



The IND-28, 9.1m 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 for water 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:

<i>Load</i>	<i>Speed</i> _____
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.

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 installation requires 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 00
BWR plywood 9 mm (8'x4')	Sheet	3 so	500 00	1750 00
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 00
Chopped strand mat 450 g/m ²	kg	6 00	85 00	510 00
Woven roving 200 g/m ²	kg	1 40	126 00	176 40
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	1 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 00
Copper nails 4 x 89 (8g x 3-1/2")	kg	0 12	125 00	150 00
Copper nails 4 x 100 (8g x 4")	kg	1 65	125 00	206 25
Copper washers	kg	0 40	160 00	64 00
B.N.W. 5/16" x 3" (copper)	Nos.	120 0	11 00	132 00
B.N.W. 5/16" x 4" (copper)	Nos.	4 00	13 00	52 00
B.N.W. 5/16" x 6" (copper)	Nos.	4 00	19 00	76 00
Brass wood screws 9g x 30	100pcs	0 so	85 00	42 50
Brass wood screws 12g x 60	100pcs	3 30	161 00	531 30
ss screws 8g x 50	144pcs	0 35	300 00	105 00
PVC pipe dia 1"	m	15 80	13 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 00
French screws 3/8"x2-1/2" (SS)	Nos	2 00	15 00	30 00
Flat belt 4" x 5 mm	m	1 20	so 00	6 000
Brass bolts 1/4" x 2"	Nos.	30 00	5 00	150 00
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

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).

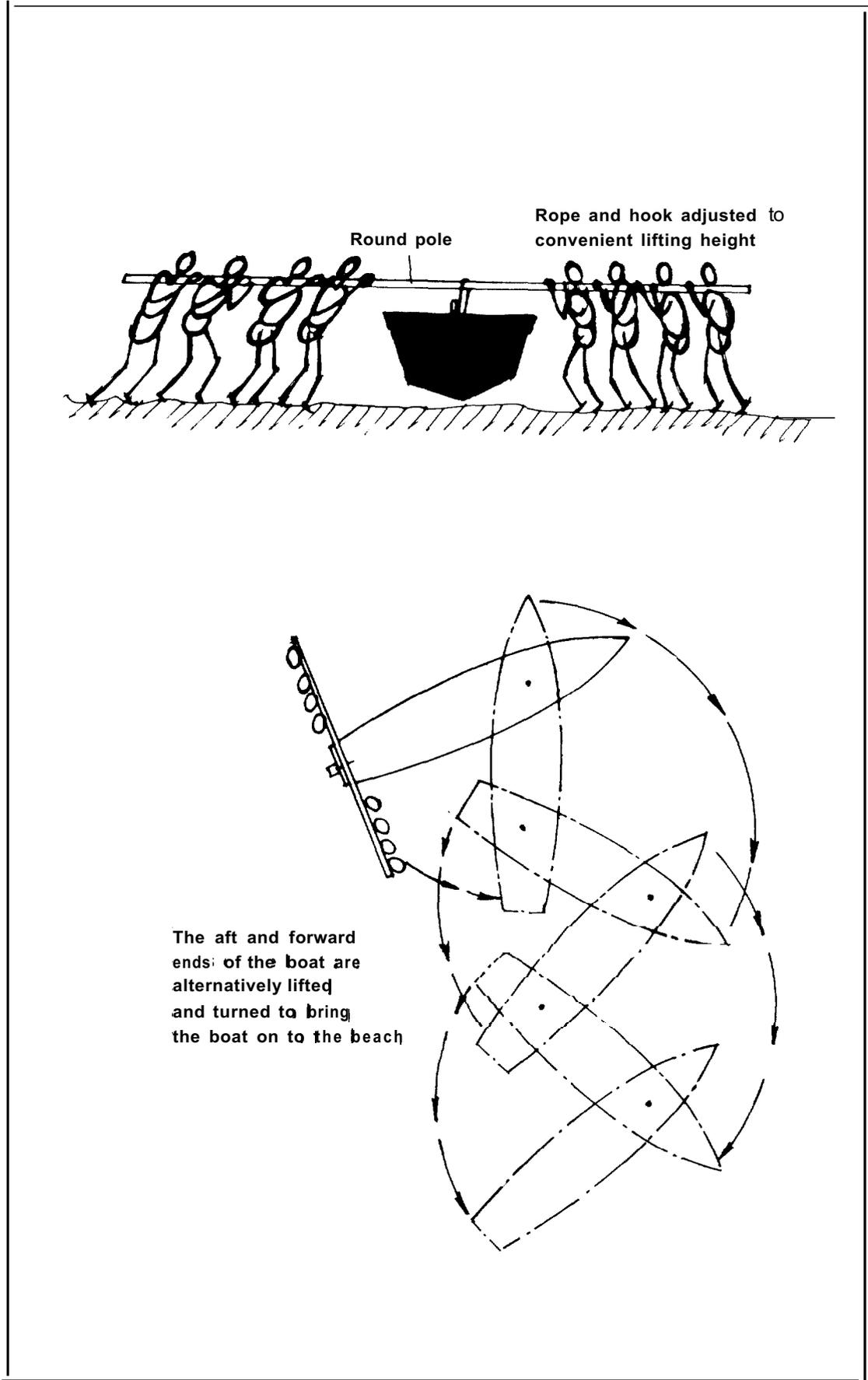
The IND-20, with a full complement of large mesh driftnets weighs about 2500 kg. To haul this craft up, an engine powered winch and a capstan were installed in Poonthura. On the first trial using the capstan, the hook at the end of the wire broke, due to faulty manufacture. No more trials were done with 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



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	1	1,000
Fishinggear	40,000	7	5,700
TOTAL	93,000		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
1. 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 (1-2)	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%

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.

IND-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 10-20 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

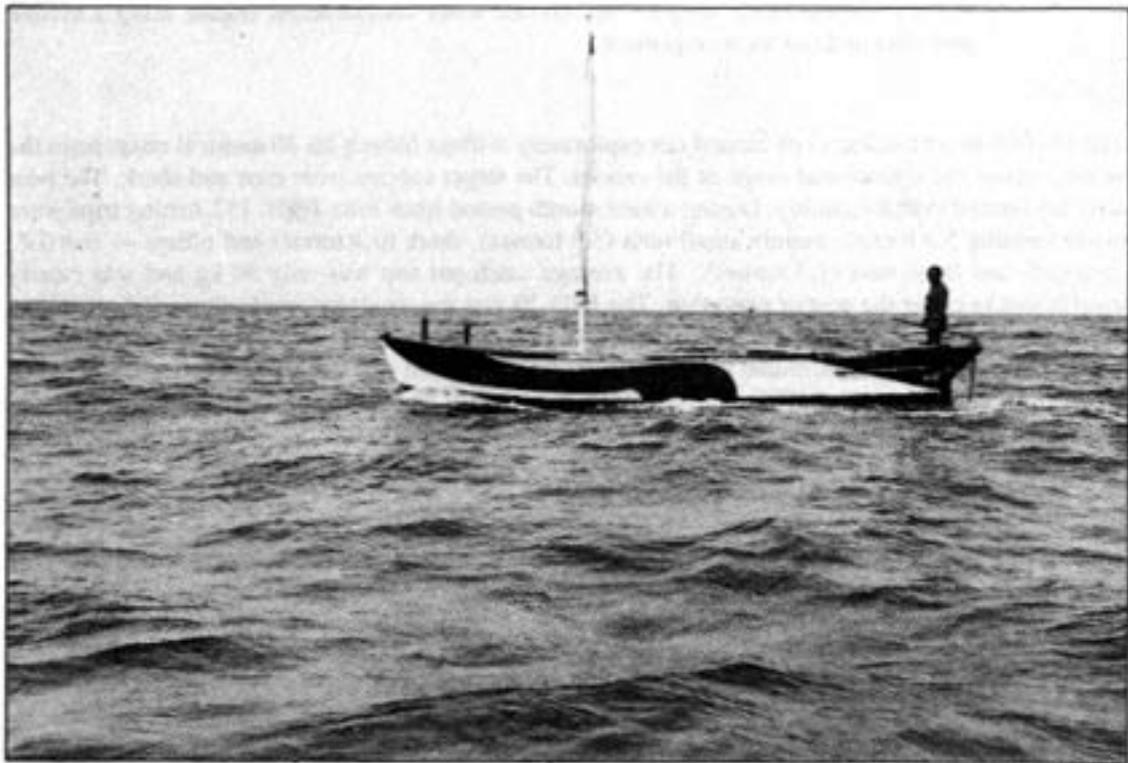
The IND-28, with more space for the engine and slightly higher speed than the IND-26, was tested only for a very brief period before the end of the project. but indicated that it might be the best canoe for fisheries 10-20 nautical miles from shore.

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 per cent 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