)	169(18)	598 (93)
Sardines	300(40)	318 (32)	368(39)	268(28)	63 (7)	265 (41)
Thryssa	150 (20)	111 (11)	107(11)	52 (5)	36 (4)	163(25)
Others	62 (8)	100 (10)	107(11)	187 (19)	70 (8)	170(26)

Source: Marine Biological Station, Directorate of Fisheries, Government of Tamil Nadu, Tuticorin.

- (iii) In the traditional sector also, the catches increased during 1982 and 1983, declined marginally in 1984 and drastically in 1985. There were again very good catches in 1986, the best of the five years. This was made possible by the return of Thryssa. It was once apprehended that increased fishing pressure from the trawlers might affect the returns from this resource for the artisanal sector. Although it seems to have affected the latter initially, it is not known how Thryssa happened to stage a recovery.
- (iv) Thus the introduction of high-opening trawls at Tuticorin seems to exert no marked or noticeable negative effect on the returns of traditional sector. Oscillations in the abundance of dominant groups and changes in the identity of certain dominant groups seem related more to their general abundance at a particular point of time than to the introduction of high-opening bottom trawls.

Personal observations and enquiries with the fishermen, owners and merchants of some of the important trawl fishing centres like Madras, Pazhayar (near Cuddalore), Nagapattinam, Mandapam, Jegathapatnam (near Mandapam), Rameswaram, Pamban (near Rameswaram) and Tuticorin brought out the following salient information :

- (i) There is a significant increase in the quantity of 'inedible' varieties such as stomatopods, empty shells, small bivalves and gastropods, besides juveniles of ponyfish, crabs, croakers, cephalopods, clupeoids and goat fishes. These are dried; empty shells, bivalves and gastropods are removed ; and the remainder is sent to producers of fish meal.

- (ii) The above trend is a sequel to reduction of cod-end mesh size to 10-15 mm in all types of trawl at all places except at Tuticorin -where in the shrimp trawl, the cod-end mesh size is 20 mm while in the other new types of trawl it is 30 mm. The argument of those using the 10-15 mm cod-end mesh size is that their profit margin is only in the seasonal occurrence of small prawns (it may be *Metapenaeus dobsoni* as on the Coramandel coast or *Trachypenaeus pescadorensis* and *Metapenaeopsis stridulans* as in the Palk Bay) and *Stolephorus* and the 'inedible trash' fish, which is available throughout the year.

### 3.1.2 Trawl design

The important types of trawl nets now employed at some selected centres are indicated in Table 8. It may be seen that at all centres the conventional shrimp trawl is the main fishing gear supplemented by one or the other type of high-opening trawls. The practice is to carry one or two types of supplementing nets along with CS.

**Table 8**  
Types of trawl used at some important centres in Tamil Nadu  
(The first part refers to front of belly (mouth) and the second part to the cod-end mesh size)

Centre	C S	OFS	OSF	OF	TF
Madras	940 meshes of 40 mm 10-15 mm	370 meshes of 120 mm 10-15 mm	620 meshes of 60 mm 10-15 mm	320 meshes of 160 mm 10-15 mm	
Pazhayar	800 to 900 meshes of 40 mm 10-15 mm				
Nagapattinam	1000 meshes of 40 mm 15 mm	—	620 meshes of 60 mm 15-20 mm	400 meshes of 120 mm 15-20 mm	480 meshes of 160 mm 25 mm
Mandapam	800 to 900 meshes of 40 mm 25 mm nylon (Palk Bay) 15 mm HDPE (Mannar)	—	—	520 meshes of 60 mm 30 mm	—
Jegathapatnam	Same as above 25 mm nylon	—	—	—	—
Rameswaram	Same as above 20-25 mm nylon	370 meshes of 120 mm 20 mm	700 meshes of 60 mm 580 meshes of 60 mm 520 meshes of 80 mm 20 mm	320 meshes of 160 mm 20 mm	480 meshes of 160 mm 25 mm
Tuticorin	Same as above 20 mm nylon	Same as above	Same as above	Same as above	Same as above

In Madras — Pazhayar, the concept of high-opening trawl has been absorbed and the 4-seam CS has been replaced by a 2-seam net but the cod-end mesh has been brought to the level of 10-15 mm in all types of trawl. In Madras, CS, OFS (620x60 mm) and OF (370x 120 mm) are the three principal types. The former two are used by fishermen throughout the year and the latter during the February-March period.

At Nagapattinam, the cod-end meshes are no better, 15-20 mm for all three types of nets used with one boat (CS, OFS and OF). In TF, the cod-end mesh size is slightly bigger, with 25 mm.

In the Palk Bay area, there are generally no high-opening trawls of BOBP design. However one party at Mandapam effectively uses OFS in his four boats. It is long winged with the front part of the belly having 550 meshes of 60 mm; the cod-end mesh is 30 mm. His interest is in ponyfish, for which he undertakes day trips. He had three nets designed for pair trawling but discontinued them after 1984 because of local opposition.

At Rameswaram there are about 150 nets of 700 meshes of 60 mm and 70 nets either of 580 meshes of 60 mm or of 520 meshes of 80 mm. Besides, there are 50 TF but only 25 of them are put into use during January to March.

At Tuticorin, besides CS as in the Palk Bay region, the BOBP designs adopted are:

OFS of 520 meshes of 80 mm, OSF of 700 meshes of 60 mm and OF of 320 meshes of 160 mm or of 370 meshes of 120 mm. Different operators have different types which are taken by the respective operators along with CS. During November to April, about 20 units operate TF; about 10-11 units operate throughout the year.

Thus briefly the impact on the trawling scene is:

- the 4-seam CS has been replaced by 2-seam nets;
- the fish-cum-shrimp trawl of 520 meshes of 80 mm and 700 meshes of 60 mm is the most popular of the BOBP designs;
- of the fish trawls, those with 120 mm mesh size at the front part of belly are more popular;
- although about 150 nets are believed to have been fabricated for two-boat trawling during 1982/83, only half of them are operating now -that too only at three places, namely Nagapattinam, Rameswaram and Tuticorin;
- for better economic returns, the tendency has been to reduce the mesh size at the cod-end to the extent that no further reduction appears possible. The resultant catch causes concern from the resources management point of view.

### 3.1.3 *Netting material*

To have some idea of the extent of increase in demand for high density polyethylene (HDPE) material used to fabricate the new trawl nets, data on the quantity of webbings of different meshes produced by the Tamil Nadu Agro Industries Corporation, which is one of the agencies catering to the demand, were obtained from the Tamil Nadu Fisheries Development Corporation. The tabulated data (Table 9) indicate that there was a sudden spurt in the takeoff since 1983/84. The annual production of HDPE which never exceeded 10 t touched double the figure in 1983/84, 15 t in 1984/85 and 11 t in 1985/86. A relatively higher demand was for 50 mm mesh size which may be utilized for the front portion of the belly of the SF trawl. Very recently there is more demand for 120 mm mesh size, presumably for the FS trawl.

### 3.1.4 *Deck equipment*

The impact of developing and demonstrating the improved equipment/accessories for trawl handling is seen at Tuticorin and to a lesser extent at Rameswaram. Probably the required extension work was not carried out at other places. At Tuticorin, 22 boats (out of about 100-120 boats) each have a gantry and 12 boats each a tiltable drum winch. All new boats under construction are reported to be provided with both these devices. Split links are also extensively used here. Cod-end clips are not in evidence, and the net-drum and the three drum winch has not been found acceptable to the operators.

Table 9

**Production of HDPE webbing at Tamil Madu Agro-Industries Corporation, Madras, 1981/82 — 1985/86**

(tonnes)

Mesh size (mm)	1981/82	1982/83	1983/84	1984/85	1985/86
50	5.2	4.7	13.2	10.8	5.0
60	3.1	1.6	3.8	3.0	2.2
80	1.6	0.8	1.9	1.5	1.3
120	—	—	1.1	—	2.8
Total	9.9	7.1	20.0	15.3	11.3

Source: Tamil Nadu Fisheries Development Corporation Ltd., Fish Net Factory, Madras.

Table 10

**Estimated marine fish landings in Gujarat, 1981/82 — 1985/86**

(tonnes)

Group	1981/82	1982/83	1983/84	1984/85	1985/86
Elasmobranchs	6801	7270	7352	11769	10290
Eels	3092	3267	3240	2699	4072
Cat fishes	6053	6951	8469	9556	10598
Clupeoids	12506	13388	18802	27179	24210
Bombay duck	47025	33259	35120	48581	29031
Small croakers	67431	51807	60101	83896	107813
Large croakers	5250	5396	6194	7457	7408
Pomfrets	10739	9199	10950	12963	9378
Hairtails	5367	4771	4152	5576	17483
Seer fishes	3106	3405	5153	5720	5089
Shrimps & Prawns	15944	15291	17566	20589	18056
Squids/Cuttlefishes	2516	2370	4394	4376	9544
Others	34779	36295	41833	50847	53600
Total	220609	192669	223326	290708	306577

Source: Commissionerate of Fisheries, Government of Gujarat.

### **3.1.5 Economics**

Actual economic data are not available. Some data collected during September-November 1983 at Madras indicated that the average value of catch per boat per day was about Rs. 1870. Deducting the running expenditure and crew wages, the net income would be about Rs. 900. Such an income for about 100 days a year may not be uncommon. A net income of Rs. 400 daily for another 150 days would result in a total net income of Rs. 150,000. Insurance, depreciation in capital costs, maintenance, salaries for supervisory staff and travelling costs would account for Rs. 100,000, leaving a profit of Rs. 50,000 which means a rate of return of about 20%.

It has been accepted by the operators, though rather reluctantly for reasons obvious, that trawling activity --which looked gloomy and faced an economic breakdown in 1982 -- has brightened in the last three years, mainly because there is no uneconomical season now. The high-opening trawl design, unfortunately modified by the operators to have a very close-meshed cod-end, has made this possible.

## **3.2 Gujarat**

### **3.2.1 Production**

The average annual production for the decade ending 1983-84 was 206,000 t and the highest 230,000 t, according to the State Government's statistics. From a level of 223,000 in 1983/84 the total production shot up to 291,000 t in 1984/85 and to 307,000 t in 1985/86 (Table 10). Although data on trawler catches alone were not readily available from the same source, it could be observed from other evidence --such as the species composition of the landings, the district-wise break up of landings, the landings data on the World Bank Project area of Veraval-Mangrol, the number of trawlers in the State in successive years, and CMFRI data --that it is the returns from the trawlers that made possible this quantum jump in the catch. The increase of 84,000 t in 1985/86 over 1983/84 was brought about by an increase of 48,000 t from the small sized croakers (*Otolithos* spp, *Johnius* spp, *Nibea* spp and *Kathala axillaris*), 13,000 t from hairtails, 5000 t from squids/cuttlefish and 6000 t from clupeoids--all of which are important components of trawler catches. It is also seen that Junagadh district, which has the largest number of trawlers, contributed to an increase of 70,000 t (Table 12). The landings at Veraval, the most important trawler landing centre in Junagadh district as well as in the whole State, leaped from 58,000 t in 1983/84 to 141,000 t in 1985/86, an increase of nearly 150% (Table 11).

From a figure of 1705 as of March 1983, the number of trawlers in the State increased to 1919 as of March 1986, adding a fleet of 214 trawlers during the three year period. Compared to this, there was no addition to the number of trawlers from 1981 to 1982; in 1983 there were 75 boats less, probably because of the November 1983 cyclone.

The CMFRI statistics also show that in 1984/85, the trawler landings of the State registered a 50% increase over those of 1983-84, from 87,000 t to 126,000 t. The catch per unit operation increased from 1018 kg to 1365 kg. The CMFRI data also indicate that the total landings in the State increased in 1984/85 by 70,000 t over those of 1983/84, which come close to the figure of the State Government.

All this information would leave no doubt about the role of the trawlers in augmenting the State's total marine fish production. As will be presented later, in a study conducted by the Aquatic Sciences Research Station of the State Fisheries Department, it was seen that the catches of the high-opening trawls were 26% higher than those of the conventional shrimp trawl.

### **3.2.2 Trawl design**

Trawlers carry CS (940 meshes of 60 mm with the cod-end mesh of 15 mm) and OF and operate the one which is more productive. They do not hesitate to operate the high-opening trawl even during the peak prawn season, if they encounter any big shoal of quality fish, as happened during winter 1984, when large quantities of red snapper were hauled in.

Initially during 1984, the operators availed themselves of the readymade nets from the Gujarat Fisheries Central Cooperative Association (GFCCA) and also fabricated their own nets based

**Table 11**  
**Estimated marine fish landings in Veraval, 1982/83-1985/86**

	(tonnes)			
<b>Group</b>	<b>1982/83</b>	<b>1983/84</b>	<b>1984/85</b>	<b>1985/86</b>
Elasmobranchs	1289	1284	2438	4077
Eels	1431	1196	987	2345
Cat fishes	1172	1114	1363	2423
Clupeids	2280	4344	2630	4841
Bombay duck	1671	18	2	113
Small croakers	30558	33346	51040	80284
Large croakers	617	900	675	1642
Pomfrets	588	855	855	1957
Hairtails	1617	2364	3997	10894
Seer fishes	1053	681	1031	1280
Shrimps & prawns	4202	4812	4313	5417
Squids/cuttlefishes	2051	2142	3570	7852
Others	9507	10988	9266	17393
<b>Total</b>	<b>58036</b>	<b>64044</b>	<b>82167</b>	<b>140518</b>

Source: Office of the Deputy Commissioner of Fisheries, Government of Gujarat, Veraval.

**Table 12**  
**District-wise marine fish landings in Gujarat, 1981/82-1985/86**

	(tonnes)				
<b>District</b>	<b>1981/82</b>	<b>1982/83</b>	<b>1983/84</b>	<b>1984/85</b>	<b>1985/86</b>
Valsad	7695	7847	9542	14570	12831
Surat	1334	1127	1255	625	858
Bharuch	1293	1105	2593	1575	711
Kheda	366	1108	1824	1586	1280
Bhavnagar	760	1155	1834	873	585
Amreli	37985	21116	29868	54047	33887
Junagadh	128695	115241	124315	149987	194095
Jamnagar	34167	29687	27443	31521	25238
Rajkot	1978	498	1302	701	1674
Kutch	6334	13785	23315	34295	35417
<b>Total</b>	<b>220607</b>	<b>192669</b>	<b>223291</b>	<b>289780*</b>	<b>306576</b>

\* Excludes 928 tonnes fish production of Ahmedabad.

Source: Commissionerate of Fisheries, Government of Gujarat.



on the BOBP design, 320 meshes of 160 mm with the cod-end mesh of 30 mm. Of late, for reasons best known to them, the design is being altered to one of 374 meshes of 80 mm. This gives a circumference of 29.9 m as against 51.2 m of the design initially introduced. The wings have 120 mm meshes and side panels (making it 4-seam) of length 7.4 m (62 meshes). The overall length of the net is 34.9 m as against the original design of 43.5 m.

Besides the above modification, the net was being fabricated during 1984/85 in one of three ways :

- (i) Wings and front portion of belly with machine-made webbing of 160 mm and 120 mm (employment of 160 mm mesh is slowly being discontinued) ; the lower portion of belly and cod-end from CS.
- (ii) wings and upper portion of belly (120 mm mesh) from the used gillnet and the lower portion from CS.
- (iii) Nylon monofilament of 0.80 mm diameter, light blue in colour, used for the front panels of the belly.

Thus the tendency is unfortunately one of reverting to shrimp oriented operations with close-meshed cod-ends. It is puzzling why this is being resorted to even after trawler operators have perceived and experienced the advantages of the high-opening bottom trawl -affectionately termed as 'disco trawl' by local fishermen.

### 3.2.3 *Netting material*

The GFCCA distributed a total of 169 readymade nets -77 in 1983/84, 84 in 1984/85 and 8 in 1985/86. The quantity of mesh-wise webbing released through the GFCCA outlet at Veraval during these years is given in Table 13. Before 1983-84, HDPE webbing was not produced. It may be seen that the largest quantity (1738 nets) was distributed in 1984/85. For each mesh size, from 60 mm to 160 mm, the quantity of webbing released was within 400 to 500 kg. However, in 1985/86 the offtake of 160 mm was very low and that of 60 mm considerably reduced; the largest offtake was for 80 mm. This trend would also confirm the trawler operators' preference for fabricating the modified design of 80 mm mesh in the front part of the belly and 120 mm mesh for the wings.

### 3.2.4 *Deck equipment*

So far no gantry has been installed in any boat. It is learnt that in one of the new boats being constructed, a gantry may be installed. It was reported that a tiltable drum winch cannot be installed in the Gujarat boats, for the cabin is almost mid-ship. But such a conclusion is too sweeping in the absence of an in-depth study to substantiate it. Almost all boats are rigged with split links. No cod-end clips are in use. It was learnt that the State Government might experiment with lighter otter boards.

### 3.2.5 *Economics*

During the introductory stage, in March 1983, one boat employing the high-opening fish trawl reported a gross income of Rs. 14,530 and a net income of Rs. 7,530 in four days (Monthly Progress Report on "Training in Diversified Fishing for Artisanal Fishermen" by CIFNET and the Department of Fisheries, Government of Gujarat). Apart from this, although there are some published data on the gross income, there are more on the economics of operation. Collection of such data is rendered difficult due to disposal of the catch to three different parties engaged respectively in purchase of prawns, quality fish and miscellaneous low-value fish. Besides, it is also reported that in many cases there is a fourth party known locally as 'Gamut' to whom the operators sell small amount of prawns and high value quality fishes.

A comparative study was made by the Gujarat Fisheries Aquatic Sciences Research Station (Annual Scientific Report for 1984/85) on the performance of CS and OFS during one season (September 1984 to April 1985) operated by identical-sized boats with engines of the same horse-power. The study revealed that the total catch of OFS was 26% higher than that of CS

**Table 13****Distribution of HDPE webbing by Gujarat Fisheries Central Cooperative Association, Veraval, 1983/84-1985/86 (in kg)**

Mesh size (mm)	1983-84	1984-85	1985-86
60	152	400	239
80	69	490	523
120	107	434	390
160	196	414	47
Total	524	1738	1199

**Table 14****Comparative performance of CS and OFS at Veraval for the period, September 1984 to April 1995**

Item	CS		OFS	
	Quantity (kg)	Value (Rs.)	Quantity (kg)	Value (Rs.)
Giant prawn	270	16740	321	19902
Large prawn	450	17100	535	20330
Medium prawn	325	6500	465	9300
Small prawn	3580	21000	1500	9000
Lobster	120	4200	165	5775
Sand lobster	740	7400	840	8400
Squids/Cuttle fish	3900	11000	5200	14300
Large croakers & Hairtails	11435	14293	19300	23125
Small croakers	67500	46565	80400	53868
Other fishes	15000	22570	21000	31710
Total	103320	167368	129726	195710

Source: Annual Scientific Report for 1984-85, Gujarat Fisheries Aquatic Sciences Research Station, Okha.

and the value was 20% more. This was because more high value prawns, quality fishes and squids/cuttlefishes were captured. The catches were also characterised by fewer low-value small prawns and small croakers (Table 14).

From a survey undertaken during November 1985 to March 1986 by the Government of Gujarat on boats operating with OF, it is seen that the average catch per boat engaged in daily fishing was 452 kg valued at Rs. 1,276; after deducting running expenses, the net income was Rs. 465. In the case of boats undertaking long trips of an average of three days, the average catch per trip was 2064 kg, valued at Rs. 4,743, and the net income was Rs. 1,888.

The increased catches of hairtails and cephalopods have generated additional earnings from exports. The hairtails weighing more than 400 g each were reportedly exported to Japan as frozen products. While the average procurement price was stated to be Rs. 3/kg, the export price was Rs. 18/kg.

In Gujarat too it would appear that there is no scope for TF. It has neither come into commercial operation nor is it expected to in the near future, mainly because there is opposition from gill-netting operators to pair trawling. However, this is not a reflection on the merits of the gear or the methodology because technically it should be feasible as has been convincingly demonstrated by Taiwanese trawlers, chartered or captured. The boats may have potential for economic operation, but they have to be utilized in deeper waters for untapped resources beyond the present fishing grounds. The skills and knowledge of the operators concerning the technology have also to be improved.

#### 4. FUTURE PROSPECTS

In Tamil Nadu, there may not be any expansion of TF over those now in existence/operation. The comparatively higher investment required in what is otherwise a small-scale sector, the capacity and tenacity required to stand up to the financial strain (the success of TF depends on the availability of large shoals of food fishes, a phenomenon which occurs only occasionally), its seasonality and general opposition from other sectors are reasons why there has been no addition to the number of TF since 1984.

In Orissa, it has not been experimented so far; if fishing trials are undertaken in future they should be demonstrated in offshore areas to ascertain economic feasibility.

With regard to the one-boat high opening trawl of various designs, that of OSF is likely to become popular in all the three States. The main reason is that it can be operated during the off-season for prawns, obtaining returns from available resources of both fish and prawn. This would make the existing small boat trawler industry active almost throughout the year, except when monsoon conditions hinder operations. Concurrently, instead of the originally recommended cod-end mesh of 30 mm, the operators in Tamil Nadu have chosen to make the cod-end closer meshed with 10-15 mm. The fishing pressure is therefore increasing on the prawn stocks, which are already reported to be under the threat of over-exploitation; moreover, juveniles of fishes, including possibly valuable food fishes, are being destroyed to augment fish meal production. There is an urgent need for establishing the identity of these juveniles.

This will have far-reaching consequences unless the situation is checked straightway by bringing in mesh size regulation -there is a provision for it under the Tamil Nadu Marine Fishing Regulation Act/Rules -to the effect that cod-end mesh size should not be less than 40 mm in these trawls.

The existing industry, no doubt, will be affected. But this will pave the way for re-deployment of effort not only to develop driftnet/longline offshore fishery for large pelagics but also to promote a healthier trawl fishery for prawns and fishes.

In Gujarat, the initial euphoria generated reminds one rather uncomfortably of what happened in Tamil Nadu during 1982 and 1983. The catches for the whole state and trawl catches in

some important landing centres increased for two years after adoption of new trawling techniques, only to decline the following year. Along with this trend, the cod-end mesh size got reduced. In Gujarat too, the catches have increased significantly following the introduction of high-opening bottom trawling techniques. The design is now being tinkered with. With what consequence? The coming years will give the answer.

There is no need for the current practice of modifying the OF by adding side panels to the wings and reducing the front panel of the belly to a circumference of only about 30 m as against 52 m of the design introduced. One hopes that the other operators will not tow this line. It is even advisable that the Government of Gujarat steps in at this juncture to prevent the spread of this unhealthy trend.

There has been an increase in the number of trawlers in Valsad, the southernmost district in Gujarat. The fishermen of Valsad operate the OF in Maharashtra waters; it attracts the attention of Maharashtra fishermen, who may take to the design, if they have not already done so.

A party from Kerala came to Madras recently and got fabricated OSF with 840 meshes of 60 mm from one of the counterparts who worked with BOBP during fishing trials.

In Orissa, since the superiority of OSF has been convincingly demonstrated, it is expected that it will have a growing demand. At the same time it is desirable that future trials are taken up offshore to demonstrate economic viability. If it is proved, it will help reduce trawling effort in the inshore area. It may also be necessary to develop an improved type of trawler to stay out for 2-3 days, which would in turn improve economic feasibility.

In addition, right from the start, the State Government should keep an eye on the cod-end mesh size to see that it does not deteriorate to 10-15 mm as happened in Tamil Nadu. If necessary even now requisite legislation may be brought in.

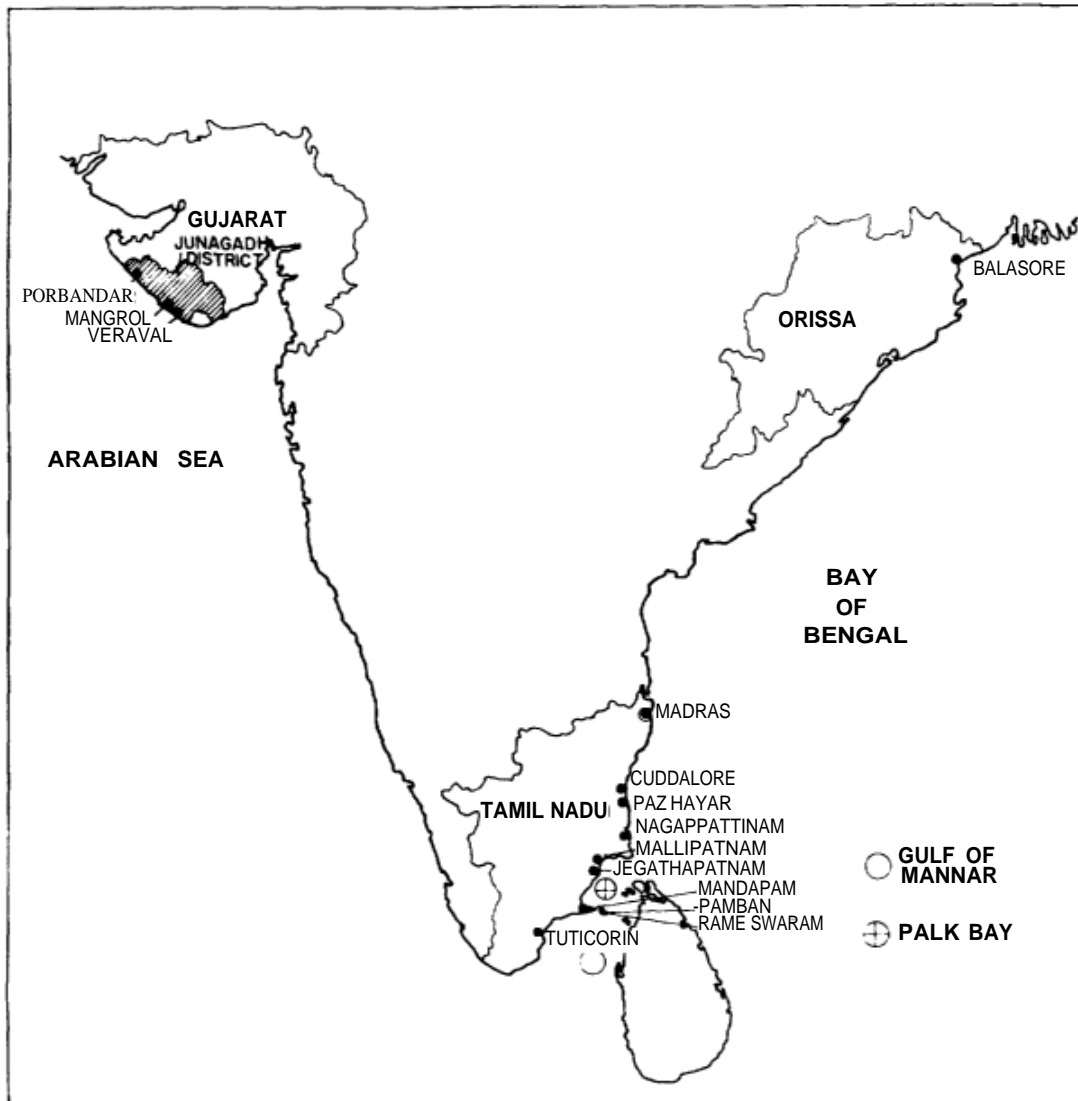
Extension continues to be a weak link in the chain of developmental activities in the country as a whole and these three states are no exception. Whenever a new fishing method has demonstrated its potential for development, it should be ensured that:

- (i) Extra efforts are made to monitor catch statistics of the area, both for new as well as existing techniques, and collect information on the economics of operation and on the social welfare; and
- (ii) Extension work is undertaken by qualified extension officers to popularize the method in the right way, in the way it was intended to be carried out, thus preventing any abuse of the method through *ad hoc* and undesirable changes in the specifications. The positive effect of extension work was clearly discernible at Tuticorin where the method has developed in a healthy manner, desired changes in deck layout have been incorporated, and new trawl accessories accepted. Simultaneously, lack or inadequacy of good extension work in other areas of Tamil Nadu and Gujarat has unfortunately resulted in or is leading to certain unhealthy trends to the detriment of existing and future fisheries.

In general, the following steps should be taken by the State Governments concerned :

- (1) Setting up of a well-organized unit to monitor activities and conduct effective extension programmes to promote the objectives of introducing the new technology.
- (2) This unit should have a qualified fishery extension officer, a fishing technologist and a master-fisherman.
- (3) The technical officers of the area should have a sound knowledge of trawling technology; if not, it should be imparted to them.
- (4) For easier and faster handling of trawling gear, use of gantry and tiltable drum which should be encouraged through demonstration. If necessary, the deck layout of the existing boats may be suitably altered to instal these gadgets.
- (5) For developing offshore fishery, slightly larger boats may have to be designed as the next generation of boats -which, incidentally, would relieve pressure in the inshore area.

HIGH-OPENING BOTTOM TRAWLING LOCATIONS, 1980-85



## *Publications of the Bay of Bengal Programme (BOBP)*

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The BOBP brings out six types of publications:

Reports (BOBP/REP/. . .) describe and analyze completed activities such as seminars, annual meetings of BOBP's Advisory Committee, and projects in member-countries for which BOBP inputs have ended.

Working Papers (BOBP/WP/. . .) are progress reports that discuss the findings of ongoing BOBP work.

Manuals and Guides (BOBP/MAG/. . .) are instructional documents for specific audiences.

Miscellaneous Papers (BOBP/MIS/. . .) concern work not originated by BOBP — but which is relevant to the Programme's objectives.

Information Documents (BOBP/INF . . .) are bibliographies and descriptive documents on *the* fisheries of member-countries in the region.

Newsletters (Bay Of Bengal News), issued quarterly, contain illustrated articles and features in non-technical style on BOBP work and related subjects.

A list of publications follows.

### Reports (BOBP/REP/. . .)

1. Report of the First Meeting of the Advisory Committee. Colombo, Sri Lanka, 28-29 October 1976. (Published as Appendix 1 of IOFC/DEV/78/44.1, FAO, Rome, 1978)
2. Report of the Second Meeting of the Advisory Committee. Madras, India, 29-30 June 1977. (Published as Appendix 2 of IOFC/DEV/78/44.1, FAO, Rome, 1978)
3. Report of the Third Meeting of the Advisory Committee. Chittagong, Bangladesh, 1-10 November 1978. Colombo, Sri Lanka, 1978. (Reissued Madras, India, September 1980)
4. Role of Women in Small-Scale Fisheries of the Bay of Bengal. Madras, India, October 1980.
5. Report of the Workshop on Social Feasibility in Small-Scale Fisheries Development. Madras, India, 3-8 September 1979. Madras, India, April 1980.
6. Report of the Workshop on Extension Service Requirements in Small-Scale Fisheries. Colombo, Sri Lanka, 8-12 October 1979. Madras, India, June 1980.
7. Report of the Fourth Meeting of the Advisory Committee. Phuket, Thailand, 27-30 November 1979. Madras, India, February 1980.
8. Pre-Feasibility Study of a Floating Fish Receiving and Distribution Unit for Dubla Char, Bangladesh. G. Eddie, M. T. Nathan. Madras, India, April 1980.
9. Report of the Training Course for Fish Marketing Personnel of Tamil Nadu. Madras, India, 3-14 December 1979. Madras, India, September 1980.
- 10.1 Report of the Consultation on Stock Assessment for Small-Scale Fisheries in the Bay of Bengal. Chittagong, Bangladesh, 16-21 June 1980. Volume 1: Proceedings. Madras, India, September 1980.
- 10.2 Report of the Consultation on Stock Assessment for Small-Scale Fisheries in the Bay of Bengal. Chittagong, Bangladesh, 16-21 June 1980. Volume 2: Papers. Madras, India, October 1980.
11. Report of the Fifth Meeting of the Advisory Committee. Penang, Malaysia, 4-7 November 1980. Madras, India, January 1981.
12. Report of the Training Course for Fish Marketing Personnel of Andhra Pradesh. Hyderabad, India, 11-26 November 1980. Madras, India, September 1981.
13. Report of the Sixth Meeting of the Advisory Committee. Colombo, Sri Lanka, 1-5 December 1981. Madras, India, February 1982.
14. Report of the First Phase of the "Aquaculture Demonstration for Small-Scale Fisheries Development Project" in Phang Nga Province, Thailand. Madras, India, March 1982.
15. Report of the Consultation-cum-Workshop on Development of Activities for Improvement of Coastal Fishing Families. Dacca, Bangladesh, October 27-November 6, 1981. Madras, India, May 1982.
16. Report of the Seventh Meeting of the Advisory Committee. New Delhi, India, January 17-21, 1983. Madras, India, March 1983.
17. Report of Investigations to Improve the Kattumaram of India's East Coast. Madras, India, July 1984.
18. Motorization of Country Craft, Bangladesh. Madras, India, July 1984.
19. Report of the Eighth Meeting of the Advisory Committee. Dhaka, Bangladesh, January 16-19, 1984. Madras, India, May 1984.

20. Coastal Aquaculture Project for Shrimp and Finfish in Ban Merbok, Kedah, Malaysia. Madras, India, December 1984.
21. Income-Earning Activities for Women from Fishing Communities in Sri Lanka. Edeltraud Drewes. Madras, India, September 1985.
22. Report of the Ninth Meeting of the Advisory Committee. Bangkok, Thailand, February 25-26, 1985. Madras, India, May 1985.
23. Summary Report of BOBP Fishing Trials and Demersal Resources Studies in Sri Lanka. Madras, India, March 1986.
24. Fisherwomen's Activities in Bangladesh: A Participatory Approach to Development. Patchanee Natpracha. Madras, India, May 1986.
25. Attempts to Stimulate Development Activities in Fishing Communities of Adirampattinam, India. Patchanee Natpracha, V.L.C. Pietersz. Madras, India, May 1986.
26. Report of the Tenth Meeting of the Advisory Committee. Male, Maldives. 17-18 February 1986. Madras, India, April 1986.
27. Activating Fisherwomen for Development through Trained Link Workers in Tamil Nadu, India. Edeltraud Drewes. Madras, India, May 1986.
28. Small-Scale Aquaculture Development Project in South Thailand: Results and Impact. E. Drewes. Madras, India, May 1986.
29. Towards Shared Learning: An Approach to Non-formal Adult Education for Marine Fisherfolk of Tamil Nadu, India. L. S. Saraswathi and Patchanee Natpracha. Madras, India, July 1986.
30. Summary Report of Fishing Trials with Large-Mesh Driftnets in Bangladesh. Madras, India, May 1986.
31. In-Service Training Programme for Marine Fisheries Extension Officers of Orissa, India. U. Tietze. Madras, India, August 1986.
34. The Coastal Set Bagnet Fishery of Bangladesh-Fishing Trials and Investigations. S.E. Akerman. Madras, India, November 1986.
35. Brackishwater Shrimp Culture Demonstration in Bangladesh. M. Karim. Madras, India, January 1987.
37. High-opening Bottom Trawling in Tamil Nadu, Gujarat and Orissa, India: A Summary of Effort and Impact. Madras, India, February 1987.

Working Papers (BOBP/WP/ . . . )

1. Investment Reduction and Increase in Service Life of Kattumaram Logs. R. Balan. Madras, India, February 1980.
2. Inventory of Kattumarams and their Fishing Gear in Andhra Pradesh and Tamil Nadu. T. R. Menon. Madras, India, October 1980.
3. Improvement of Large-Mesh Driftnets for Small-Scale Fisheries in Sri Lanka. G. Pajot. Madras, India, June 1980.
4. Inboard Motorisation of Small G.R.P. Boats in Sri Lanka. Madras, India, September 1980.
5. Improvement of Large-Mesh Driftnets for Small-Scale Fisheries in Bangladesh. G. Pajot. Madras, India, September 1980.
6. Fishing Trials with Bottom-Set Longlines in Sri Lanka. G. Pajot, K. T. Weerasooriya. Madras, India, September 1980.
7. Technical Trials of Beachcraft Prototypes in India. O. Gulbrandsen, G. P. Gowing, R. Ravikumar. Madras, India, October 1980.
8. Current Knowledge of Fisheries Resources in the Shelf Area of the Bay of Bengal. B. T. Antony Raja. Madras, India, September 1980.
9. Boatbuilding Materials for Small-Scale Fisheries in India. Madras, India, October 1980.
10. Fishing Trials with High-Opening Bottom Trawls in Tamil Nadu, India. G. Pajot, John Crockett. Madras, India, October 1980.
11. The Possibilities for Technical Cooperation between Developing Countries (TCDC) in Fisheries. E. H. Nichols. Madras, India, August 1981.
12. Trials in Bangladesh of Large-Mesh Driftnets of Light Construction. G. Pajot, T. K. Das. Madras, India, October 1981.
13. Trials of Two-Boat Bottom Trawling in Bangladesh. G. Pajot, J. Crockett. Madras, India, October 1982.
14. Three Fishing Villages in Tamil Nadu. Edeltraud Drewes. Madras, India, February 1982.
15. Pilot Survey of Driftnet Fisheries in Bangladesh. M. Bergstrom, Madras, India, May 1982.
16. Further Trials with Bottom Longlines in Sri Lanka. Madras, India, July 1982.

17. Exploration of the Possibilities of Coastal Aquaculture Development in Andhra Pradesh. Soleh Samsi, Sihar Sircgar and Martono. Madras, India, September 1982.
18. Review of Brackishwater Aquaculture Development in Tamil Nadu. Kasemsant Chalayondeja and Arrant Saraya. Madras, India, August 1982.
19. Coastal Village Development in Four Fishing Communities of Adirampattinam, Tamil Nadu, India. F. W. Blase. Madras, India, December 1982.
- 20.** Further Trials of Mechanized Trawling for Food Fish in Tamil Nadu. G. Pajot, J. Crockett, S. Pandurangan, P. V. Ramamoorthy. Madras, India, December 1982.
21. Improved Deck Machinery and Layout for Small Coastal Trawlers. G. Pajot, J. Crockett, S. Pandurangan and P. V. Ramamoorthy. Madras, India, June 1983.
22. The Impact of Management Training on the Performance of Marketing Officers in State Fisheries Corporations. U. Tietze. Madras, India, June 1983.
23. Review of Experiences with and Present Knowledge about Fish Aggregating Devices. M. Bergstrom. Madras, India, November 1983.
24. Traditional Marine Fishing Craft and Gear of Orissa. P. Mohapatra. Madras, India, April 1986.
25. Fishing Craft Development in Kerala: Evaluation Report. O. Gulbrandsen. Madras, India, June 1984.
26. Commercial Evaluation of IND-13 Beachcraft at Uppada, India. R. Ravikumar. Madras, India, June 1984.
27. Reducing Fuel Costs of Small Fishing Boats. O. Gulbrandsen. Madras, India, July 1986.
28. Fishing Trials with Small-Mesh Driftnets in Bangladesh. G. Pajot and T. K. Das. Madras, India, March 1984.
- 29.** Artisanal Marine Fisheries of Orissa: a Techno-Demographic Study. M. H. Kalavathy and U Tietze. Madras, India, December 1984.
30. Mackerels in the Malacca Straits. Colombo, Sri Lanka, February 1985.
31. Tuna Fishery in the EEZs of India, Maldives and Sri Lanka. Colombo, Sri Lanka, February 1985.
32. Pen Culture of Shrimp in the Backwaters of Killai, Tamil Nadu: A Study of Techno-economic and Social Feasibility. Rathindra Nath Roy, Madras, India, January 1985.
33. Factors that Influence the Role and Status of Fisherwomen. Karuna Anbarasan. Madras, India, April 1985.
34. Pilot Survey of Set Bagnet Fisheries of Bangladesh. Abul Kashem. Madras, India, August 1985.
35. Pen Culture of Shrimp in the Backwaters of Killai, Tamil Nadu. M. Karim and S. Victor Chandra Bose. Madras, India, May 1985.
36. Marine Fishery Resources of the Bay of Bengal. K. Sivasubramaniam. Colombo, Sri Lanka, October 1985.
37. A Review of the Biology and Fisheries of Hilsa ilisha in the Upper Bay of Bengal. B. T. Antony Raja. Colombo, Sri Lanka, October 1985.
38. Credit for Fisherfolk: The Experience in Adirampattinam, Tamil Nadu, India. R. S. Anbarasan and Ossie Fernander. Madras, India, March 1986.
39. The Organization of Fish Marketing in Madras Fishing Harbour. M. H. Kalavathy. Madras, India, September 1985.
40. Promotion of Bottom Set Longlining in Sri Lanka. K. T. Weerasooriya, S. S. C. Pieris, M. Fonscka. Madras, India, August 1985.
41. The Demersal Fisheries of Sri Lanka. K. Sivasubramaniam and R. Maldeniya. Madras, India, December 1985.
42. Fish Trap Trials in Sri Lanka. (Based on a report by T. Hammerman). Madras, India, January 1986.
43. Demonstration of Simple Hatchery Technology for Prawns in Sri Lanka. Madras, India, June 1986.
44. Pivoting Engine Installation for Beachlanding Boats. A. Overa, R. Ravikumar. Madras, India, June 1986.
45. Further Development of Beachlanding Craft in India and Sri Lanka. A. Overa, R. Ravikumar, O. Gulbrandsen, G. Gowing. Madras, India, July 1986.
46. Experimental Shrimp Farming in Ponds in Polekurru, Andhra Pradesh, India. J. A. J. Janssen, T. Radhakrishna Murthy, B. V. Raghavulu, V. Sreekrishna. Madras, India, July 1986.
47. Growth and Mortality of the Malaysian Cockle (Anadara Granosa) under Commercial Culture: Analysis through Length-Frequency Data. Ng Fong Oon. Madras, India, July 1986.
48. Fishing Trials with High-Opening Bottom Trawls from Chandipur, Orissa, India. G. Pajot and B. B. Mohapatra. Madras, India, November 1986.
50. Experiences with Manually Operated Net-Braiding Machine in Bangladesh. B.C. Gillgren. Madras, India, November 1986.
51. Hauling Devices for Beachlanding Craft. A. Overa, P. A. Hemminghyth. Madras, India, August 1986.



53. Atlas of Deep Water Demersal Fishery Resources in the Bay of Bengal. T. Nishida and K. Sivasubramaniam. Colombo, Sri Lanka, September 1986.
54. Experiences with Fish Aggregating Devices in Sri Lanka. K.T. Weerasooriya. Madras, India, January 1987.

*Manuals and Guides (BOBP/MAG/ . . . )*

1. Towards Shared Learning: Non-formal Adult Education for Marine Fisherfolk. Trainers' Manual. Madras, India, June 1985.
2. Towards Shared Learning: Non-formal Adult Education for Marine Fisherfolk. Animators' Guide. Madras, India, June 1985.
3. Fishery Statistics on the Microcomputer: A BASIC Version of Hasselblad's NORMSEP Program. D. Pauly, N. David, J. Hertel-Wulff. Colombo, Sri Lanka, June 1986.

*Miscellaneous Papers (BOBP/MIS/ . . . )*

1. Fishermen's Cooperatives in Kerala: A Critique. John Kurien. Madras, India, October 1980.
2. Consultation on Social Feasibility of Coastal Aquaculture. Madras, India, 26 November-1 December 1984. Madras, India, November 1985.
3. Studies on Mesh Selectivity and Performance: the New Fish-cum-Prawn Trawl at Pesalai, Sri Lanka. M.S.M. Siddeek. Madras, India, September 1986.
4. Motorization of Dinghy Boats in Kasafal, Orissa. S. Johansen and O. Gulbrandsen. Madras, India, November 1986.

*Information Documents (BOBP/INF/ . . . )*

1. Women and Rural Development in the Bay of Bengal Region: Information Sources. Madras, India, February 1982.
2. Fish Aggregation Devices: Information Sources. Madras, India, February 1982.
3. Marine Small-Scale Fisheries of India: A General Description. Madras, India, March 1983.
4. Marine Small-Scale Fisheries of Andhra Pradesh: A General Description. Madras, India, June 1983.
5. Marine Small-Scale Fisheries of Tamil Nadu: A General Description. Madras, India, December 1983.
6. Marine Small-Scale Fisheries of Sri Lanka: A General Description. Madras, India, November 1984.
7. Marine Small-Scale Fisheries of Orissa: A General Description. Madras, India, December 1984.
8. Marine Small-Scale Fisheries of Bangladesh: A General Description. Madras, India, September 1985.
9. Food and Nutrition Status of Small-Scale Fisherfolk in India's East Coast States: A Desk Review and Resource Investigation. V. Bhavani. Madras, India, April 1986.

*Newsletters (Bay of Bengal News) :*

24 issues quarterly from January 1981 to December 1986.