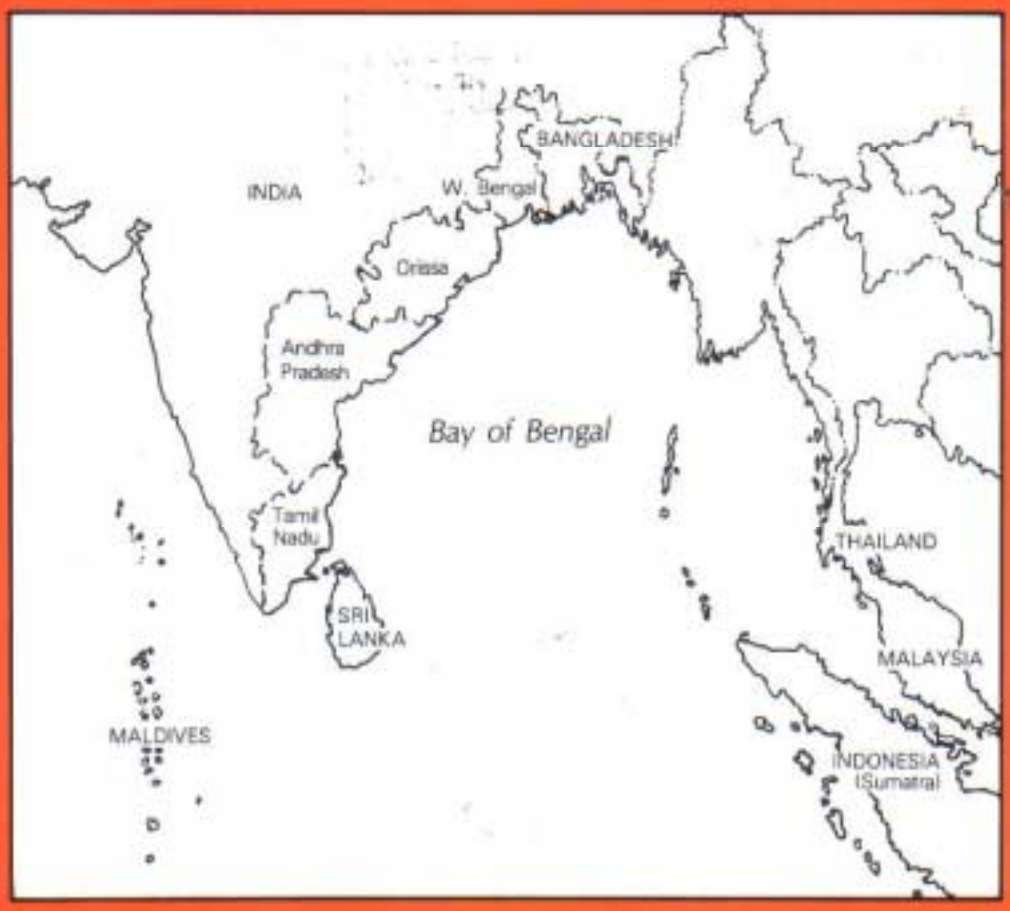
BOBP/REP/49

Introduction of new small fishing craft in Kerala, India



BOBP For Fisheries Development
BAY OF BENGAL PROGRAMME

Introduction of new small fishing craft in Kerala, India

BY

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BAY OF BENGAL PROGRAMME;
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1992

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This report describes attempts to introduce modified and new types of small fishing craft in the State of Kerala India. Three new types were constructed and tested and one type. a beachlanding craft available on the east coast of India, was introduced. All the craft underwent commercial fishing trials. The work was carried out during l Wc)-90.1989-90.

The project. on request from the Government of India. was funded to the tune of US $ 139.000 by FAO under its Technical Cooperation Programme (TCP).

The Kerala State Cooperative Federation for Fisheries Development Limited (MATSYAFED) was designated as the government agency responsible for the project execution. The Bay of Bengal Programme (BOBP) provided technical support, equipment and monitory services to implement the project. Besides the authors, other persons actively engaged in the project work were officials ofthc MATSYAFED, officers and technicians of BOBP, managers and staff of two boatyards and. not least, the fisherfolk.

The Bay of Bengal Programme (BOBP) is a multi-agency regional fisheries programme which covers seven countries around the Bay of Bengal – Bangladesh. India, Indonesia, Malaysia, Maldives, Sri Lanka. Thailand. The Programme plays a catalytic and consultative role: it develops, demonstrates and promotes new techniques. technologies or ideas to help improve the conditions of small-scale fisherfolk communities in member-countries. The BOBP is sponsored by the governments of Denmark. Sweden and the United Kingdom. by member-government!, in the Bay of Bengal region. and also by AGFUND (Arab Gulf Fund for United Nations Development Organizations) and UNDP (United Nations Development Programme). The main executing agency is the FAO (Food and Agriculture Orgunization of the United Nations).

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CONTENTS

		Page
1.	**Background**	
2.	Objectives and approach	3
3.	IND-20 : FRP beachlanding craft, 8.5 m with 9 hp diesel watercooled engine	5
	3. I Fishing trials	
	3.2 Catch	
	2.3 Cost of construction	
	3.4 Engine and speed performance	
4.	IND-27 : Plywood canoe, 9.5 m with 9 hp diesel engine	9
	4. I Fishing trials	
	3.2 Engine and speed performance	
5.	IND-26 : Plywood canoe, 8.5 m with 7 hp outboard motor	11
	5. I Fishing trials	
	S.2 Catch data	
	5.3 Design modifications	
	5.4 Engine and speed performance	
	5.5 Construction materials and costs	
6.	IND-28 : Plywood canoe, 9. 1 m with 9 hp diesel engine	18
	6.1 Engine and speed performance	
	6.2 Cost of construction	
7.	Surf crossing and handling of craft on the beach	20
8.	Economics	20
9.	Summary and conclusions	23

Figures

1.	**Traditional fishing craft in Kerala**	iv
2.	**Map of the project area**	2
3.	**IND-20: General arrangement**	4
4.	**IND-20: Catch record by type of fishing gear**	6
5.	**IND-27: General arrangement**	8
6.	**Installation of diesel engines**	10
7.	**IND-26: Weight and value of catch by fishing gear**	12
8.	**IND-26: Weight and value of catch by species**	12
9.	**IND-26: General arrangement**	14
10.	**Monthly catches by different craft**	15
11.	**Handling of craft on the beach**	21

Tables

1.	**IND-26: Record of catch, earnings and expenses, (Sept 1989-August 1990)**	13
2.	**IND-26: Breakdown of construction costs**	16
3.	**IND-28A: Breakdown of construction costs**	19

Publications of the Bay of Bengal Programme 25

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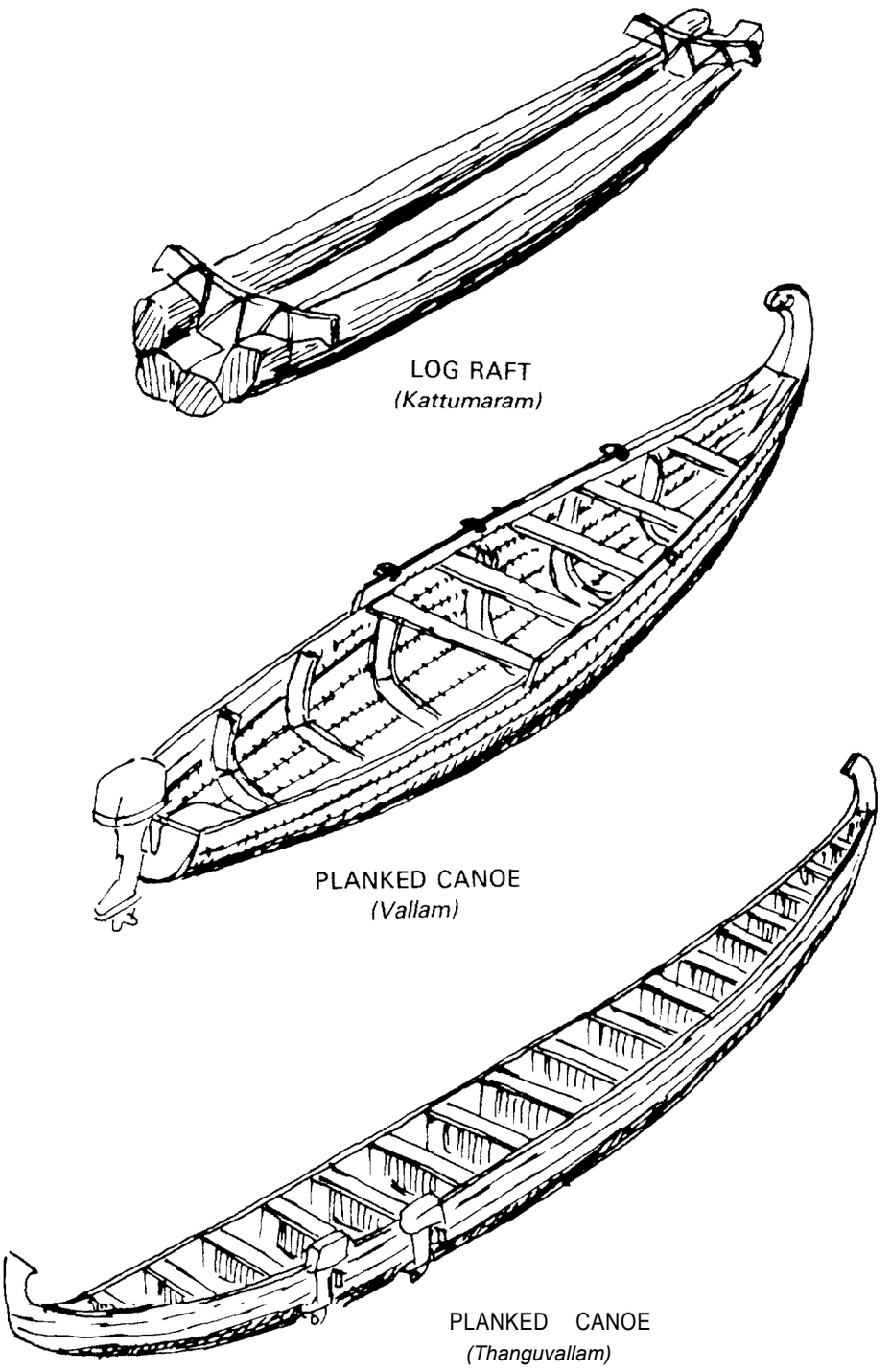
Fig. 1. Traditional fishing craft in Kerala



1. BACKGROUND

The marine fish landings of the State of Kerala constitute nearly one third of India's total fish production and a corresponding number of India's seagoing fishermen live in the State. The density of the fisher population in relation to the rest of India is very high. There are about 148,000 active marine fishermen (1988) and the number is increasing. Landings. during the period 1980-88, has averaged 330,000 tonnes per year of which about two-thirds are landed by the small-scale sector. The production has not shown a long term increase, although there can be large variations from year to year, depending on the abundance of the main pelagic species: oil sardine, mackerel and small tuna.

The traditional fishing fleet comprises **about** 35,000 craft of which 25,000 are planked canoes *(vallam, thanguvallam)* and 10,000 log rafts *(kuttumaram).* Sketches of them are shown in Figure 1 (see facing page). There are also about 3500 larger **boats fitted** with inboard diesel engines, of which about 2500 are doing trawling and the others driftnetting, hook and line fishing and purse seining.

The first attempt to motorize traditional craft was made by the indo-Norivegian Fisheries Project in 1955. The project concluded that motorization of the traditional planked canoe *(vallam),* although technically feasible, was not economically viable at that time. The Indo-Belgium Fisheries Project during 1970-73 made an attempt to motorize Log rafts *(kattumaram)* in the Kanyakumari district of Tamil Nadu with 25 hp outboard motors. This project failed mainly due to the selection of a too costly outboard motor and problems of engine service.

In 198 l-82, an FAO project investigated the possibility of improving the sailing performance by introducing a new plywood craft *(Fishing Craft Development in Kerala.* BOBP/WP/25, Madras, 1984). Although the sailing performance was much improved, fishing trials showed that favourable sailing wind was only available 50 per cent of the time. Usually sail could be used when going fishing in the evening, while the return during the night had to be made with the help of oars.

The plywood canoes were then fitted with 7 hp outboard motors which resulted in complete abandonment of the sail. The data collected over a one-year period indicated that although the outboard motors increased the landings, the income per crew member was not increased. The report recommended a cautious approach in motorization and the **use** of 4 hp outboard motors on the canoes.

From 1982, however, the motorization of traditional craft started in earnest. The fishermen appreciated the speed obtained with the 7 hp outboard motors and would not consider any smaller engines. Some of the canoes are now fitted with outboard motors of 15 hp and the larger *thanguvallams* with motors up to 40 hp.

Attempts in 1980-82 to introduce diesel outboard motors made in India by one manufacturer failed because of the difficulty of achieving the same speed as with the kerosene outboard motors. There were also problems with the reliability.

In 198 1, the Kottar Social Service Society (KSSS) in Kanyakumari District, Tamil Nadu, started a boat building project in cooperation with the Intermediate Technology Development Group (ITDG). A method for building plywood boats called 'stitch and glue' was introduced. Initial trials with a twin hull craft was a failure, but a plywood *canoe,* the *ply-valfam,* modelled along the lines of the traditional canoes, gained acceptance by the fishermen. The ply- *vallam* was intended for sailing, but the fishermen soon found out that it gave higher speed than the traditional planked canoes when fitted with a 7 hp outboard motor and the ply-vallam rapidly increased in popularity; the original concept of a non-motorized, sailing *ply-vallam* had no appeal.

Construction of the ply-vallam, and the decked model called *kotturkat,* is done in several boatyards in Kerala operated by the South Indian Federation of Fishermen's Societies (SIFFS) and in a few private boatyards. More than a thousand plywood canoes have been built since the project started in 1982.

In 1984, the Government of India requested FAO assistance to implement a project to test different types of craft that might be suitable for the Kerala fishery. The project was approved by in late 1988 under its Technical Cooperation Programme (TCP).

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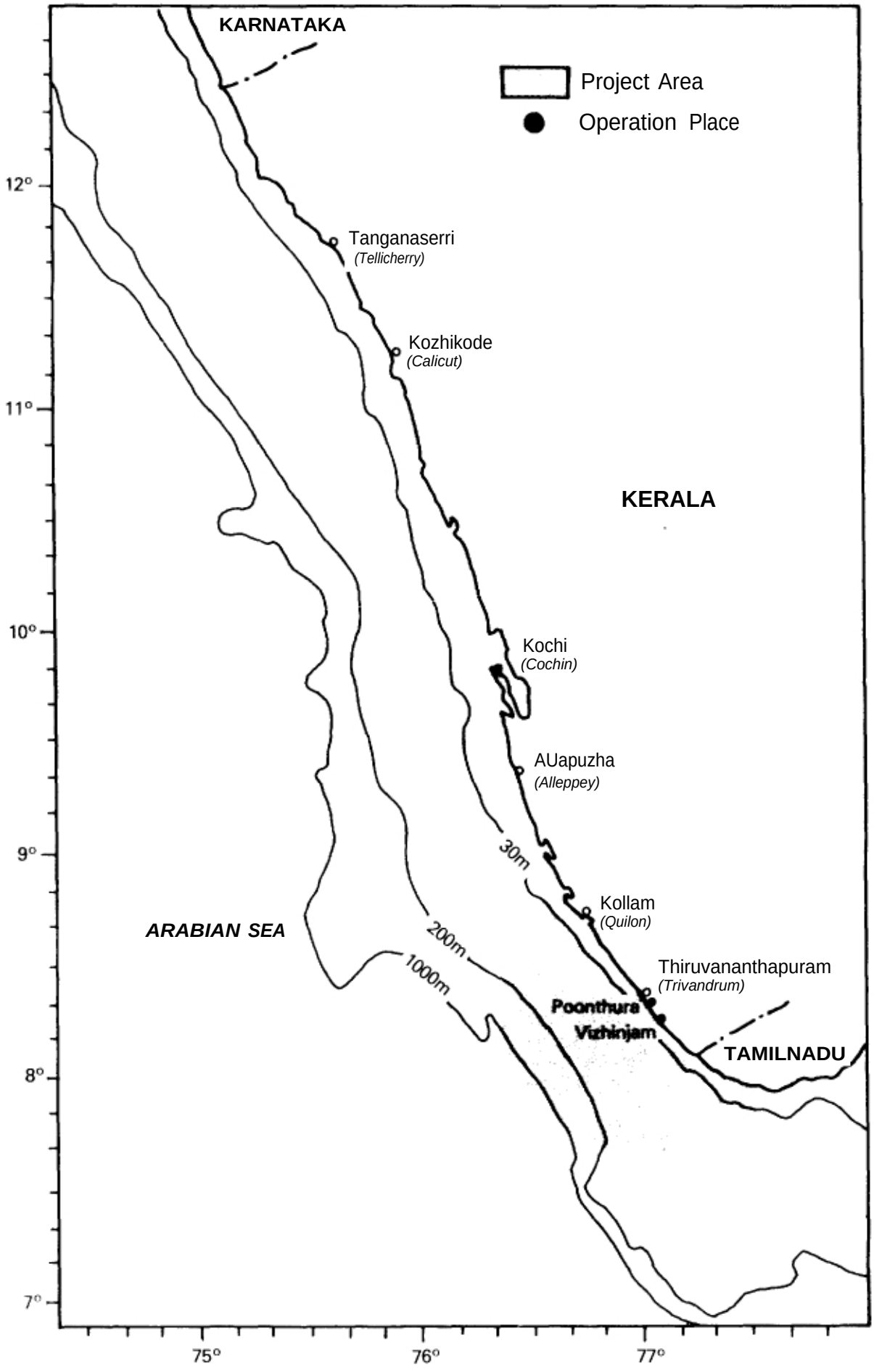
Fig. 2. Map of the project area



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2. OBJECTIVES AND APPROACH

The original project objective, formulated in 1984, was to increase the production of motorized fishing craft in Kerala State and to train the local fishermen in their use. At the inception of the project in November 1988 the objectives were sharpened and redefined as **introduction of new types of cost effective motorized fishing craft and training of local fishermen in their use.**

The preconditions for success in introducing diesel powered canoes in Kerala are:

- Introduction of the diesel boat, initially, in a limited area;
- A diesel engine installation with a proven reliability;
- Availability of a trained mechanic;
- Availability of spare parts; and
- Training of fishermen in day-to-day use and maintenance.

Considering the high degree of motorization of small fishing craft at the start of the project, one of the approaches had to be based on exploitation of resources outside the reach of the traditional canoes ***(vallam*** and ***thanguvallam)*** and log raft ***(kattumaram).*** This, it was decided, would be possible, by using an IND-20 type of beach- landing craft employing large mesh driftnet, drift longlines and trolling lines for tuna, shark and billfish species in the range of about 30 nautical miles from the shore. The IND-20 had been developed by BOBP as a beachlanding craft for the east coast of India and more than two hundred of these craft are in use in Andhra Pradesh and Orissa, mainly for large mesh driftnet fishing. To reach fishing areas about 30 nautical miles from the shore, a running time of about five hours would be required, and experience from the east coast showed that for such prolonged operations a watercooled diesel engine was preferable. The project therefore undertook to install a watercooled diesel engine of 9 hp in one of the existing IND-20 boats already available with MATSYAFED and to use this boat to determine the feasibility of fishing further offshore.

The IND-20, made of FRP, had been developed for the moderate to heavy surf conditions prevailing on the east coast and was felt to be unnecessarily expensive for the Kerala conditions. It was, therefore, decided to test a lighter, cheaper craft with the same fishing capacity as the IND-20 upto a distance of about 30 nautical miles. The model was called IND-27 and was a 9.5 m long canoe built of marine plywood, powered with a 9 hp watercooled engine fitted with a reverse/reduction gearbox and a propeller in a tunnel to permit beachlanding.

The other approach was to demonstrate a suitable design and good construction practices of new canoes as replacements of planked canoes or alternatives to the ply-vallams for inshore fisheries upto about 15 nautical miles. The resulting prototype was the IND-26, a canoe 8.5 m long and powered with a 7 hp kerosene outboard motor. The most common fishing gear for such a craft would be small mesh driftnet and hook-and-lines.

During the course of the project, as experience was gained, it was decided to introduce a third prototype, the IND-28, a 9.0 m canoe based on the IND-26 design, but equipped with an inboard diesel engine with a liftable propeller and rudder.

For construction of the prototypes, MATSYAFED selected a private boatyard in Vizhinjam and SIFFS in Trivandrum. The construction work was supervised by BOBP staff. Detailed records were kept on the quantity of materials utilized and this was to serve as a basis for a realistic costing of the craft. Labour costs for building the prototypes were, of course, higher than what could be expected during commercial production.

Due to the limited duration of the project, it was necessary to concentrate the fishing trials of the new craft to one area of Kerala. MATSYAFED selected Vizhinjam harbour and the nearby Poonthura beach village in Trivandrum District (Figure 2, see facing page) as base for the trial fishing.

The government cooperating agency, MATSYAFED, provided two full-time staff members to supervise fishing craft operation and for data collection, and financed the construction of the prototype craft.

FAO provided a short term consultant in Naval Architecture and other BOBP staff for supervision of construction of prototype craft and of fishing trials.

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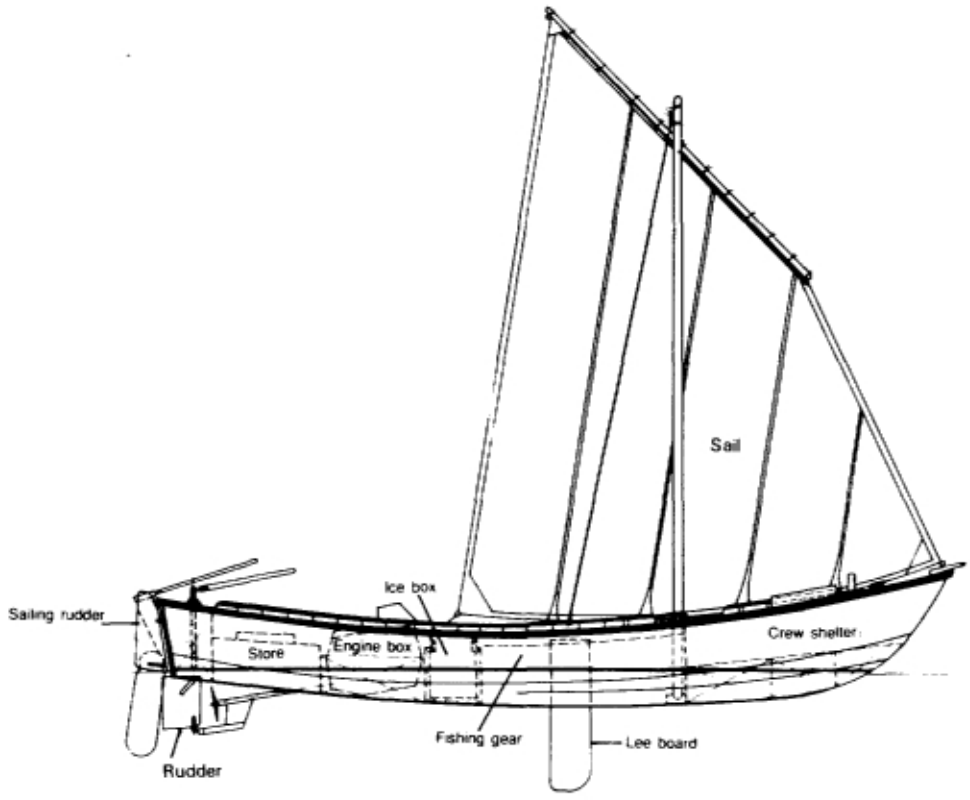
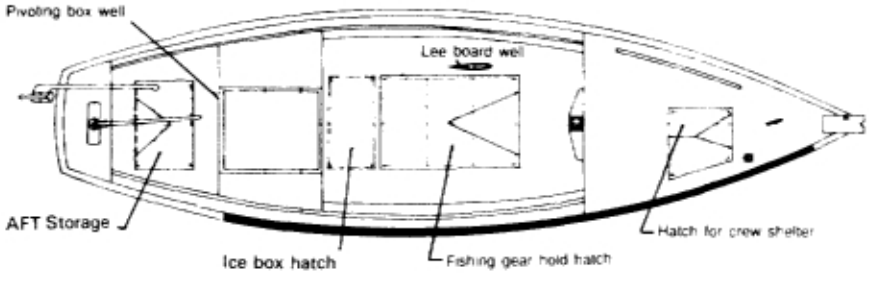
Fig. 3. IND-20: General arrangement





PARTICULARS

Length overall	LOA	8.5 m
Beam moulded	B	2.27 m
Depth moulded	D	0.83 m
Cu No	LOA x B x D	15.88 m
Engine	Diesel	9 hp
Sail	Dipping lug	20 m

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3. IND-20: FRP BEACHLANDING CRAFT, 8.5 m WITH 9 hp DIESEL WATERCOOLED ENGINE

3.1 Fishing trials

The modified IND-20 with a 9 hp watercooled diesel engine (Figure 3, see facing page) was operated partly from Vizhinjam harbour and-partly from Poonthura village. Several fishing gear were **tried (see** table below). Large mesh driftnets were operated during June 1989- February 1990 while small mesh driftnets were used during the period March-August 1990. The driftnets were usually set once a night. Drift longlines and bottom longlines were only used for a few trials. Trolling lines were operated throughout the daylight period to and from the fishing ground.

Fishing gear

Twine size (denier)	Stretched mesh size (mm)	Hook per piece (No.)	Hung length per piece (m)	Cost per piece (Rs)	Pieces (No)	Total length (m)	Total cast (Rs)
Large mesh driftnet							
21od18	I 10		60	3700	3	180	11,100
2lod18	120		66	3600	7	469	25,200
2lod18	140		77	3500	7	539	24.500
							60,800
Small mesh driftnet							
21od9	80		104	3500	15	1560	52,500
Trolling line (Multi hooks/lines)							
		10	100	loo	2	100	200
Drift longline							
		5	150	1100	20	3ooo	22.000
Bottom longline							
		300	350	1070	3	1050	3,210
						TOTAL COST (Rs)	138,710

Initially, the target species for the IND-20 were, primarily, the larger tuna, shark and billfish species further offshore. The fishing area was 20-30 nautical miles out from Vizhinjam.

The boat would leave for fishing about 13.00 hours and return the next morning at about 09.00 hours. With an average speed of 5.5 knots, it took 4-6 hours to reach the fishing area. The engine was used for about 10- 11 hours on each trip and the fuel consumption was about 20 litres of diesel. The crew was normally four persons.

The operational data of the IND-20 over a one-year period shows that there were 247 fishing days. The reasons for not fishing on the remaining days were:

Holidays	61
Engine problems	29
Rough weather	13
Mending of fishing gear	6
Other reasons	9
TOTAL NON-FISHING DAYS	118

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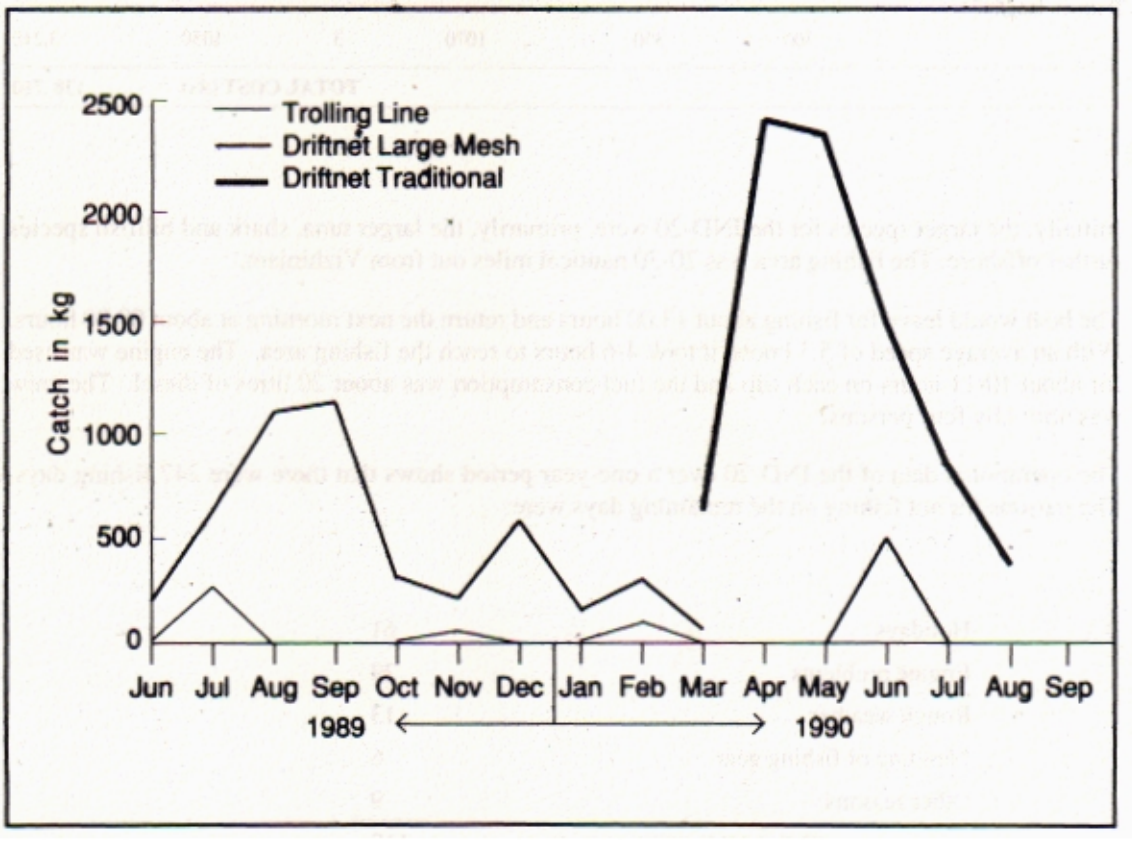
The IND-20, 8.5 m with 9 hp dieselwater-cooled engine

Fig. 4. IND -20 : Monthly catch record by type of fishing gear



3.2 Catch

The record of the catch by type of fishing gear is shown in Figure 4.

The catch with large mesh driftnet in the offshore area was very low (Figure 4, see facing page). During the nine-month period, 155 trips were made and average catch of 30 kg/trip was recorded, which is clearly insufficient for economic viability. A few trials were made with pelagic drift longline for shark, using 20 baskets each of 150 m and 5 hooks. The results were very poor. The use of the bottomset longline of 1000 m with 350 hooks proved to be difficult, due to interference by large trawlers operating at depths ranging from 100 to 250 m and at a distance of 25-30 nautical miles from shore. The fishing area was, therefore, changed in March 1990 to 10-15 nautical miles inshore. The fishing gear too was changed to small mesh driftnets. During the six month period March - August 1990 the average catch per trip increased to 66 kg/trip. The total length of net utilized, however, was about 1200 m and this proved to be difficult to supervise. Several cases of stealing of fish from the net were reported.

As a result of these trials it was concluded that the offshore trials with the IND-20 were negative, the main reason seeming to be the poor availability of large pelagic species within the range of operation of IND-20 because of the width of the continental shelf. Whereas a depth of 200 m is reached 30 nautical miles from Vizhinjam, this depth is reached about 20 nautical miles from the shore on the east coast of 1ndia, where IND-20 operates successfully with large mesh driftnets and drift longlines for large pelagic species.

3.3 Cost of construction

The following cost of the IND-20 is based on the price of the craft as delivered from the Andhra Pradesh Fisheries Corporation Boatyard in Kakinada on the east coast:

	Rs
Hull	72,000
Engine 9 hp (diesel)	22, ooo
Engine installation	22, 000
Sail rig	2000
TOTAL	118,000
Fishing Gear (large mesh driftnets)	60,000
TOTAL INVESTMENT	178,000

The low catches obtained with large mesh driftnets during the fishing trials show that this craft is not economically viable in this part of Kerala. For inshore fishing with small mesh driftnets, the IND-20 is unnecessarily expensive. The same fishing results can be produced with cheaper craft.

3.4 Engine und speed performance

The IND-20 has a 9 hp watercooled diesel engine with a liftable propeller and rudder and the engine fitted in a watertight box. The installation incorporates a reduction gearbox (no neutral and reverse). The method of installation has been proven on the east coast, with few problems experienced with the installation itself.

The problems that occurred on the IND-20 in Kerala were mainly related to a malfunctioning water pump. resulting in overheating and loss of fishing days. The boat lost a total of 29 fishing days due to engine problems in a one-year period. This is about twice as high as on the outboard powered IND-26. Although a diesel engine should basically be more reliable than an outboard kerosene/petrol motor, there have been several quality problems connected with the Indian-made diesel engines which the imported outboard motors do not suffer from

The speed of the IND-20 is 556.0 knots (while the IND-26 and IND-28 do 7- 7.5 knots). Speed is a very important status factor for the fishermen in Kerala. For this reason alone, it is difficult to introduce this typc of IND-20 in Kerala. On the east coast, where there are very few craft with outboard motors, there is no problem in finding acceptance among the fishermen for the slower IND-20.

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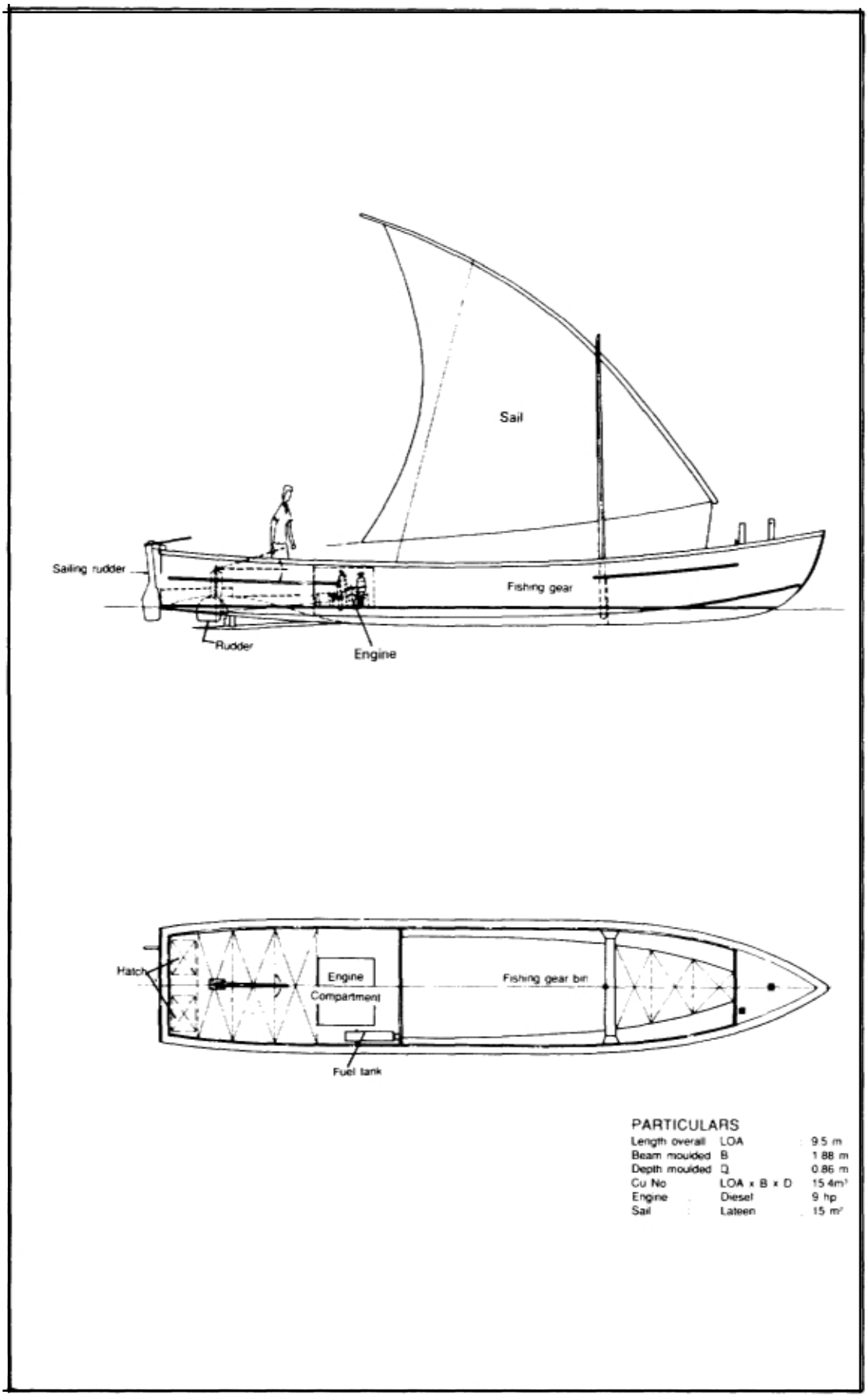
Fig. 5. IND-27: General arrangement



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The IND-27, 9.5m with 9 hp diesel water-cooled engine

4. IND-27 : PLYWOOD CANOE, 9.5 m WITH 9 hp DIESEL ENGINE

4.1 *Fishing trials*

The IND-27 (Figure 5, see facing page) was designed to carry out large mesh driftnet fishing 20-25 nautical miles from the shore. Constructed of plywood, instead of FRP, and not decked, the investment in it was less than in the IND-20

Fishing trials started with the IND-27 in June 1989, but due to continuous problems with the reverse/reduction gearbox, the trials had to be discontinued. In view of the poor catches by IND-20 in the offshore fishery, it was decided not to pursue similar trials but to modify and use the IND-27 to test a new liftable propulsion system.

4.2 *Engine and speed performance*

The diesel engine in IND-27 was the same 9 hp watercooled VST engine used in the IND-20. The installation was, however, different, the propeller and rudder not being liftable, and fitted inside a tunnel for protection when beachlanding. With this fixed installation, a reverse/reduction gearbox was required when setting and hauling the fishing gear. (The liftable propeller system permits a neutral without a gearbox; this is possible because, in the lifted position, the propeller is run in air and does not move the boat. Some degree of control when setting and hauling nets is also possible by operating the propeller in a semi-submerged position.)

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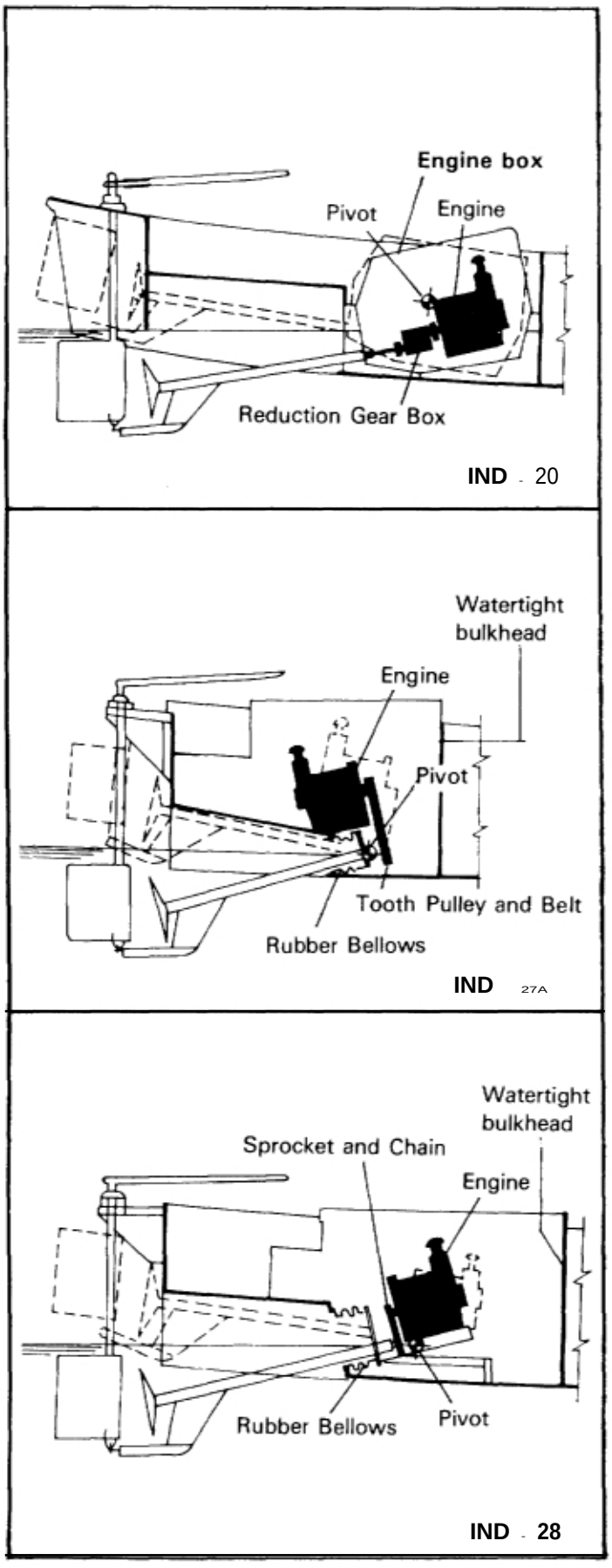
Fig. 6. Installation of diesel engines



The reverse/reduction gearbox fitted to the IND-27 engine gave repeated problems and, even though close contact was kept with the manufacturer to find a satisfactory solution, it was finally concluded that the available reverse/reduction gearbox of this engine was not dependable enough for a fishing boat. There were also problems with the clearing of nets that got entangled with the propeller inside the tunnel.

The engine installation of IND-27 was, therefore, changed in June 1990 to a liftable propeller system (IND-27A) similar to the IND-20, hut rubber bellows were used instead of a watertight box to permit the pivoting of the engine and the propeller (Figure 6). This proved not only cheaper to install hut it also provided more room to work on the engine.

The question of safety of the rubber bellows system was raised in connection with the possibility of the rubber bellows fracturing and resulting in flooding of the engine compartment. This isan unlikely scenario, nevertheless the consequences were tested loosening the hose clamps on the bellows on the IND-27A. It was found that water entering the engine compartment would rise to 30cm above the bottom planking and then stop when equilibrium with the sea level was established.

The watertight bulkhead in front of the engine is an important feature. Adverse stern trim of the boat can he prevented by shifting the crew and fishing gear forward. Since the engine is well above the water level, it can he operated at a reduced speed to reach the shore safely.

The modified IND-27 (IND-27A). shortened by 0.5 m to 8.5 m. made a speed of 6.9 knots in calni water with a load of 50() kg (eight men).

The IND-26. 8.5m with 7 hp outboard motor

5. *IND-26 : PLYWOOD CANOE, 8.5 m WITH 7 hp OUTBOARD MOTOR*

5.1 Fishing trials

The prototype IND-26 (Figure 9, see page 14) was transferred to a crew of three fishermen in Poonthura village in June 1989. The canoe was equipped with the following fishing gear:

Type of Fishing **Gear**

Twine size (denier)	*Stretched mesh size (mm)*	*llung length per piece (m)*	*Cost per piece (Rs)*	*Pieces (No)*	*Total length (m)*	*Total cost (Rs)*
Traditional driftnets						
210d3	62	140	3000	5	700	15,000
210d3	80	120	3500	2	240	7,000
210d9-12	90	140	4500	3	420	13,500
Trammelnet (disco)						
210d9	300					
210d2	20	135	2000	2	270	4,000
HOOK AND LINE *(Multi-hook trolling line and handline)*				2	100	500
				TOTAL COST (Rs)		40,000

Fishing with small mesh driftnets is generally carried out 10-15 nautical miles from the shore. The outboard powered canoes leave about 15.00-16.00 hours and return the next morning at about 07.00 hours. At a speed of 7 knots it takes upto two hours to reach the fishing area.

The fishermen constantly adopt different combinations of nets, but most commonly use four nets of 62 mm and two nets of 80 mm, a total length of 800 m. The reason for not using more nets, as stated by the fishermen, was the difficulty of supervising the end of the fleet of nets stretching further than 800-900 m from the boat; other boats could start hauling in the nets at that end and steal not only the fish but, sometimes, even the nets. There is, therefore, little advantage in Kerala in using small mesh

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Fig. 7. IND-26 : Weight and value of catch by fishing gear

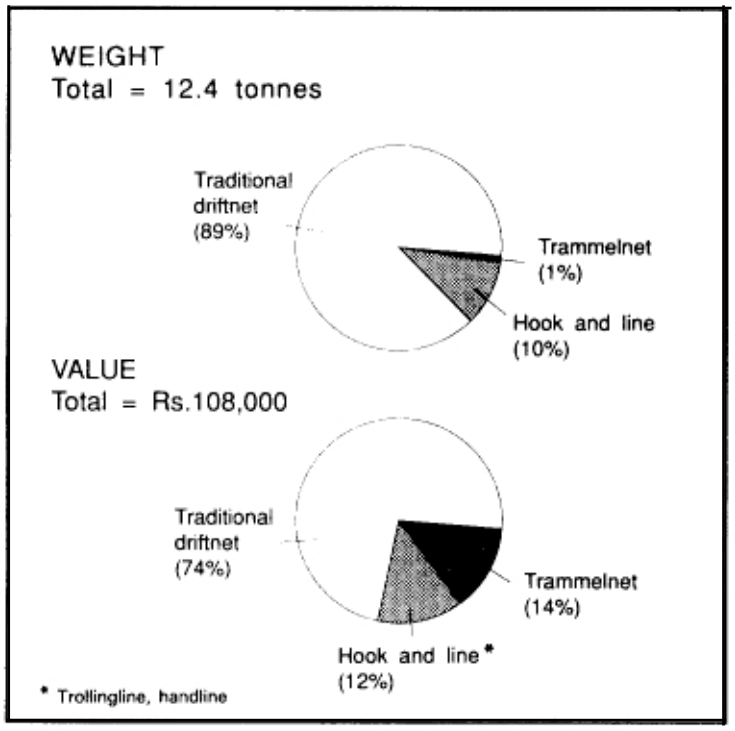
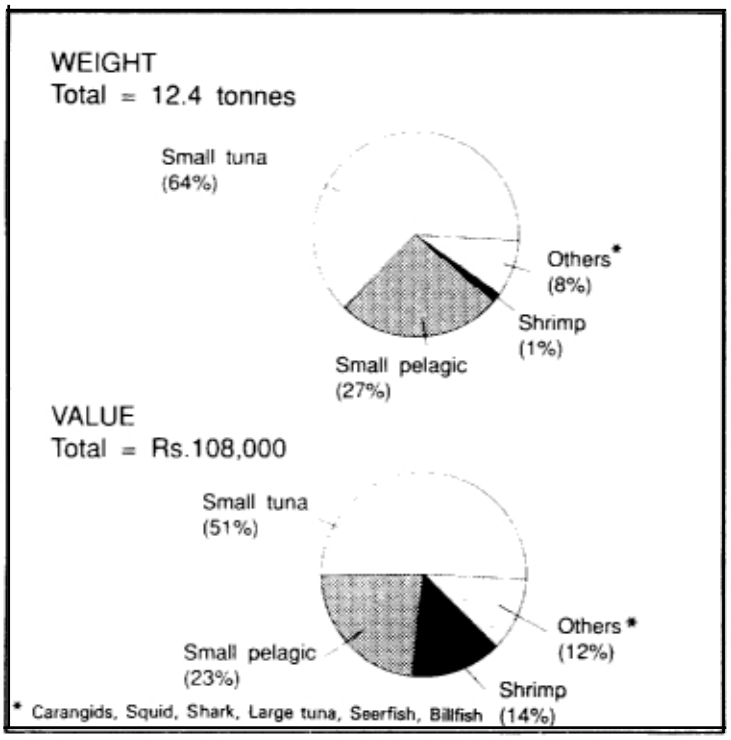


Fig. 8. IND-26 : Weight and value of catch by species



drift nets of more than 800 -900m in length. This in effect means. there is also little need to increase the size of the craft for such a fishery.

The IND-26 made 273 fishing trips in the one year of the trials (September 1989 - August 1990). This is a very high number and showed the prolessional level of the fishermen. The reasons given for the days when there was no fishing were:

Holidays	61
Engine problems	13
Rough weather	9
Mending of fishing gear	3
Other reasons	6
TOTAL NON-FISHING DAYS	92

The number ot days lost due to rough weather is remarkably few. This is. to a great extent, due to the prosimily of the harbour vvheie craft could operate from May to September.

5.2 *Catch data*

The total catch over the one year September 1989 - August 1990 was 12.4 tonnes. valued at Rs. 08.000. The average catch Per trip was 45 kg and valued at Rs 395 A detailed record is given in Table 1.

The traditional driftnett con— tributed 89 percent of the catch in weight and 75percent in value (Figure7. It is also of interest to note that the trammelnet for shrimp, used in June alone. caught only 1 percent in weight bL it accounted for 14 percent of the otal value. Further study, to investigate means of extending the fishing season for shrimp and improving the catching ability of the trammelnet seems well justified. This would inciease the access of the small—scale fisherman to the rich shrimpre sources of Kerala.

Small tuna and small pelagics constituted 91of the catch by weight and 74 percent by value (Figure8).

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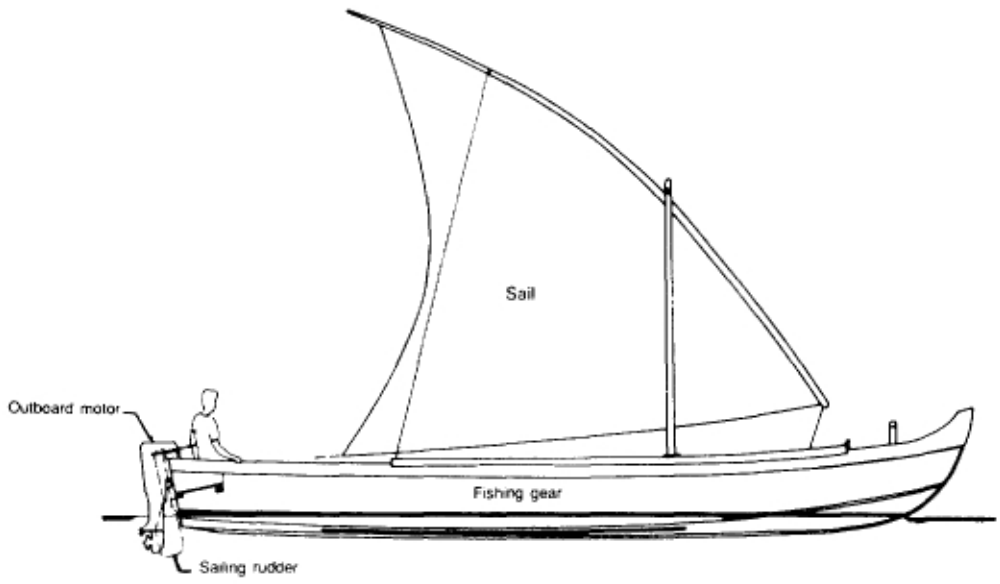
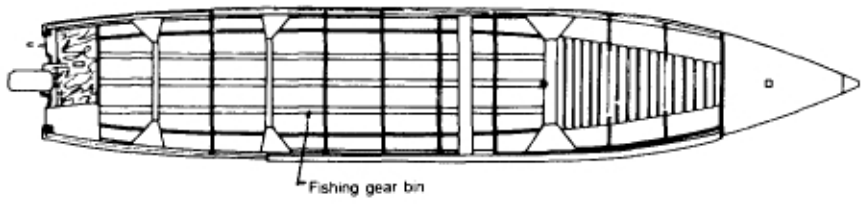
Table 1: IND-26 : Record of catch, earnings and expenses

Month/Year	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	TOTAL
PART I													
1. **Fishing Time**													
No. of fishing days	21	23	21	23	20	23	26	20	24	25	23	24	273
No. of man-days	63	69	63	69	60	69	78	60	72	75	69	72	819
Hours at sea	296	311	293	345	306	355	384	301	323	312	313	226	3765
Hours fishing	171	202	184	169	172	214	264	207	205	199	190	127	2304
Sail time eng	95	98	92	169	127	141	117	90	118	113	123	99	1382
Engine + Sail	30	11	17				3	4					65
Sail				7	7								14
2. Gearwise catch and Earnings													
Drifmet (Traditional) wgt. (kg)	1219	728	376	906	970	868	924	1456	1885	783	865	59	11039
val. (Rs.)	8388	6609	2490	6114	5632	5969	6940	9469	11258	7804	8572	598	79843
Trammelnet (kg)										145			145
val. (Rs.)										15115			15115
Hook and Line (multi hook trolling and handlines wgt. (kg.)		98	278	422	15	16						346	1175
val. (Rs.)		4255	1602	2459	100	74						4458	12948
Total wgt (kg)	1219	826	654	1328	985	884	924	1456	1885	928	865	405	12359
val. (Rs.)	8388	10864	4092	8573	5732	6043	6940	9469	11258	22919	8572	5056	107906
PARTII													
3. Specieswise Catch and Earning													
Small tuna wgt. (kg.)	1013	502	230	884	655	706	477	1233	910	783	498	59	7950
val.(Rs.)	6884	3059	1225	5766	3794	4757	3557	8036	5146	7804	4946	598	55572
Small pelagics wgt. (kg.)	161	31	404	293	20	120	447	223	975		312	346	3332
val. (Rs.)	829	220	2421	1702	126	856	3383	1433	6112		3001	4458	2454 1
Prawn wgt. (kg.)										145			145
val. (Rs.)										15115			15115
*** Others** wgt. (kg.)	45	293	20	151	310	58					55		932
val. (Rs.)	675	7585	446	1105	1812	430					625		12678
*** carangid. shark, largetuna, seer fish and bill fish**													
TOTAL wgt. (kg.)	1219	826	654	1328	985	884	924	1456	1885	928	865	405	12359
val. (Rs.)	8388	10864	4092	8573	5732	6043	6940	9469	11258	22919	8572	5056	107906
PART III													
1. Total Sales Value (Rs.)	8388	10864	4092	8573	5732	6043	6940	9469	11258	22919	8572	5056	107966
2. Variable Operational Costs													
— Fuel (kerosene/petrol)	1910	1650	1860	3495	2785	2985	2615	2022	2533	2560	2746	2208	29369
Food	1260	1380	1260	1380	1200	1380	1560	1200	1440	1770	1380	1440	16650
TOTAL	3170	3030	3120	4875	3985	4365	4175	3222	3973	4330	4126	3648	46019
3. Cash flow before payment to crew and boat-owner (1 – 2)	5218	7834	972	3698	1747	1678	2765	6247	7285	18589	4446	1408	61887
4. Distribution of cash flow to : — Crew members (50% of 3)	2609	3917	486	1849	873	839	1382	3123	3642	9294	2223	704	30943
5. Gross cash flow to boat-owner (50% of 3)	2609	3917	486	1849	873	839	1382	3123	3642	9294	2223	704	30943
6. Repairs													
— craft	70										135		205
— Fishing Gear		25				260	115						400
— Engine		119	769	215	1760	360	145		210				3578
TOTAL	70	144	769	215	1760	620	260		210		135		4183
Net cash flow to boat-owner (5-6)	2539	3773	-283	1634	-887	219	1122	3123	3432	9294	2088	704	26760

Fig. 9. IND-26 : General arrangement



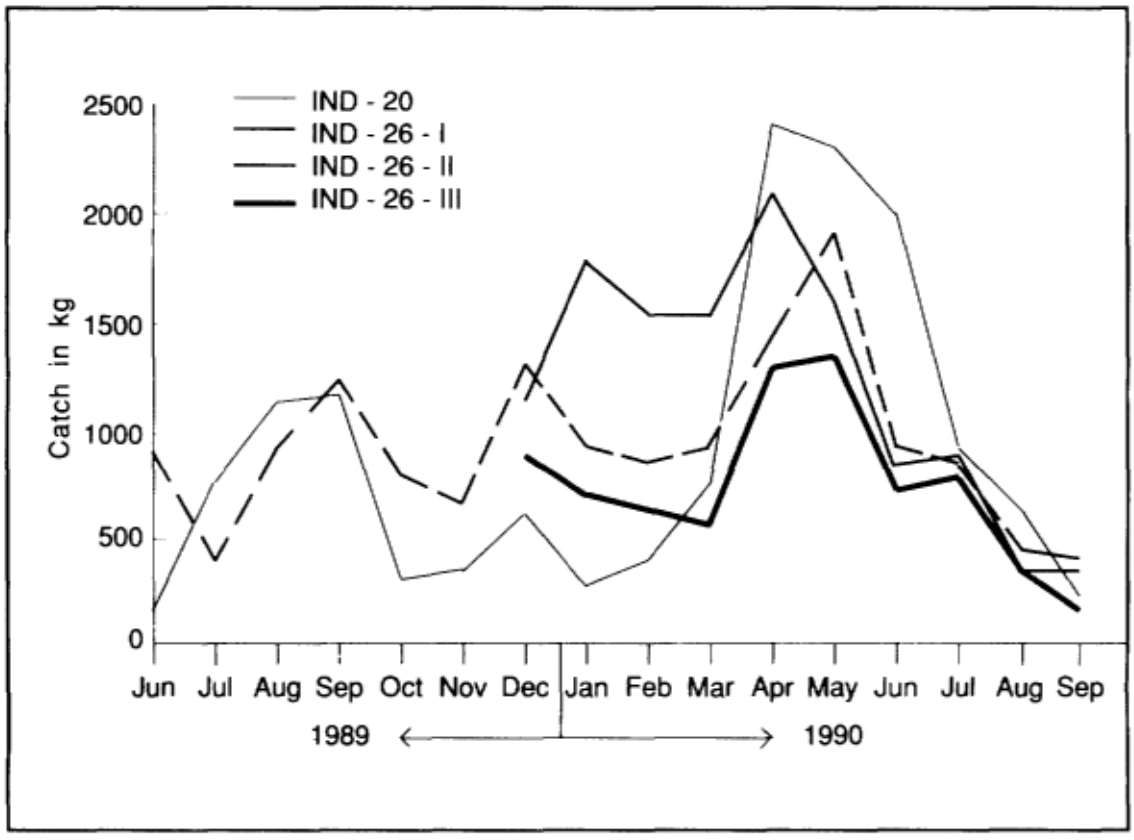


PARTICULARS

Length overall	LOA	:	8.5 m
Beam moulded	B	:	1.55 m
Depth moulded	D	:	0.78 m
Cu No	LOA x B x D	:	10.3m³
Outboard motor	Kerosene	:	7 hp
Sail	Lateen	:	15 m²

The good results obtained by the prototype encouraged MATSYAFED to order two more canoes of IND-26 design from a private boatyard. These canoes were handed over to fishermen in Poonthura in December 1989. The monthly catches of these two canoes, called IND-26 II and IND-26 III, show a pattern similar to that of the original IND-26 (Figure 10). The catch record of IND-20 is also given for comparison.

Fig. 10. Monthly catches by different craft



5.3 Design modifications

In order to determine the effect of some design changes on speed and seaworthiness, two canoes of modified IND-26 design were ordered by MATSYAFED from SIFFS boatyard at Veli, Trivandrum. IND-26A had sharper waterlines in the bow, but no changes aft, while IND-26B was 0.60 rn shorter in length and had a deck installed with a net bin midship.

Trials proved that IND-26A, although having better performance in a head sea, did lose some stability. The IND-26B did not have sufficient stability and was later converted to an open canoe. Overall, the original IND-26 was preferred. The conclusion of the trials with the IND-26 type was that the original version was very good and should be the one used in the future with only a few minor modifications. The prototype operated from Poonthura village for 16 months without any structural problems. The three owners of this type of craft were very satisfied with the sea-kindliness, stability and strength of the construction.

5.4 Engine and speed performance

All the IND-26 craft were fitted with 7 hp outboard motors of Japanese origin. These motors are manufactured by companies with long experience and large resources for research and development. The end product is, therefore, reliable and of relatively low cost. The problems with them lie in the use of kerosene as fuel. This creates high wear on the motor and leads to high repair costs and a short service life (of only about three years). Because spare parts are imported and carry a heavy duty, they are expensive. Another problem connected with the use of this fuel is shortage of kerosene at government rates. This forces the fisherman to buy most of his kerosene in the open market at a higher cost.

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Despite these drawbacks, the kerosene outboard motors have become extremely popular in Kerala, with the number of motors increasing from nil in 1980 to an estimated 11,000 in 1990. The bulk of the outboard motors are the 7 hp Yamaha, but other makes, such as Suzuki and Mariner, have also been introduced. The main advantages of the outboard motor are the relatively low purchase price and its low weight and portability. The latter enable the motors to be easily taken to the workshops for repairs. There are many mechanics in Kerala experienced in the repair of outboard motors, and spare parts, although expensive, are freely available.

Calm water speed trials were performed in Vizhinjam harbour to measure the performance of the new IND-26 design. The speed was measured with an electronic STOWE trailing log. Two different loadings were tested:

Load	*Speed*
500 kg (8 men)	7.2 knots
750 kg (I2 men)	6.8 knots

The new design is slightly faster than the comparable size of plywood vallams. Tests conducted in a choppy sea outside the harbour showed a considerable better performance by the IND-26 in a head sea compared with that of the existing design of plywood *vallam,* which slammed heavily due to the flat bottom in the forebody.

5.5 Construction materials and costs

The IND-26 was built of aini timber and marine plywood. A cost breakdown is shown in Table 2.

Table 2: IND-26 - Breakdown of construction costs

Item	Unit	Qty	*Price/unit* RS	Cost *RS*
Timber. Aini. sawn	Cub ft	2 0 80	23.5 00	4888 00
Marine plywood Y mm (8'x4')	Sheet	9 00	773 00	69.57 00
BWR plywood Y mm (8'x4')	Sheet	I 50	500 00	7.50 0 0
Epoxy resin, Araldite 103 + hardener	kg	300	445 00	133s 00
Epoxy resin. Araldite 106 + hardener	kg	6 24	320 00	1996 80
Polyester resin	kg	53 00	71 00	3763 00
Chopped strand mat 450 g/m2	kg	I2 00	75 00	900 0 0
Woven roving 200 g/m2	kg	0 75	145 00	108 75
HDG nails 3.35 x 32 (10g x 1-1/4")	kg	7 00	20 00	140 0 0
Copper nails 4 x 5 I (10g x 2")	kg	0 65	12s 00	81 25
Copper nails 4 x 63 (10g x 2-1/2")	kg	0 20	125 00	25 0 0
Copper nails 4 x 76 (8g x 3")	kg	0 35	125 00	4 3 75
Copper nails 4 x 89 (8g x 3-1/2")	kg	0 15	125 00	18 75
Copper nails 4 x 100 (8g x 4")	kg	0 05	125 00	6 25
Copper nails 4 x I52 (8g x 6")	kg	0 IS	125 00	18 75
Carriage bolts HDG 5/16" x 3"	Nos.	II 00	3 00	33 00
Carriage bolts HDG 5/16" x 4"	Nos.	I 00	3 00	3 0 0
Carriage bolts HDG 5/16" x 6"	Nos.	6 00	3 00	18 0 0
Copper washers	kg	0 18	160 00	2x 80
Brass wood screws (9g x 30)	100pcs	0 24	85 00	20 40
Brass wood screws (12g x 60)	100pcs	2 37	161 00	381 57
Wood primer	litre	5 .70	45 00	256 5 0
Gloss paint	litre	8 00	80 00	640 00
Chalk powder	kg	1 50	5 00	7 so
			TOTAL MATERIAL COST	22421 07
Labour	Mandays	70 00	82 00	5740 0 0
Overheads & profit 10%				2816 11
			SELLING PRICE	30977 18

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The selling price of the IND-26 was estimated at Rs 31 .000 in August 1990. This includes FRP covering of the lower parts upto just above the waterline.

The total investment cost of the final version of IND-26, including outboard motor and fishing gear. was as follows:

	Rs.
Hull	30,000
7 hp outboard motor	22,000
Sail rig	1000
Fishing gear	40,000
TOTAL INVESTMENT (no subsidy)	**93,000**

The cost of an IND-26 canoe in FRP may be estimated from the weight of the canoe and the material cost. The plywood version weighs 400 kg. The FRP version will be about 15 per cent lighter, that is, about 340 kg. Assuming 10 per cent wastage. the FRP material weight would be 375 kg. The cost of FRP materials in October 1990 was 7 1 Rs/kg for polyester resin, isothalic, 85 Rs/kg for chopped strand mat.

Assuming 72 per cent polyester resin and 28 per cent chopped strand mat, the cost of the FRP laminate will be 75 Rs/kg. The FRP material component in an IND-26 would, therefore, cost 375 kg x 75 Rs/kg = Rs.28,125/-. In addition, there are plywood tloorboards and various fittings costing about Rs.3000/-. The total material cost will therefore be about Rs.3 1,000/-.

The labour cost of the FRP canoe will be lower than of the plywood canoe, but the overhead costs would be higher because of the cost of the mould.

The comparative cost picture of the IND-26 in plywood and FRP would. therefore, he:

	Plywood Rs.	FRP Rs.
Materials	2 1,000	31,000
Labour	5000	3000
Overheads + Profit	4000	7000
SELLING PRICE	**30,000**	4 1,000

The price of the plywood canoe is based on a plywood cost of Rs.820 per sheet of 9 mm x 1.2 x 2.4 m. This cost has risen rapidly over the last few years, but the FRP prices are also going up. It is. therefore, difficult to predict future price levels. But at present it seems that a fisherman will not be willing to pay an additional 30 per cent to get an FRP canoe, although the question of status could be important in his decision. Saving on maintenance cost by using FRP would not be considerable, as the plywood canoe is in any case covered with FRP up to just above the waterline. Repairs of plywood canoes are more easily done at village level. Plywood canoes also permit a more decentralized construction. But the service life of a well-built FRP canoe is, probably. longer and, therefore, the depreciation per year will be lower than for the plywood canoe.

It must, however, be noted with concern that, since materials constitute the major portion of the cost in a FRP canoe, there is a temptation by the manufacturer to reduce the thickness of the FRP laminate. There is also a temptation to use inferior, cheaper grade of plywood to cut costs in the case of plywood canoes.

Any private company wanting to go into FRP construction should be encouraged. It is only in this way that fishermen will get a choice of construction material which they do not have at present.

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The IND-28, 9.Im with 9hp diesel water—cooled engine

6. IND-28 : PLYWOOD CANOE, 9.1 m WITH 9 hp DIESEL ENGINE

The operation of the diesel powered IND-20 and IND-27 in offshore fishing showed disappointing results. It was realized that these craft were too big for inshore fishing. On the other hand, the outboard powered IND-26 obtained good catches with small mesh driftnet in inshore areas. In order to reduce the fuel costs, it was decided to test a diesel powered version of the IND-26 using the same 9 hp watercooled VST diesel engine used on the IND-20 and IND-27. To compensate for the loss of space caused by the engine installation, the length of the IND-26 was increased from 8.5 m to 9.1 m. This new craft, called the IND-28, was launched in March 1990.

Various modifications had to be carried out on the prototype installation and only two months of fishing trials were completed from Vizhinjam before the end of the project. The initial catch results were similar to those of IND- 26 I, but the fuel costs were half those of the outboard powered canoe.

6.1 *Engine and speed performance*

As in the JND-27A the diesel engine is installed with a liftable propeller and rudder, using a rubber bellows forwater tightness. The difference between IND-28 and IND-27A is that the engine is installed forward of the transmission and that the transmission is by chain drive rather than with a tooth belt(Figure 6). The speed of IND-28, measured in calm water in Vizhinjam harbour under two different loads, was:

Load	*Speed*
500 kg (8 men)	7.5 knots
750 kg (12men)	7.1 knots

The speed is slightly higher than the outboard powered IND-26, especially with heavy load. The IND-28 also maintains the speed better in waves because of the larger and slower running propeller.

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The IND-27A installation takes up less space in the canoe than the IND-28's. This is because the engine has been turned around and placed alongside. and above, the tunnel. The IND-27A installationrequires a smaller rubber bellows and should be the recommended installation in the future (Figure 6). The question of using a chain drive transmission. as in IND-28, or toothbelt transmission, as in IND-27A, needs to be considered after more operating experience is available. More prolonged trials are also required to determine reliability of the installation.

The trials have been done with a make of engine which is not well represented in Kerala. There are few trained mechanics for this engine and no representative for spare parts. Spare parts have to be bought from Tirunelveli in Tamil Nadu. which means that the fishermen lose two days to obtain spare parts.

The operations of the diesel powered IND-27A and IND-28 clearly indicated that the optimum diesel propulsion craft for use in a fishery 10-20 nautical miles from shore is the IND-28 type, but with reduction in length (8.5 m) and a slight increase in the beam to improve stability. This modified and final version is called the IND-28A and has the improved engine installation of the IND-27A.

6.2 Cost of construction

The cost breakdown for the IND-28A is shown in Table 3.

Table 3: IND-28 - Breakdown of construction costs

Item	Unit	Qty	Price/Unit Rs	Cost Rs
Timber. Aini. sawn	Cub ft	22 60	235 00	5546 00
Marine plywood 9 mm (8'x4')	Sheet	14 50	820 00	11890 0 0
BWR plywood 9 mm (8'x4')	Sheet	3 so	500 00	1750 0 0
Epoxy resin. Araldite 106 + hardener	kg	7 so	320 00	2400 00
Epoxy resin. Araldite 103 + hardener	kg	3 so	445 00	1557 50
Polyester resin	kg	36 00	71 00	2556 0 0
Chopped strand mat 450 g/m2	kg	6 0 0	85 00	510 0 0
Woven roving 200 g/m2	kg	1 40	126 00	176 4 0
HDG nails 3.35 x 32 (10g x 1-1/4")	kg	8 00	20 00	160 00
Copper nails 4 x 38 (10g x 1-1/2")	kg	I 40	125 00	175 00
Copper nails 4 x SO (10g x 2)	kg	0 15	125 00	18 75
Copper nails 4 x 63 (10g x 2-1/2")	kg	0 70	125 00	87 50
Copper nails 4 x 76 (8g x 3")	kg	2 00	125 00	250 0 0
Copper nails 4 x 89 (8g x 3-1/2")	kg	0 12	125 00	150 0
Copper nails 4 x 100 (8g x 4")	kg	I 65	125 00	206 25
Copper washers	kg	0 40	160 00	6400
B.N.W. 5/16" x 3" (copper)	Nos.	120 0	11 00	132 0 0
B.N.W. 5/16" x 4" (copper)	Nos.	4 00	13 00	52 0 0
B.N.W. 5/16" x 6" (copper)	Nos.	4 0 0	19 00	76 00
Brass woodscrews 9g x 30	100pcs	0 so	85 00	42 50
Brass wood screws 12g x 60	100pcs	3 30	161 00	531 3 0
ss screws 8g x 50	144pcs	0 35	300 00	105 0 0
PVC pipe dia 1"	m	15 80	1 3 60	214 88
Wood primer	litre	9 00	45 00	405 00
Gloss paint	litre	11 50	80 00	920 00
Chalk powder	kg	1 00	5 00	5 0 0
French screws 3/8"x2-1/2" (SS)	Nos	2 00	15 00	30 00
Flat belt 4" x 5 mm	m	I 20	so 00	6000
Brass bolts 1/4" x 2"	Nos.	30 00	5 00	150 0 0
Thermocole foam t=2"(0.5x 1.0m)	sheet	6 00	70 00	420 00
			TOTAL MATERIAL COST	30,506 08
Labour	Mandays	80 00	82 00	6560 00
Overheads & profit 10%				3706 60
			SELLING PRICE	40,772 68

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The hull is Rs 10,000 more expensive than that of the IND-26, mainly because of the added complications of the diesel engine installation. The cost summary is:

	Rs
Hull	40,000
Engine + installation	36. 000
Sail rig	1,000
Fishing gear	40.000
TOTAL INVESTMENT (No subsidy)	117.000

The total investment is Rs 24,000 higher than for the outboard powered IND- 26. But the operational costs of the diesel engine are much lower, giving the diesel alternative an overall economic advantage.

7. SURF CROSSING AND HANDLING OF CRAFT ON THE BEACH

The canoes operating from Poonthura are normally not hauled up on the beach after each fishing trip. The reason for this is the surf which frequently plunges heavily on to the beach, and the steep beach slope, which makes beachlanding risky. When returning from a fishing trip, the catch is put in a bag made of heavy netting and thrown into the sea. A crew member swims with the bag to the shore. The canoe is then anchored outside the surf zone and the crew is taken ashore in a kattumaram.

At weekends, or when expecting rough weather, the canoes are brought ashore. If the surf is heavy, an anchor is thrown out and one man stays aboard while the rest of the crew swims ashore with a second rope. The bow is kept against the waves by the man in the canoe letting out the anchorage, while the people ashore pull the canoe in using the stem rope.

The canoes are pulled by manpower to the top of the beach. The heavier diesel powered canoes require more effort to be hauled on to the beach. The IND-26, with nets on board, weighs about 700 kg while a diesel powered canoe, such as the IND-28A, will weigh about 900 kg. It is the opinion of the fishermen in Poonthura that this canoe can be handled by manpower alone, either by hauling it up on the beach using planks and rollers or by "walking" it up the beach, alternatively lifting and turning the ends (Figure I I see facing page).

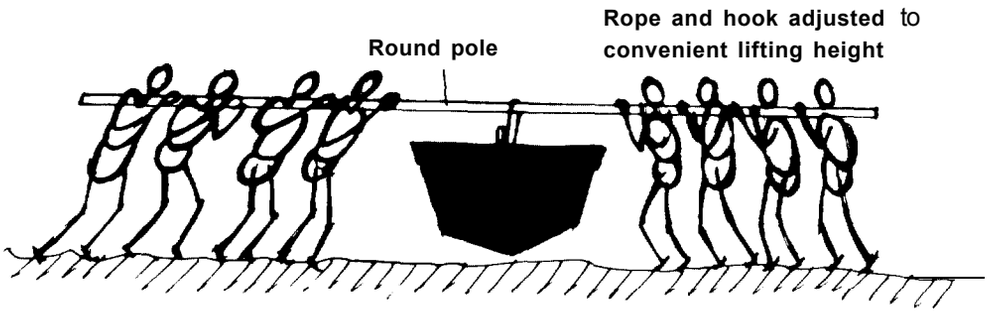
The IND-20. with a full complement of large mesh driftnets weighs about 2500 kg. To haul this craft up. an engine powered winch and a capstan were installed in Poonthura. On the first trial using the capstan, the hook at the end of the wire broke, due to faulty manufacture. No more trials were done with the motorized winch or the capstan, partly because the fishermen had lost confidence and partly because the beach in Poonthura is so crowded that it would be difficult to find a place for the hauling device. This also applies to the manual capstan that was later installed in Vizhinjam harbour.

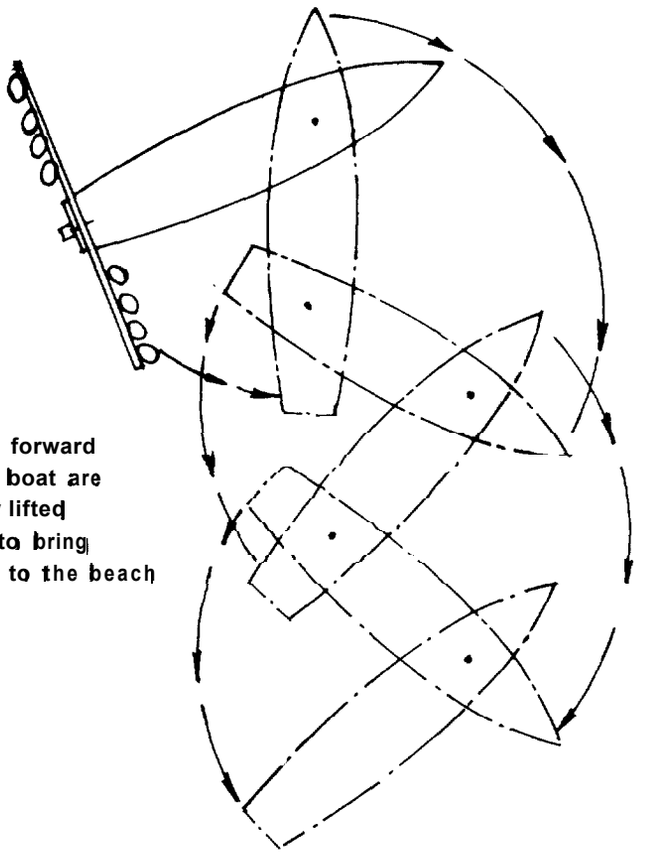
The method of anchoring the canoe outside the surf zone is not practised everywhere in Kerala. If the canoe is to be hauled out after each fishing trip, in these areas the added weight of the diesel engine is a definite disadvantage compared to the outboard motor.

8. ECONOMICS

The conclusion of the trials carried out during the project is that two types of craft show promise — the IND-36. with a 7 hp outboard motor, and the IND- 28, with a 9 hp diesel engine. It can be assumed that the final improved version of these two types of craft (IND-26C and IND-28A) will be able to handle the same amount of fishing gear and, therefore, have the same catch potential. Catch data for the prototype IND-26 has already been presented (Table 1). The diesel powered IND-28 calls for higher

Fig. 11. Handling of craft on the beach





The aft and forward ends of the boat are alternatively lifted and turned to bring the boat on to the beach

investment but has lower fuel consumption than the IND-26. An economic evaluation of all this data will give an indication of the relative income of the fishermen and profitability of the investment:

Investment and depreciation

	Investment (Rs)	*Depreciation (Years)*	*Depreciation (Rs/year)*
Outboard-powered: IND-26			
Hull	**30,000**	**10**	**3,000**
Outboard motor(7 hp)	**22,000**	**3**	**7.300**
Sail rig	**1,000**	I	**1,000**
Fishinggear	40,000	**7**	**5,700**
TOTAL	**93,ooo**		**17,000**
Diesel-Powered: IND-28			
Hull	**40,000**	**10**	**4,000**
Engine (9 hp) + Installation	**36,000**	**7**	**5.100**
sail rig	**1,000**	**1**	**1,000**
Fishing gear	**40,000**	**7**	**5,700**
TOTAL	**117,000**		**15,800**

The kerosene outboard motor consumes 3.7 litres of fuel per hour. The cost of kerosene mixed with lubrication oil SAE 30 at a rate of 4 per cent oil to kerosene and including the cost of petrol required for starting and slow running is estimated 5.49 Rs/litre (September 1990). It has been assumed that 1/3rd of the kerosene was bought at the government rate of 2.70 Rs/litre and 2/3rds at the open market rate of 5 Rs/litre. For five hours of running on an average per fishing trip, fuel consumption is 18.5 litres and costs Rs. 102. Based on the data from the IND-26, the number of trips per year is 273, giving a yearly fuel consumption of 5050 litres, costing Rs 28,000.

For the diesel engine, which is assumed to operate at the same power output as the outboard motor (7 hp), the fuel consumption is 1.9 litre per hour and the cost 5.17 Rs/litre. With five hours engine use per trip and 273 trips per year, the consumption per trip is 9.5 litres, costing Rs 49, and the yearly consumption is 2600 litres, costing Rs 13,500.

Rate of Return

		IND-26 7 hp Kerosene Outboard Motor Rs.	*IND-28 9 hp Diesel Engine Rs.*
TOTAL INVESTMENT (Rs)		**93,000**	**117,000**
I.	**YEARLY REVENUE (Rs)**	**108,000**	**108,000**
2	**YEARLY VARIABLE COSTS (Rs)**		
	Fuel	**28,000**	**13,500**
	Food	**17,000**	**17,000**
	TOTAL	**45,000**	**30,500**
3.	**Income before payment to crew (I-2)**	**63.000**	**77,500**
4.	**crew share (50%)**	**31,500**	**38.750**
5.	**Boat share (3-4)**	**31,500**	**38,750**
6.	**Repairs**		
	Hull	3000	3000
	Engine	4000	4000
	Fishing gear	**1000**	**1000**
	TOTAL	**8000**	**8000**
7.	**NET INCOME To BOAT OWNER (5-6)**	**23,500**	**30,750**
8.	**DEPRECIATION**	**17,000**	**15,800**
9.	**NET RETURN (7-8)**	**6500**	**14.950**
	ACCOUNTING RATE OF RETURN	**7%**	**13%**

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Although these figures indicate that the diesel engine alternative requires a larger investment, its rate of return over the economical life is higher than that of the kerosene outboard motor.

The advantage of the diesel engine was further emphasised in October 1990 when the fuel prices were increased by 25 per cent. This price rise had the following effect:

	Outboard Motor		Inboard Diesel Engine	
	Sep 90	NOV.90	St-p.90	NOV.90
Crew share (Rs)	31,500	28,000	38.750	37,000
Net return (Rs)	6,500	3,800	14,950	14,000
Accounting Rate of Return	7%'	4 %	13%	12%

9. CONCLUSIONS

Four main types of cost-effective craft were tested:

IND-20 8.5 m FRP beachlanding craft with 9 hp watercooled diesel engine. (Mot-e than 200 of this type of craft are operating on the east coast of India.)

IND-27 9.5 m plywood canoe with a 9 hp inboard water cooled diesel engine fitted with the propeller in a tunnel.

IND-26 X.5 m plywood canoe with a 7 hp kerosene outboard motor.

IND-28 9.2 m plywood canoe with a 9 hp inboard water cooled diesel engine using a liftable propeller and rudder arrangement.

lND-20

The IND-20 beachlanding craft carried out exploratory driftnet fishing 20-30 nautical miles from the shore, outside the operational range of the canoes. The target species were tuna and shark. The boat also did limited drift longlining. During a nine month period from June 1989, 152 fishing trips were made yielding 5.0 tonnes, mainly small tuna (3.3 tonnes), shark (0.4 tonne) and others — seerfish, cardngids and large tuna (1.3 tonnes). The average catch per trip was only 30 kg and was clearly insufficient to cover the cost of operation. The IND-20 was too small for use further offshore where the target would have been large pelagic species. The fishing gear of IND-20 was changed from March 1990 to smaller mesh of traditional type and the fishing operation was shifted further inshore. During six months, until September 1990, nine tonnes were caught at an average of 65 kg per trip. However, other types of craft that had lower investment are more economical in this fishery I O-20 nautical miles from the shore.

IND-27

The IND-27 suffered technical problems due to the poor quality of its reverse reduction gearbox. This solution had to be abandoned and the canoe rebuilt. The canoe was shortened and fitted with the same diesel engine but with a liftable rudder and propeller, so that the reverse reduction gearbox could be eliminated. New trials of IND-27A started in September 1990.

IND-26

The IND-26 was used by a fisherman from Poonthura. It utilized the traditional type of fishing gear, mainly small mesh driftnets, for small pelagics. Over the 15-month period from June 1989 till the end of August 1990, the canoe landed 14.5 tonnes of fish at an average of 45 kg per trip. This canoe performed well both technically and economically. Two more canoes of this design were built and handed over to fishermen in Poonthura in December 1989. These had some design modifications, but their trials showed that the original concept was best. The IND-26 has a better performance in the waves and is of stronger construction than the plywood design that's been used so far in Kerala.

IND-28

The IND-28. with more space for the engine and slightly higher speed than the IND-26, was tested only for a very brief period before the end of the project. but indicated that it might be the best canoe for fisheries 10-20 nautical miles from shore.

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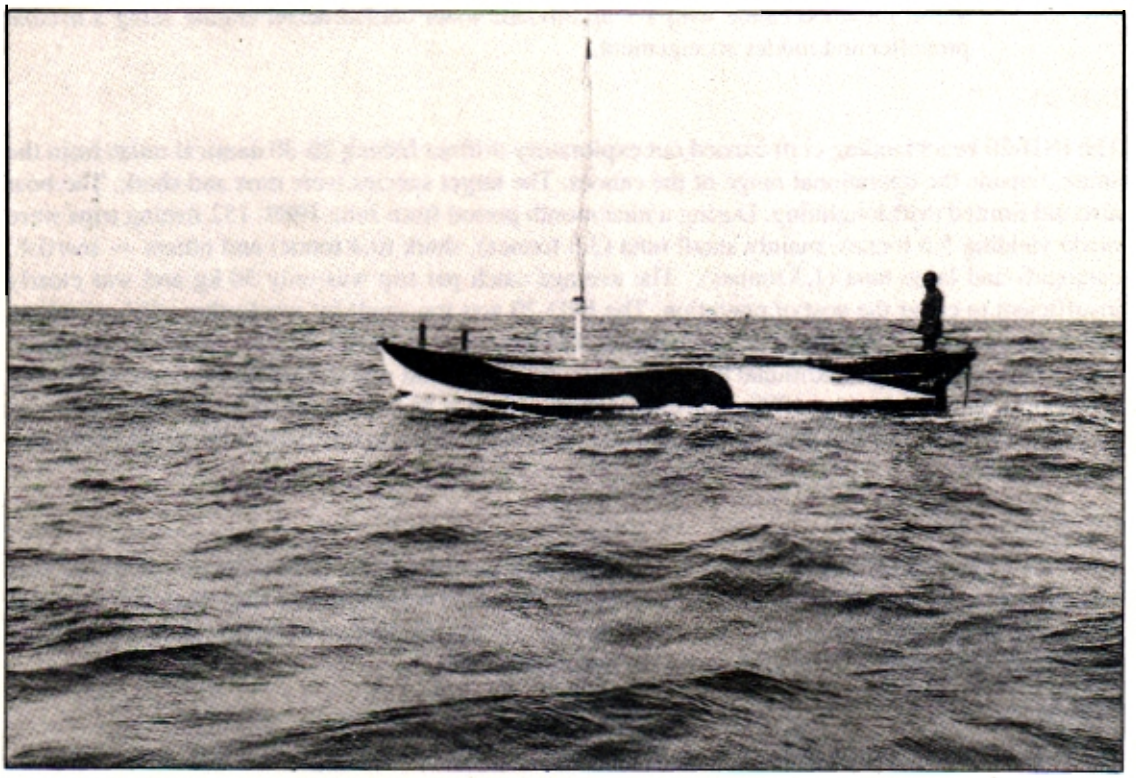
HANDLING OF CRAFT

The hauling on the beach of IND-26 and IND-28 can be done by manpower without winches or capstans. However, the increased weight of the diesel-powered IND-28 makes hauling the canoe on to the beach strenuous, and so anchoring outside the surf zone may, in most places, be the preferred method.

ECONOMICS

The economic evaluation of the IND-26 outboard kerosene powered canoe and the IND-28 inboard diesel powered canoe showed that the latter had a 24 per cent higher crew income than the former. The accounting rate of return on the investment was 13 per cent for the IND-28 and 7 percent for the IND-26. With 25 per cent increase in fuel prices after October 1990, the economic advantage of the diesel powered canoe was further increased.



The IND-27A, 8.9m with 9hp diesel water-cooled engine

PUBLICATIONS OF THE BAY OF BENGAL PROGRAMME (BOBP)

The BOBP brings out the following types of publications:

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

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

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

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

Newsletters (Bay ofBengal News) which are issued quarterly and which contain illustrated articles and features in non-technical style on BOBP work and related subjects.

Other publications which include books and other miscellaneous reports.

A list of publications in print follows. A complete list of publications is available on request.

Reports (BOBP/REP/...)

23. *Summary Report of BOBP Fishing Trials and Demersal Resources Studies in Sri Lanka.* (Madras, March 1986.)
24. *Fisherwomen's Activities in Bangladesh : A Participatory Approach 10 Developmenr.* P. Natpracha, (Madras, May 1986.)
25. *Attempts to Stimulate Developmenr Activities in Fishing Communities in Adirampattinam. India.* P. Natpracha, V. L. C. Pietersz. (Madras, May 1986.)
26. *Report of the Tenth Meeting of the Advisory Committee. Male. Maldives.* 17-18 February 1986. (Madras, April 1986.)
27. *Activating Fisherwomen for Development through Trained Link Workers in Tamil Nadu. India.* E. Drewes. (Madras, May 1986.)
28. *Small-scale Aquaculture Development Project* in *South Thailand: Results and Impact.* E. Drewes. (Madras, May 1986.)
29. *Towards Shared Learning: An Approach to Nonformal Adult Education for Marine Fisher-folk of Tamil Nadu. India.* L. S. Saraswathi and P. Natpracha. (Madras, July 1986.)
30. *Summary Report of Fishing Trials with Large-Mesh Driftnets in Bangladesh.* (Madras, May 1986.)
31. *In-service Training Programme for Marine Fisheries Extension Officers in Orissa, India.* U. Tietze. (Madras, August 1986.)
32. *Bank Credit for Artisanal Marine Fisherfolk of Orissa, India.* U. Tietze. (Madras, May 1987.)
33. *Non-formal Primary Education for Children of Marine Fisherfolk in Orissa, India.* U. Tietze. Namita Ray. (Madras, December 1987.)
34. *The Coastal Set-Bagnet Fishery of Bangladesh- Fishing Trials and lnvestigations.* S. E. Akerman. (Madras, November 1986.)
35. *Brackishwater Shrimp Culture Demonstration in Bangladesh.* M. Karim. (Madras, December 1986.)
36. *Hilsa Investigations in Bangladesh.* (Colombo, June 1987.)
37. *High-Opening Bottom Trawling in Tamil Nadu, Gujarat and Orissa, India : A Summary of Effort and Impact.* (Madras, February 1987.)
38. *Report of the Eleventh Meeting of the Advisory Committee,* Bangkok, Thailand, March 26-28, 1987. (Madras, June 1987.)
39. *Investigations on the Mackerel and Scad Resources of the Malacca Straits.* (Colombo. December 1987.)
40. *Tuna in the Andaman Sea.* (Colombo, December 1987.)
41. *Studies of rhe Tuna Resource in the EEZs of* Sri Lanka and Maldives.(Colombo, May 1988.)
42. *Report of the Twelfth Meeting of the Advisory Committee.* Bhubaneswar, India, 12-15 January 1988. (Madras, April 1988.)
43. *Report of the Thirteenth Meeting of the Advisory Committee.* Penang, Malaysia, 26-28 January, 1989. (Madras, March 1989.)
44. *Report of the Fourteenth Meeting of rhe Advisory* Committee. Me&n, Indonesia, 22-25 January, 1990. (Madras, April 1990.)
45. *Report of the Seminar on* Gracilaria *Production and Utilization in the Bay of Bengal Region.* (Madras, November 1990.)
46. *Exploratory Fishingfor Large PelagicSpecies in the Maldives.* R.C.Anderson and A.Waheed, (Madras, December 1990.)
47. *Exploratory Fishing for Large Pelagic Species in Sri* Lanka R Maldeniya. S L Suraweera. (Madras, April 1991.)
48. *Report of the Fifteenth Meeting of the Advisory Committee.* Colombo, Sri Lanka, 28-30 January, 1991. (Madras, April 1991)

27. ***Reducing the Fuel Costs of Small Fishing Boats.*** O. Gulbrandsen. (Madras, July 1986.)

38. ***Creditfor Fisherfolk : The Experience in Adirampattinam, Tamil Nadu, India.*** R. S. Anbarasan, 0. Femandez. (Madras, March 1986.)

42. ***Fish Trap Trials in Sri Lanka.*** (Based on a report by T. Hammerman). (Madras, January 1986.)

43. ***Demonstration of Simple Hatchery Technologyfor Prawns in Sri Lanka. (Madras,*** June 1986.)

44. ***Pivoting Engine Installation for Beachlanding Boats.*** A. Overa, R. Ravikumar. (Madras, June 1986.)

45. ***Further Development of Beachlanding Craft in India and Sri*** Lanka. A. Overa, R. Ravikumar, 0. Gulbrandsen, G. Gowing. (Madras, July 1986.)

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49. ***Pen Culture of Shrimp by Fisheflolk : The BOBP Experience in Killai, Tamil*** Nadu, ***India.*** E. Drewes, G. Rajappan. (Madras, April 1987.)

50. ***Experiences with a Manually Operated Net-Braiding Machine in Bangladesh.*** B. C. Gillgren, A. Kashem. (Madras, November 1986.)

51. ***Hauling Devicesfor Beachlanding Craft.*** A. Overa, P. A. Hemminghyth. (Madras, August 1986.)

52. ***Experimental Culture of Seaweeds*** (Gracilaria Sp.) ***in Penang, Malaysia.*** (Based on a report by M Doty, J Fisher). (Madras, August 1987.)

53. ***Atlas of Deep Water Demersal Fishery Resources in the Bay of Bengal.*** T. Nishida, K. Sivasubramaniam. (Colombo, September 1986.)

54. ***Experiences with Fish Aggregating Devices in Sri Lanka.*** K. T. Weerasooriya. (Madras, January 1987.)

55. ***Study of Income, Indebtedness and Savings among Fishelfolk of Orissa, India.*** T. Mammo. (Madras, December 1987.)

56. ***Fishing Trials with Beachlanding Craft at Uppada, Andhra Pradesh, India.*** L. Nyberg. (Madras, June 1987.)

57. ***Identifying Extension Activities for Fisherwomen in Visakhapatnam District, Andhra Pradesh, India.*** D Tempelman. (Madras, August 1987.)

58. ***Shrimp Fisheries in the Bay of Bengal.*** M. Van der Knaap. (Ma&as, August 1989.)

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60. ***Pen Culture of Shrimp in Chilaw, Sri Lanka.*** D. Reyntjens. (Madras, April 1989.)

61. ***Development of Outrigger Canoes in Sri Lanka.*** 0. Gulbrandsen, (Madras, November 1990.)

62. ***Silvi-Pisciculture Project in Sunderbans, West Bengal : A Summary Report of BOBP's assistance.*** C.L. Angell, J. Muir. (Madras, September 1990.)

63. ***Shrimp Seed Collectors of Bangladesh.*** (Based on a study by UBINIG.) (Madras, October 1990.)

64. ***Reef Fish Resources Survey in the Maldives.*** M. Van Der Knaap, Z. Waheed, H. Shareef, M. Rasheed (Madras, April 1991.)

65. ***Seaweed*** (Gracilaria Edulis) ***Farming in Vedalai and Chinnapalam, India.*** Ineke Kalkman, Isaac Rajendran, Charles L.Angell. (Madras, June 1991.)

66. ***Improving Marketing Conditionsfor Women Fish Vendors in Besant Nagar, Madras.*** K Menezes. (Madras, April 1991.)

67. ***Design and Trial of Ice Boxes for Use on Fishing Boats in Kakinada, India.*** LJ. Clucas. (Madras, April 1991.)

68. ***The By-catch from Indian Shrimp Trawlers in the Bay of Bengal: Thepotentialfor its improved utilization.*** **AM Gordon.** (Madras, August 1991.)

69. ***Agar and Alginate Productionfrom Seaweed in India.*** J J W Coppen, P Nambiar. (Madras, June 1991.)

70. ***The Kattumaram of Kothapatnam-Pallipalem, Andhra Pradesh, India-A Survey of the Fisheries and Fisherfolk.*** K Sivasubramaniam. (Madras, December 1991.)

72. ***Giant Clams in the Maldives-Astockassessmentandstudy*** *of* ***theirpotentialforculture.*** J R Barker. (Madras, December 1991.)

73. ***Small-scale culture of the flat oyster*** (Oyster folium) ***in Pulau Langkawi, Kedah, Malaysia.*** Devakie Nair and Bjom Lindeblad. (Madras, November 1991.)

76. ***A View from the Beach- Understanding the status and needs of fisherfolk in the Meemu, Vaavu and Faafu Atolls of the Republic of Maldives.*** The Extension and Projects Section of the Ministry of Fisheries and Agriculture, The Republic of Maldives. (Madras, June 1991.)

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3. ***Fishery Statistics on the Microcomputer : A BASIC Version of Hasselblad's NORMSEP Program.*** D. Pauly, N. David, J. Hertel-Wulff. (Colombo, June 1986.)
4. ***Separating Mixtures of Normal Distributions : Basic programs for Bhattacharya's Method and Their Application for Fish Population Analysis.*** H. Goonetilleke, K. Sivasubramaniam. (Madras, November 1987.)
5. ***Bay of Bengal Fisheries Information System (BOBFINS): User's Manual.*** (Colombo, September 1987.)
10. ***Our Fish, Our Wealth.*** A guide to fisherfolk — in 'comic book' style (English/Tamil/Telugu) on resources management. Kamala Chandrakant with K. Sivasubramaniam and Rathin Roy. (Madras, December 1991.)

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10. ***Bibliography*** on Gracilaria- ***Production and Utilization in the Bay of Bengal.*** (Madras, August 1990.)
11. ***Marine Small-Scale Fisheries of West Bengal : An Introduction.*** (Madras, November 1990.)
12. ***The Fisherfolk of Puttalam, Chilaw, Galle and Matara-A study of the economic status of the fisherfolk of four fisheries districts in Sri Lanka.*** (Madras, December 1991.)

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Other Publications

Artisanal Marine Fisherfolk of Orissa : Study of their Technology, Economic Status, Social Organization and Cognitive Patterns. U Tietze. (Madras, December 1985.)

Studies on Mesh Selectivity and Performance : The New Fish-cum-Prawn Trawl at Pesalai, Sri Lanka M. S. M. Siddeek. BOBP/MIS/3. (Madras, September 1986.)

Motorization of Dinghy Boats in Kasafal, Orissa. BOBP/MIS/4. S. Johansen and 0. Gulbrandsen. (Madras, November 1986.)

Helping Fisherfolk to Help Themselves : A Study in People's Participation, (Madras, 1990.)

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