



**BAY OF BENGAL PROGRAMME  
DEVELOPMENT OF SMALL-SCALE FISHERIES**



INBOARD MOTORIZATION      BOBP/WP/4  
OF SMALL  
G.R.P. BOATS IN SRI LANKA

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Executing Agency:  
Food and Agriculture Organisation  
of the United Nations

Funding Agency:  
Swedish International  
Development Authority

Development of Small-Scale Fisheries in the Bay of Bengal  
Madras, India, September 1980.

## **PREFACE**

This document presents the initial findings of an experiment to study the feasibility of installing low-powered diesel engines in suitable small craft presently operating in Sri Lanka.

The diesel engine used in the experiment (Petter AC1 6 hp aircooled) was donated to the Ministry of Fisheries in Sri Lanka by the Ministry of Overseas Development, U.K. The Ceynor Foundation Limited, Karainagar, were contracted to supply the 18.5 ft GRP boat used in the experiment.

The inboard motorization project is an activity of the Bay of Bengal Programme (Development of Small-Scale Fisheries in the Bay of Bengal – GCP/RAS/040/SWE). The Programme is executed by the Food and Agriculture Organisation of the United Nations (FAO) and funded by the Swedish International Development Authority (SIDA). The main aims of the Programme are to develop and demonstrate technologies to improve the conditions of small-scale fishermen and the supply of fish from the small sector in five countries that border the Bay of Bengal – Bangladesh, India, Malaysia, Sri Lanka and Thailand.

This document is a working paper and has not been officially cleared by the Sri Lanka Government or by the FAO.

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## 1. INTRODUCTION

Coastal fish resources in Sri Lanka are mainly exploited by about 2,000 gillnet boats 28 to 32 ft long, powered by 16-33 hp inboard engines; 17 to 19 ft GRP boats (about 3,000), powered by outboard motors of 6-12 hp, running on kerosene; and traditional craft, some of which are motorised by outboard engines (about 4,000) but mostly powered by sail (about 13,000).

The increasing costs of fuel are of grave concern to the fishermen and to the Government and it is of prime interest to all parties concerned to identify and implement fuel saving measures. One such measure is to use sails as auxiliary power and the Ministry of Fisheries has recently launched a subsidy scheme for equipping existing and new fishing craft with sails. Another measure would be to reduce the power of engines for new boats. Better cost and earnings data are required to enable the Government to introduce a suitable incentive scheme to promote the use of low-powered engines.

A third measure could be to substitute outboard motors, which are heavy consumers of fuel, by inboard diesel engines. The 17-19 ft GRP boats, of which there are some 3,000 units in operation, might be suitable for inboard motorization. A preliminary cost analysis made by the Ministry of Fisheries in late 1978 indicated that for an 18.5 ft GRP boat the cost of fuel for an inboard diesel engine would be about one third of that of a kerosene-driven outboard engine.

Most of these boats have a flat bottom and need to be modified to provide for a skeg to hold the shaft and protect the propeller. However, some of the existing boats in this size range, mainly used in the northern part of Sri Lanka, are constructed with a skeg and can be equipped with an inboard engine without any modification to the hull.

It was therefore decided to examine the technical feasibility of installing a small (6 hp) aircooled inboard diesel engine in one of the suitable boats, and if found feasible to conduct commercial fishing trials and subsequent demonstrations.

## 2. ENGINE INSTALLATION

The boat selected for the experiment, a 18.5 ft GAP boat of displacement hull form with a skeg, is shown in Appendix 1. The design permits the installation of an inboard engine with conventional shafting and a fixed propeller.

The principal dimensions of the boat are:

Length overall	:	18'6"
Beam maximum	:	6'10"
Depth	:	2'6"

The engine develops 6 hp at an rpm of about 3,000 with a 2:1 reduction box. The size of the propeller is 11" x 7". Details of the installation are given in Appendix 2. The weight of the complete installation is about 60 kg. (The weight of a 6 hp kerosene driven outboard motor is about 30 kg).

During trials a speed of 5.5 knots was attained with a 5-man crew and commercial quantity of fishing nets. The engine developed 2,900 rpm and consumed about 1.1 litres of fuel per hour. (The 6 hp outboard motor gives the same speed at a fuel consumption of about 3.8 litres per hour).

Initially, an engine without reduction box was installed and tested. The engine became overloaded—it developed black smoke and only 2,000 rpm was attained, giving a speed of 4 knots. A reduction gear was necessary.

Clutch and reverse gear were not required.

The fairing of the skeg and the propeller clearances were far from the optimum level on the boat used for the experiments; refinements will slightly improve the performance.

Though the inboard engine takes up much more space than an outboard motor, the installation in no way hampered the fishing operations during technical trials and initial commercial fishing trials. The same amount of fishing nets as used in outboard driven boats was used in the trials.

### 3. COST ANALYSIS

The trials clearly demonstrated that the installation of an inboard engine in the selected boat will have no adverse effect on the fishing operations as compared with an outboard motor installation. The amount of fishing gear carried and the speed of the boat-and therefore also the earning power-are identical in the two cases,

The difference in economic performance of the two alternatives thus depends on the costs related to the engines--i.e. the costs of capital, fuel and maintenance/repair. The latter item has been left out in the comparison below, which implies an assumption that the costs of maintenance and repair are equal.

The comparison of costs between the two engines is given in the table below.

Cost comparison : Outboard kerosene motor vs. Inboard diesel engine  
(in Sri Lanka Rupees)

<i>Cost of fuel</i>	Outboard kerosene motor (6 hp)	Inboard diesel engine (6 hp)
1. Fuel consumption (l/h)		
— petrol	0.3	
—kerosene	3.5	—
— diesel	—	1.1
2. Fuel costs 1 per hour	14.67	4.95
3. Running time per year (hours)	1,000	1,000
4. Fuel costs per year	14,670	4,950
<i>Cost of Capital :</i>		
5. Initial cost 2	8,700	24,000
6. Life of engine (years)	3	5
7. Annuity factor (12%)	0.416	0.277
8. Capital costs per year	3,620	6,650
9. Yearly costs of engine (4 + 8)	18,290	<b>11,600</b>
<b>Saving per year</b>		<b>Rs. 6,690</b>

1 Petrol at 9.00 Rs/l; kerosene 3.42 Rs/l; diesel 4.50 Rs/l.

2 Cost of the diesel engine is inclusive of clutch and reverse gear. (In practice, a simple reduction gearbox without clutch and reverse gear is considered sufficient), Other similar engines may cost less or more than the ones used for the experiment.

3 Annuity factor gives the fraction of the initial cost representing depreciation and interest of equal yearly amounts over the life time of the investment.

The use of a diesel-driven inboard engine instead of a kerosene-driven outboard motor results in considerable cost savings and thereby in improved economic performance. The estimated savings of Rs. 7,000 represent a higher return of about 10% of the total invested for boat, engine and gear.

The higher cost of capital for the inboard engine (As. 2,750) is small in comparison with the saving on fuel (Rs. 10,000). In this connection it is interesting to note that about two years ago when the trials were first contemplated, the savings on fuel were of the order of As. 3,500 – very close to the difference in capital costs between the two engines. The advantages of an inboard diesel engine were then not as clear as they are today.

Looking ahead: as fuel costs keep rising, the advantages of the low-fuel-consumption diesel engine over the kerosene-driven outboard motor will be increasingly pronounced. It is not unthinkable that the fuel prices two years from now will be twice as high as presently (July 1980). In such a case the savings from use of the inboard diesel engine will amount to Rs. 16,000 (allowing for a slight increase in the difference in capital costs) which will then correspond to a 20% return on the total capital of the fishing unit.

The assumption of equal costs for maintenance/repair, the life time of the engines and the discounting rate (12%) may not be absolutely correct. However, the order of magnitude is representative, and furthermore quite drastic variations must be made in these variables to significantly change the picture. The variables of overriding importance are the rate of consumption and the cost of fuel.

From a national standpoint, the low consumption engine is of course preferable. The saving per unit is 2,700 litres per year. A replacement of say 2,000 outboards would result in an import reduction of 6,000 tonne per year.



## 5. CONCLUSIONS AND RECOMMENDATIONS

The employment of inboard diesel engines instead of kerosene driven outboard motors in the 17-19 ft GRP boats commonly used in Sri Lanka would result in considerably better economic performance to the benefit of the owners/operators and a saving to the country.

An experimental installation of the inboard engine followed by trials has demonstrated that the fishing capacity has not been reduced despite some loss of space in the boat.

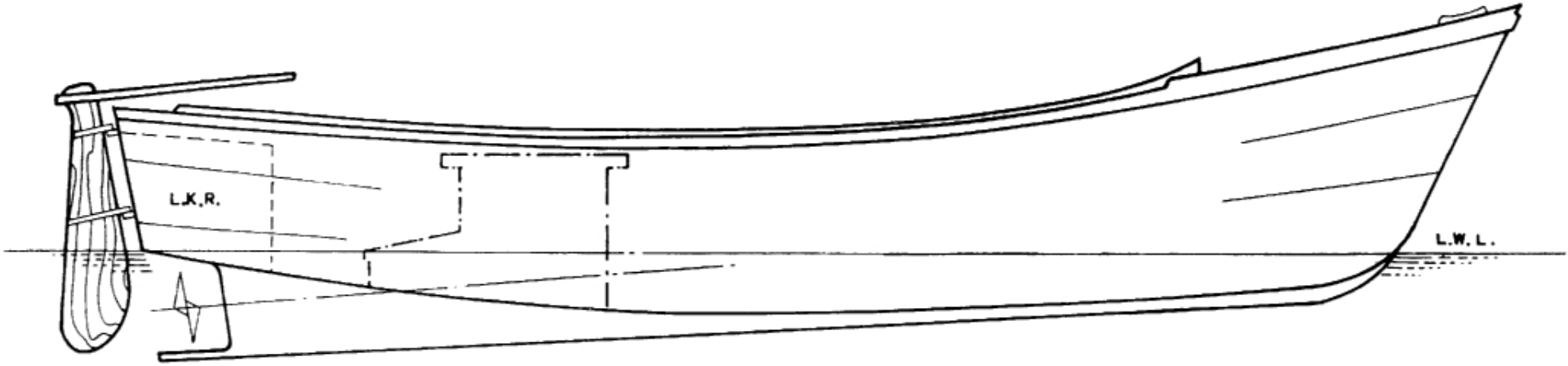
Some of the existing boats of this type can be motorised with inboard engines without any major modifications. Most of them however are of flat bottom type and need to be constructed with a fixed skeg or alternatively with a tunnel and retractable stern gear to provide protection for shaft and propeller.

Many of the 17-19 ft GRP boats are operating from and landing on open beaches. For these conditions, the outboard motors offer technical advantages—absence of obstructing stern gear; light weight; and instant removal and installation of the motors.

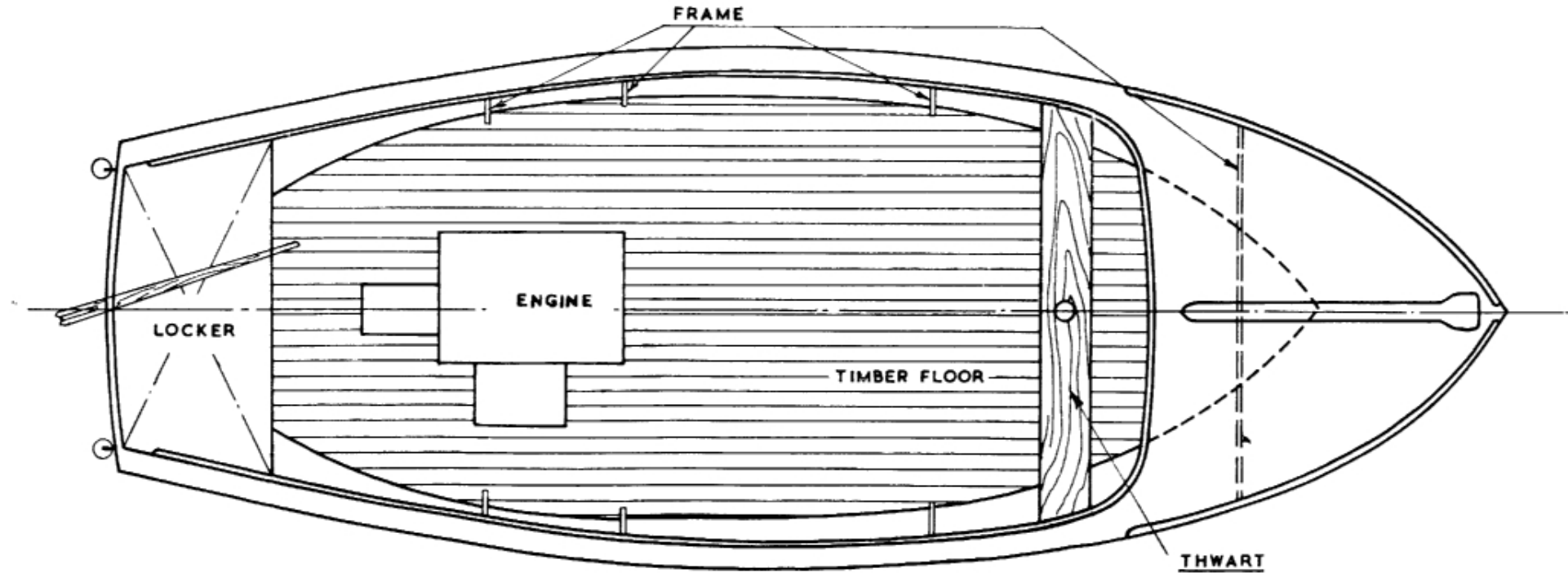
However, in view of the very high fuel costs for outboard motors, every effort should be made to modify the craft as necessary, enabling the installation of low consumption diesel engines. Because of the considerable economic advantages, renewed efforts should also be made to equip traditional craft with small light aircooled diesel engines rather than with outboard motors.

The higher investment cost for a diesel engine may make the fishermen hesitate about going in for it—or they may find it difficult to raise the necessary capital. The Government might therefore find it appropriate to modify its subsidy scheme to promote the development of more economic and fuel-saving motorization of fishing craft.

**APPENDIX 1: GENERAL ARRANGEMENT OF 18.5ft GAP BOAT WITH  
INBOARD ENGINE**



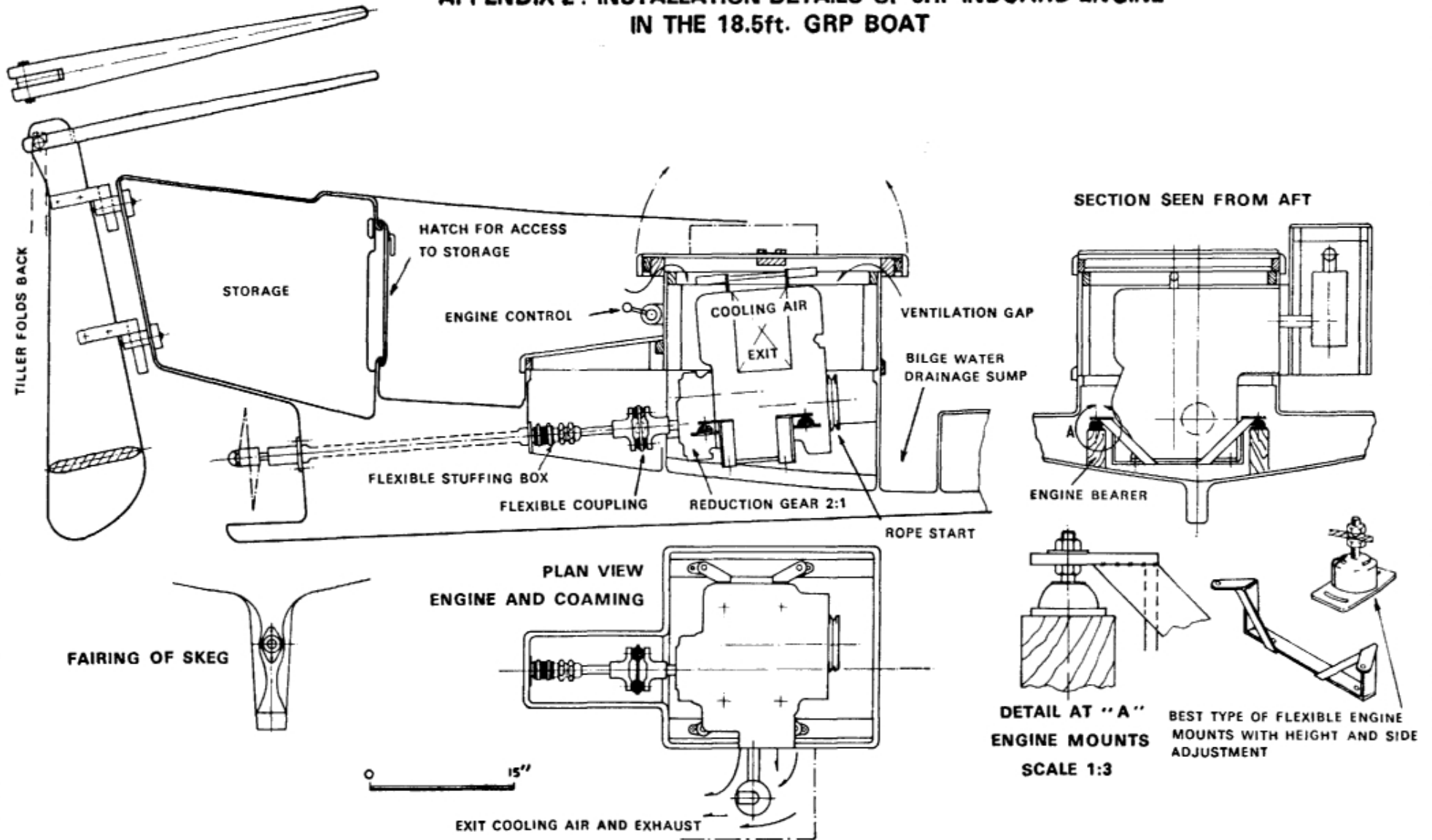
PROFILE



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**APPENDIX 2 : INSTALLATION DETAILS OF 6HP INBOARD ENGINE  
IN THE 18.5ft. GRP BOAT**



## **PUBLICATIONS OF THE BAY OF BENGAL PROGRAMME (BOBP)**

Development of Small-Scale Fisheries (GCP/RAS/040/SWE)

*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 7-10 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. 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.

*Working Papers* (BOBP/WP/ )

1. Investment Reduction and Increase in Service Life of Kattumaram Logs.  
Balan, R. Madras, India, February 1980.
2. Inventory of Kattumarams and Their Fishing Gear in Andhra Pradesh and Tamil Nadu India. (In preparation)
3. Improvement of Large-Mesh Driftnets for Small-Scale Fisheries in Sri Lanka.  
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.  
Madras, India, September 1980.

6. Fishing Trials with Bottom-Set Longlines in Sri Lanka.  
Madras, India, September 1980
7. Technical Trials of Beachcraft Prototypes in India.  
Madras, India, October 1980
8. Current Knowledge of Fisheries Resources in the Shelf Area of the Bay of Bengal. 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.  
Madras, India, October 1980

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

1. Fisheries Cooperatives in Kerala: A Critique.  
Madras, India, October 1980.