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Fishing Technology

DEVELOPMENT OF CANOE FISHERIES IN SUMATERA, INDONESIA

BOBP/WP/77

FOOD AND AGRICULTURE ORGANISATION OF THE UNITED NATIONS

BAY OF BENGAL PROGRAMME
Fishing Technology

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DEVELOPMENT OF CANOE FISHERIES IN SUMATERA, INDONESIA

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BAY OF BENGAL **PROGRAMME,**
Madras, India
1992

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This paper describes the developnient, technical trials, and fishing trials of larger plank—built outrigger canoes in Nias Island, Surnatera, Indonesia. The outrigger canoes were constructed during 1989. The technical and fishing trials were conducted during 1989 and 1990 in three villages in Nias Island. The purpose of the trials was to assess the technical and economic feasibilit\ of the new outrIgger canoes and their acceptability to the fisherfolk.

The project for development of outrigger canoe fisheries and this paper which reports on it have been sponsored by the Bay of Bengal Programnic’s (BOBP) “Small-Scale Fisherfolk Communities in the Bay of Bengal” (GCP/RAS/1 18/MUL). The work was done in cooperation with the Provincial Fisheries Service of North Sumatera. Besides the authors, other BOBP and PFS officers, an FAO Consultant Boatbuilder, local carpenters and not least the fishermen were actively involved in the Project.

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 and 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 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 Organization of the United Nations).

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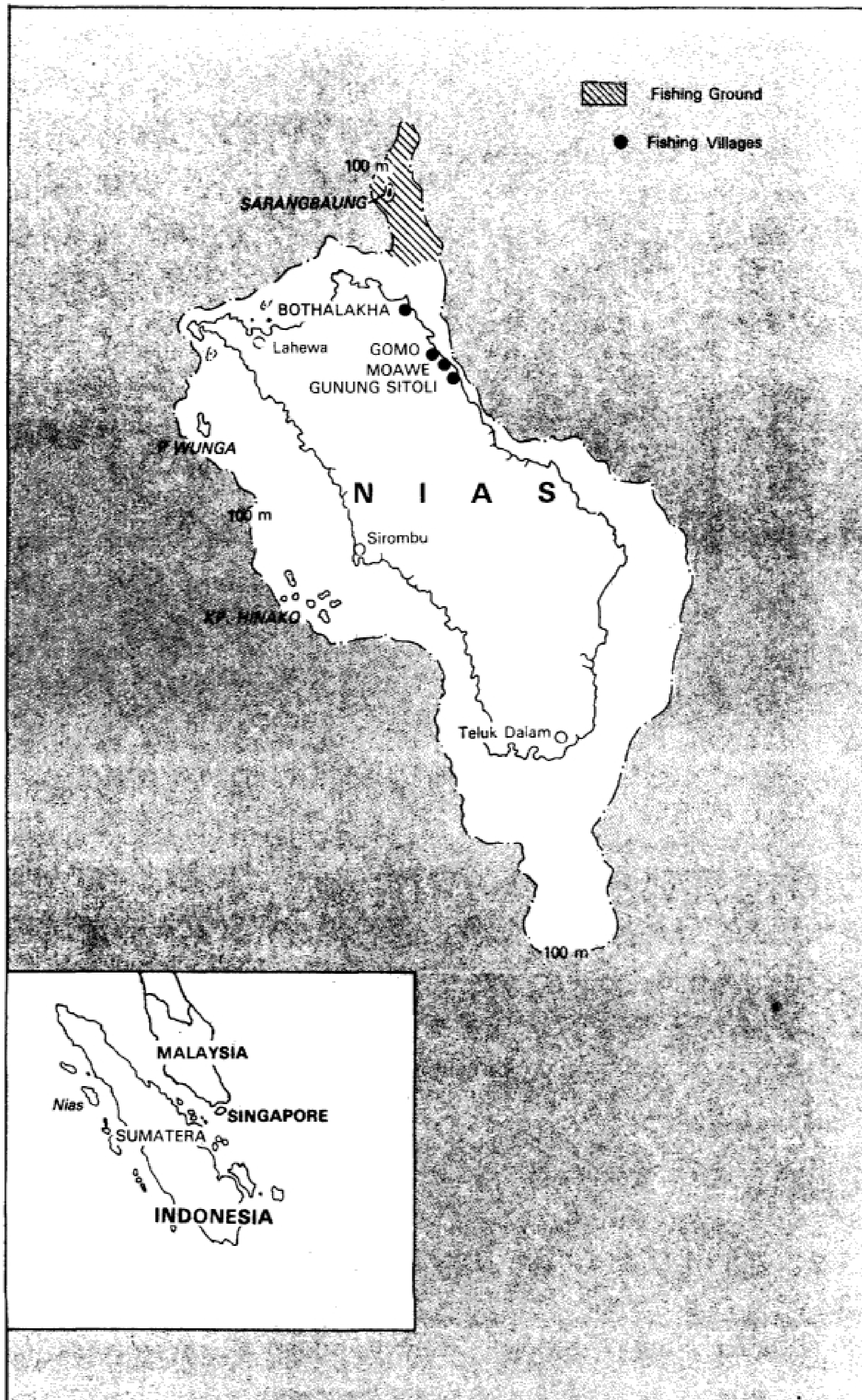

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The owrigger canoes of Nias

1. INTRODUCTION

1.1 Background

Nias Island is part of North Sumatera province in Indonesia and is situated about 60 nautical miles west of the Sumatera coast. Figure 1 (see facing page) shows its location and the configuration of the continental shelf.

About *95* per cent of the *530,000* people living on Nias Island are dependent on agriculture and fisheries. There are about 2200 full-time and 500 part-time fishermen. Nine hundred people are engaged in ancillary activities, such as fish marketing and boat-building. Most of the fishermen (80 per cent) are Muslims. The others are Christians.

The total fish landings in Nias Island are estimated at 3400 tonnes a year, or about 1.4 tonnes per fisherman. Taking into account imports of about 1500 tonnes, mainly comprising dried fish from Sumatera, the fish supply is about 10 kg/person. Almost the entire local fish catch is marketed fresh in the nearby villages. Although some excess fish is salted and sun dried, it is not sufficient to meet the local demand.

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The most important fishing gear for the smaller craft are handlines and trolling lines. Some trammel gillnetting is carried out for shrimp, and gillnetting for small pelagics and flyingfish. The larger 'speed boats' and diesel-powered boats use large mesh driftnets for tuna, shark and billfish species and hottomset longlines for oil shark.

lhc following are the main limitations of the extsting fishing fleet:

- The dugout outrigger canoes are too small for an extended range of operation.
- The 'speed boats' with outboard motors are too expensive to operate.
- The planked boats with inboard diesel engines are too big and too heavy for operation from most villages which do not have sheltered anchorages.

1.2 Purpose of the project

'['he BOBP financed project for development of outrigger canoe fisheries in Sumatera aimed at improving the productivity of the small-scale fishing sector, and the earning capacity and livelihood of the fisherfolk. through the development of larger plank-built motorized outrigger canoes for more extensive fishing operations. The immediate objective of the project was to assess the technical and economic feasibility of the new outrigger canoes and their acceptability to the fisherfolk of Nias Island.

2. NEW PLANK-BUILT OUTRIGGER CANOES

The generation of improved earnings for the fisherfolk depends to a great extent on the harvesting of the under-exploited resources of the coastal, deep water and offshore zones by the small-scale fishing sector to meet local and export demand. While it has not been possible to fully achieve this with the existing fishing fleet due to its limitations, the familiarity of the fisherfolk with the outrigger canoe concept pointed to further development of the outrigger canoe fisheries as the appropriate path to development.

2.1 Design

Staff from the Bay of Bengal Programme (BOBP) and the Provincial Fisheries Service (PFS) and the FAO Consultant Naval Architect visited Nias Island in July and October 1988 to gather information on the fishery and the existing craft. In planning the introduction of planked outrigger canoes of larger size than so far used in Nias Island, the other considerations taken into account were:

- their ability to operate from beaches.., since most villages do not have protected anchorages;
- their capacity to achieve a given speed with less engine power than a monohull;
- fuel efficiency;
- better crew comfort due to the stabilizing effect of the outriggers.
- the availability and cost of boat-building timber and the scarcity of logs: and
- the possibility of construction at village level.

Detailed drawings of planked outrigger canoes of different sizes were completed in January 989.

Fig. 2. Dugout outrigger canoe, non-motorized.

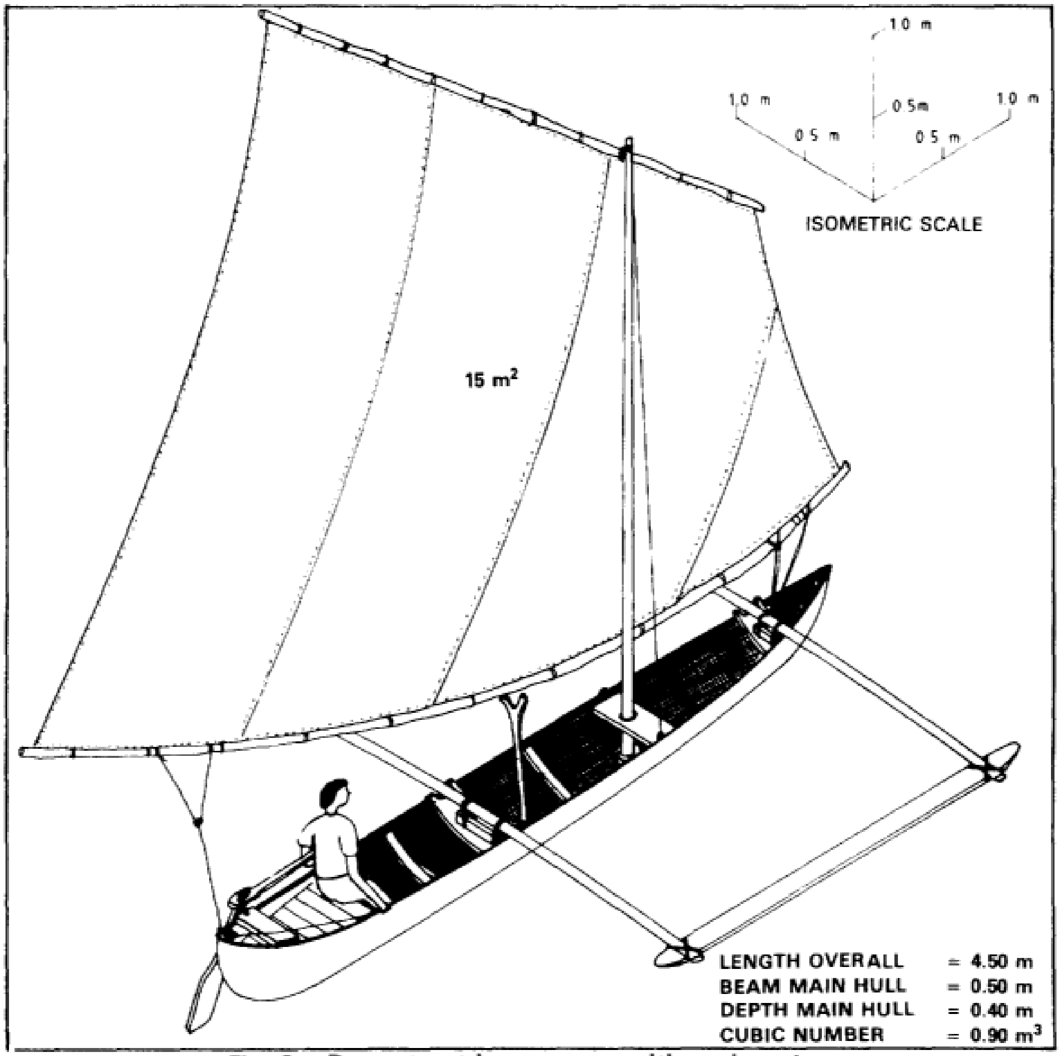
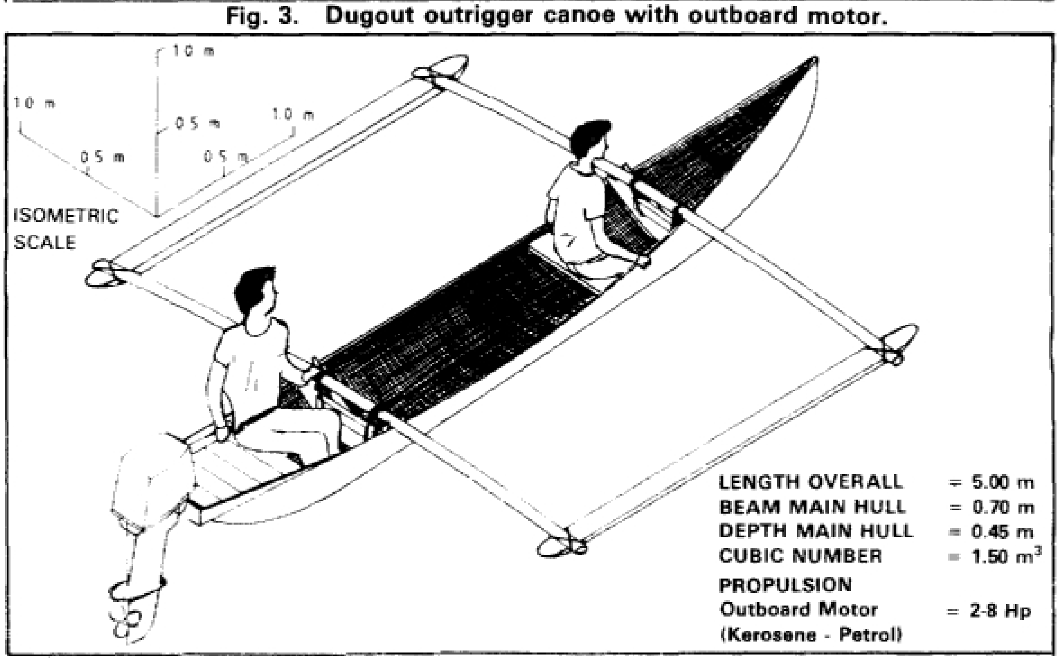


Fig. 3. Dugout outrigger canoe with outboard motor.



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The fishing craft comprise the following:

Craft	*Type*	*Number*
Dugout outrigger canoes	4-6 m non-motorized (Figure 2)	2100
	5-8 m with 2-8 hp outboard motors (Figure 3)	70
Planked boats	7-10 m 'speed boats' with 20-25 hp outboard motors (Figure 4)	30
	8-12 m with 12-30 hp inboard diesel engines (Figure *5)*	30

Fig. 4. Planked 'Speed boat' with outboard motor.

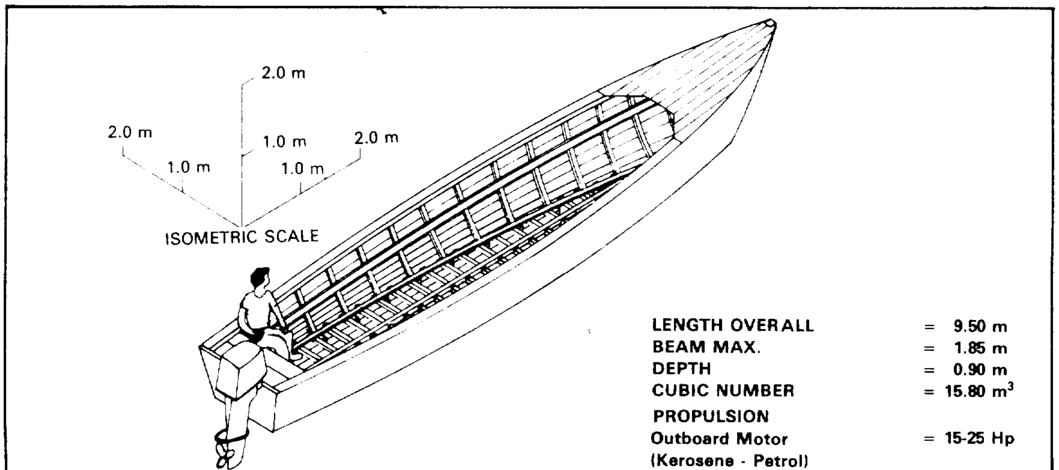
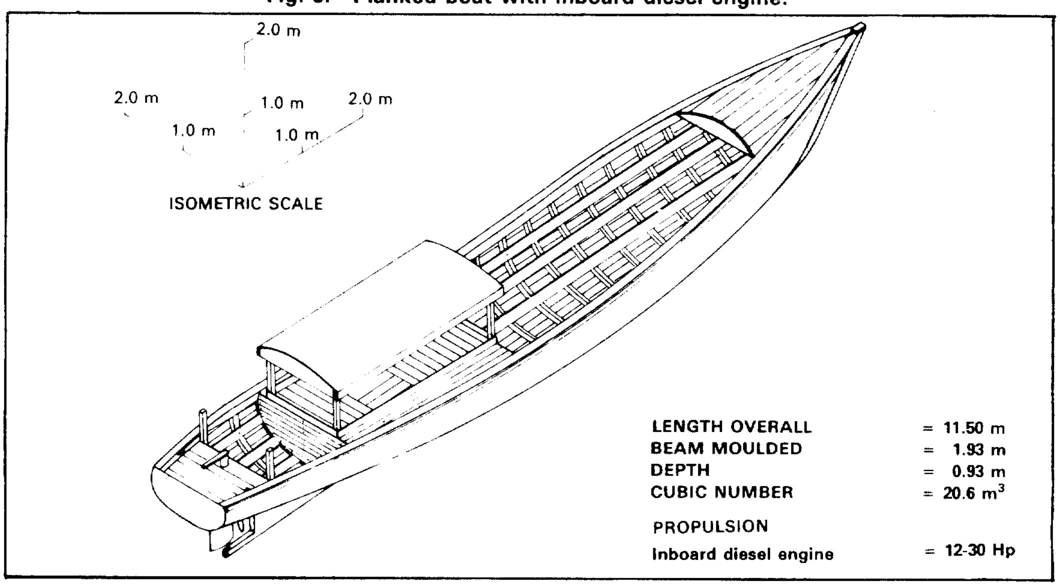
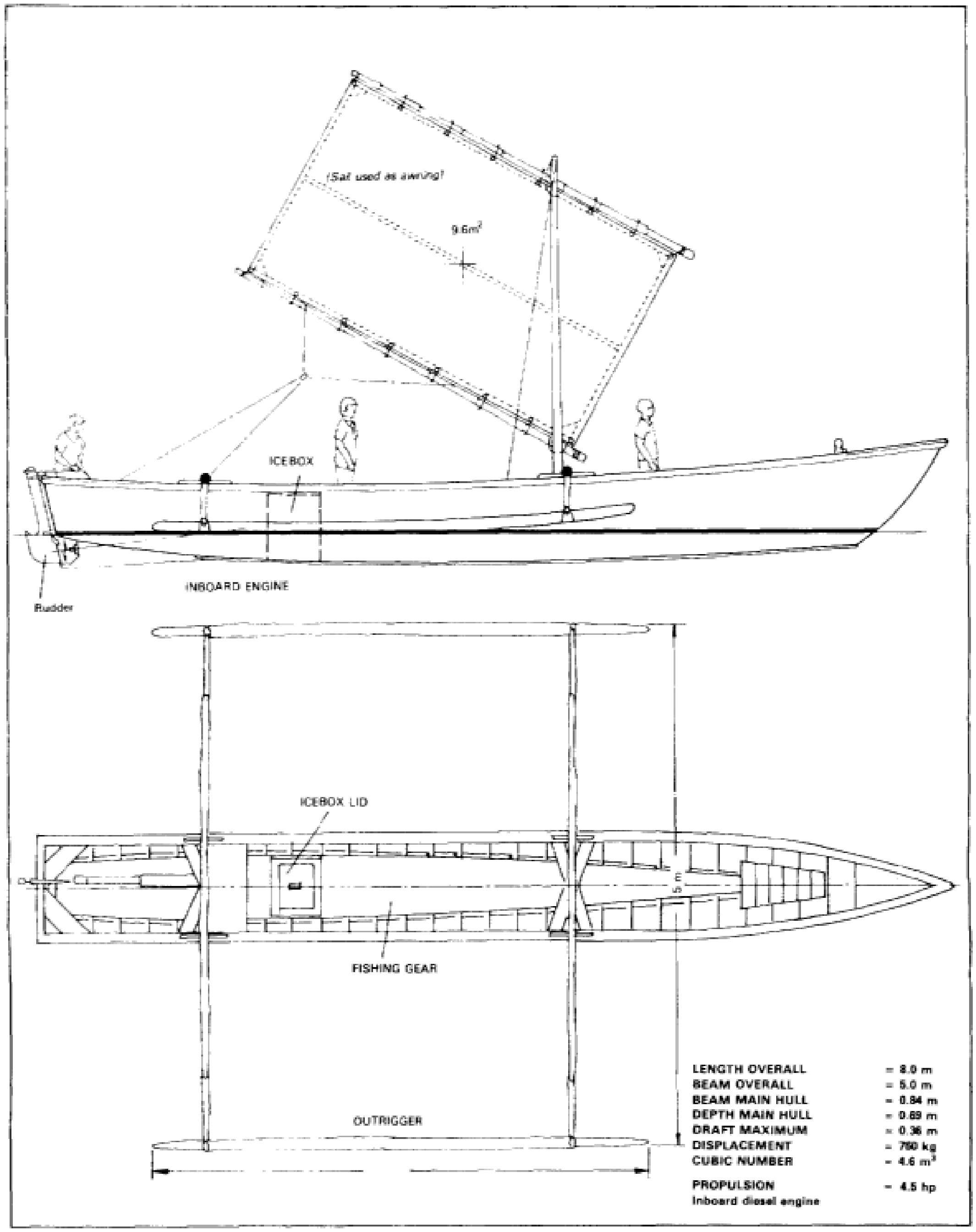


Fig. 5. Planked boat with inboard diesel engine.



The planked boats operate mainly from Gunung Sitoli and Teluk Dalam.

Fig. 6. INS-2, 8.0 m Planked outrigger canoe.

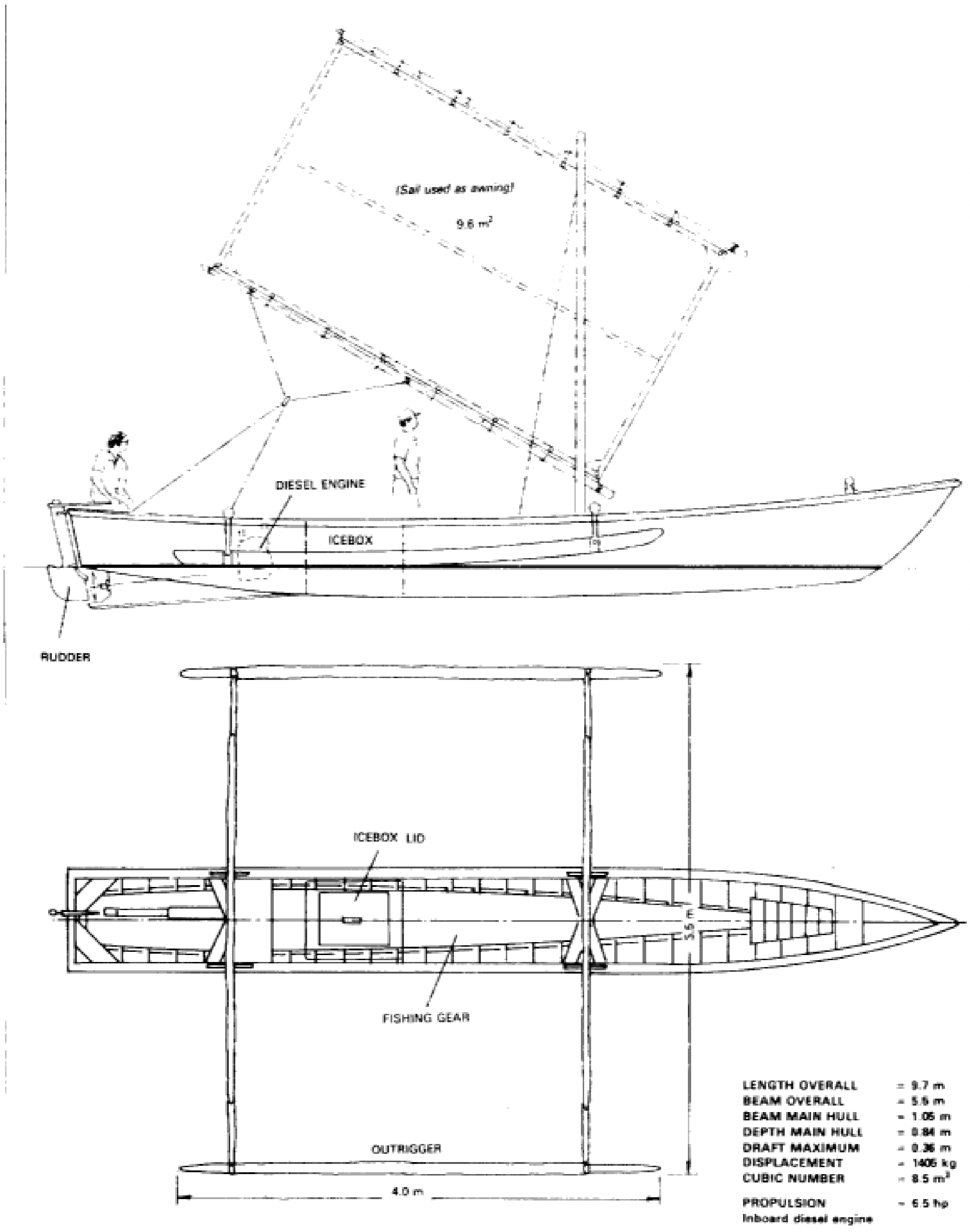


INS-2 : (Fig. 6) An 8.0 m outrigger canoe with a 4.Sph (continuous duty) diesel inboard engine. It was designed for handlining, trolling and small mesh gillnetting by a 2- or 3-man crew.

Weight with engine	50() kg
Total load with two crew and fishing gear	300 kg
Displacement	80() kg

Range of operation : 15-20 n miles

Fig. 7. INS-3, 9.7 m Planked outrigger canoe.

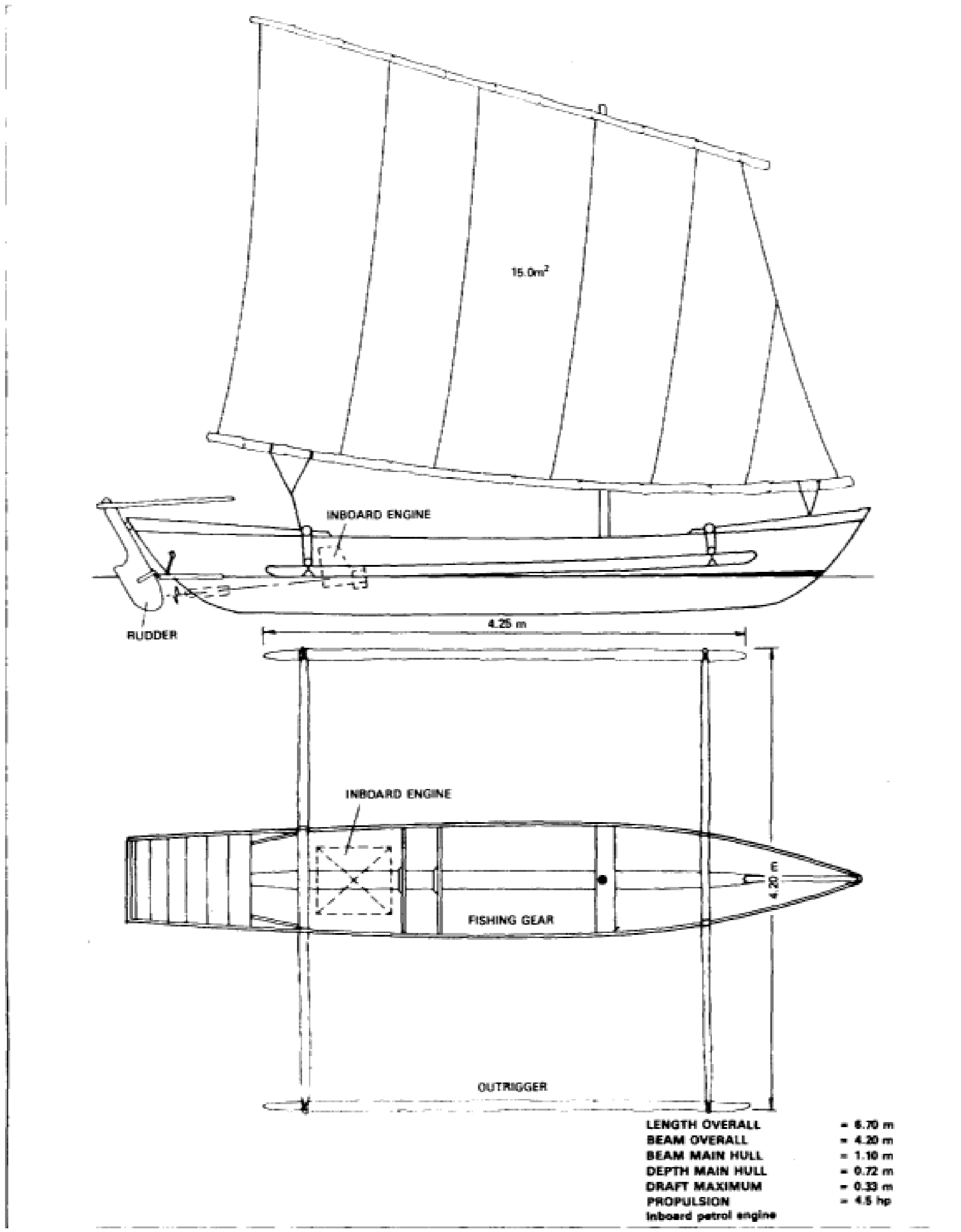


INS-3 : (Fig. 7) An 9.7 m outrigger canoe with a 6.Shp (continuous duty) diesel inboard engine. It was designed for large mesh driftnetting, longlining, trolling and handlining by a 3- or 4-man crew.

Weight with engine	700 kg
Total load with three crew and fishing gear	700 kg
Displacement	1400 kg

Range of operation : 15-25 n miles

Fig. 8 INS-4, 6.7 m Planked outrigger canoe.



INS-4 : (Fig. 8) An 6.7 **m** outrigger canoe with a 4.Shp (continuous duty) aircooled petrol engine fitted with a longtail propeller arrangement. It was designed for handlining, trolling, small mesh gilinetting by a 2-man crew.

Weight with engine	300 kg
Total load with two crew and fishing gear	200 kg
Displacement	500 kg

Range of operation : 5-15 n miles

2.2 *Choice of engine*

The most important consideration in the design of these craft was the choice of engine power which would have the greatest influence on investment and running cost. For long range operation, as in the case of INS-2 and INS-3, only an inboard diesel engine could he considered. The cheapest diesel engine available in Indonesia in the 4-15 hp range is the hopper-cooled horizontal cylinder engine, used for many applications, such as power tillers, water pumps and generators. These engines are assembled in Indonesia and spare parts are readily available. When fitted in a craft, the hopper-cooling is closed with a lid containing a water inlet and outlet pipe. Water circulation is achieved by the propeller, which pushes water into a pipe fitted behind it and then to the engine *via* a rubber hose. The engine is directly coupled to the propeller shaft with a flexible coupling and no reverse/reduction gearbox is used. This type of installation is very common on the east coast of Sumatera.

For economical operation, the size of the engine installed should he 5-6 hp per tonne displacement and the engine should he operated in service condition at 3-4 hp per tonne displacement. With this powering, an outrigger canoe with a waterline length of 7.0 m will achieve a service speed of 6.0-6.5 knots. To increase the service speed by 0.5 knots, from 6.5 to 7.0 knots, the engine power would have to be increased from 4 hp/tonne to 5.5 hp/tonne – a 10 per cent increase in speed thus requiring a 40 per cent increase in engine power, which is not economically justifiable. The installed engine power of the outrigger canoes was, therefore, kept in the range of 5-6 hp/tonne displacement and it was assumed that around 4 hp per tonne would be utilized in service.

The engines selected were as follows:

Outrigger canoe	*Engine*	*Service speed*
INS-2 : 8.0 m	YANMAR TF-55, diesel, 4.5 hp/220() rpm (continuous duty) direct drive	6.3 knots
ENS-3: 9.7 m	YANMAR TF-75, diesel, 6.5 hp/2200 rpm (continuous duty) direct drive	6.7 knots
INS-4: 6.7 m	KUBOTA GS 200. petrol, 4.5 hp/3500 rpm 2:1 reduction	6.0 knots

2.3 *Construction*

The method of construction of the outrigger canoes followed the practices developed in other FAO boat-building projects. To simplify the construction and reduce the amount of transverse framing, the bottom was planked crosswise. This made possible the use of short planks which are more easily found in Nias Island. The bottom was planked with two layers of 15 mm planking. Water tightness between the two layers was achieved by using mosquito screen and bitumastic compound. Besides achieving complete water tightness, there was also the advantage that the outer layer of planking could he easily replaced in case of attack by toredo worms.

The sides were planked longitudinally in the conventional way, except that all planks had straight edges, making construction easier and reducing wastage. A rabbeted loint was used between the planks to allow some swelling and shrinking of the planks without loss of waler tightness in the joint. The plank thickness on the sides was kept to 15 mm – except the lowest plank in the 9.7 m outrigger canoe, which was 20 mm – thus reducing weight as much as possible and making hauling up on the beach easier. The side frames were bolted to the lower plank and the planking nailed to the frames. All nails were round wire nails of ordinary type. except that the thickness of the nails was increased in relation to the length. The nails were available on special order from the nail factory in Medan. All bolts and nails were hot-dip galvanized. This was essential to stop corrosion of the fastening. Electroplated nails at present used for boat-building in Nias have very low resistance to corrosion

The timber specified for construction was a locally known boat-building timber called *Bito (Calophyllum Soulatri)* with a weight of 540 kg/m^3 at 15 per cent moisture content. *Bib* is usually sawn with a chainsaw or handsaw by small contractors in the forest. Due, however. to the poor quality of *Bito* timber delivered by the local saw mill, other varieties of timber had to he utilized. These comprised *Meranti* for bottom and side planking. *Kapur* for frames, coaming. capping and rubbing battens, and *flantar Lout* for chines and deadwood. These timbers were available from timber stores in Gunung Sitoli at a cost only slightly higher than that of ***Bito.*** They also had the advantage of long, straight planks being available, thus reducing wastage.

The outrigger canoes were built with the bottom up on a building jig. This was faster and ensured uniformity of construction, compared with the traditional way of construction.

Construction of the prototypes started in Gunung Sitoli in February 1989 under the supervision of a FAO master boathuilder. Six local carpenters and hoatbuilders had been selected for training by staff of the Provincial Fisheries Service.

The FAO master boathuilder expressed satisfaction with the skill and enthusiasm of the boat-building trainees. To obtain a complete knowledge of the new construction technique, however, the trainees would, it was felt, need to build two or three more outrigger canoes.

The 8.0 m outrigger canoe INS-2. named *Tagiri,and* the 9.7 m outrigger canoe INS-3, named *Tuhu,* were launched at the beginning of April 1989. The 6.7 m outrigger canoe INS-4. named *Turusi,* was launched one month later.

2.4 Technical trials

Technical trials with *Tagiri* and *Tuhu* were carried out after launching. With a load of 300 kg (four persons), the maximum speed of the 8.0 m *Tagiri* at full power was 7.0 knots at an engine rpm of 2100. The engine is rated at maximum 2200 rpm, which indicated that the diameter (230 mm) and pitch (150 mm) of the selected propeller was correct. The cruising speed of *Tagiri* was around 6.5 knots with engine rpm of 1900-2000. The manoeuvrahility was rather poor, which could he rectified with a larger rudder. With the traditional type at outriggers, stability was low, hut sufficient for use with the engine. The auxiliary sail rig had to he utilized with care.

The 9.7 m *Tuhu* was tested with a load of 750 kg (11 persons). The maximum speed recorded was 6.8 knots at an engine speed of 2200 rpm. The diameter and the pitch of the propeller were too low and later trials with a new propeller (240 mm diameter and 165 mm pitch) showed improvement in speed. This craft could achieve a service speed of 6.5 knots at engine rpm of 20(X). Manoeuvrahility of the single outrigger canoe *Tuhu* was fairly good due to a large size rudder equipped with an end plate, to increase efficiency. Stability was very good with the single planked outrigger. Two men could stand on the outrigger before it submerged. There was no wind to try the emergency sail rig of 9.6m^2. The sail was rectangular in shape and was meant to he utilized normally as an awning — a system that works well on outrigger canoes in the Pacific.

3. *FISHING TRIALS*

3.1 INS-2 Tagiri

INS-2 Tagiri

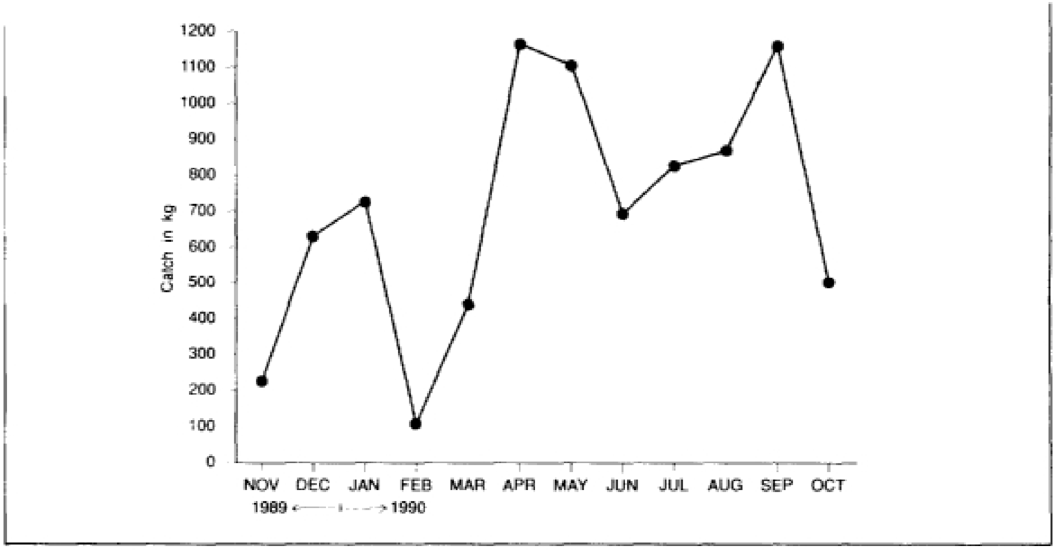
Fishing trials started in Botholakha village on the east coast, 22 km north of Gunung Sitoli, in May 1989. The canoe was in this village until October 1989 when it was transferred to Gomo village 6 km north of Gunung Sitoli. The fishing gear used comprised handlines for demersal and pelagic species, bottomset longlines for demersal species and trolling lines for pelagic species. The trials in Botholakha were not successful. Appendix 1 gives the fishing results for one year from Gomo. The results may be summarized as follows:

Average per month

	Botholakha	Gomo
No: of fishing trips	10	12
Catch by weight	89 kg	702 kg
Catch by value	Rp 95,000	Rp 599,000
Catch weight/trip	9kg	59 kg
Catch value/trip	Rp 9,000	Rp. 50,000

The reason for the poor results in Botholakha village seems to have been a disagreement between the fishermen operating the craft and the leader directly cooperating with the Project. It resulted in low intensive fishing near the shore. In Gomo, the fishermen came from one family and the responsibilities were clearly defined. The Gomo crew consisted of three fishermen and the fishing area was around Sarangbaung island, 23 n miles or about four hours running time from Gomo. (See Figure 1.) The craft normally left for fishing around 1O:OO hours and returded the next day. Fishing was carried out at depths of 50-100 m and while sailing.

Fig. 9. Monthly catch by the *Tagiri*



The 22-24 hours duration of the fishing trip made it essential to carry ice to preserve the catch. Ice boxes were made locally to fit inside the outrigger canoe. The ice box, of 0.20 m^3 net volume, was adequate to keep on ice the average catch of 59 kg/trip. Ice was purchased in Gunung Sitoli and brought to the village by bicycle.

The catch was generally taken to the market in Gunung Sitoli by bicycle and fetched a high price, since it mainly consisted of grouper, snapper and other high quality species.

During one year of operation from Gomo village, *Tagiri,* which made 143 fishing trips, caught 8415 kg of fish valued at Rp 7.2 million. Figure 9 shows the monthly variation of the catch over the year. Figure 10 gives the percentage of fish caught, by weight and value, using the various fishing gear. It is noteworthy that 84 percent of the total catch was caught by demersal handline. The relative importance of the various fish species is shown in Figure 11. Snapper and grouper represent 69 per cent of the catch, with carangids second (10 per cent)

Fig. 10. Weight and value of the *Tagiri's* catch, by fishing gear

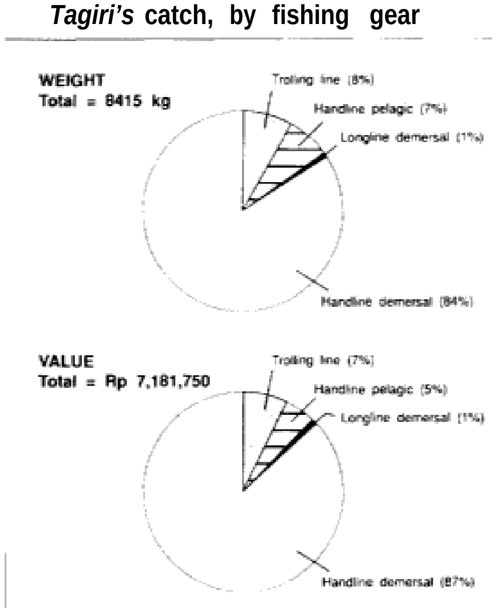
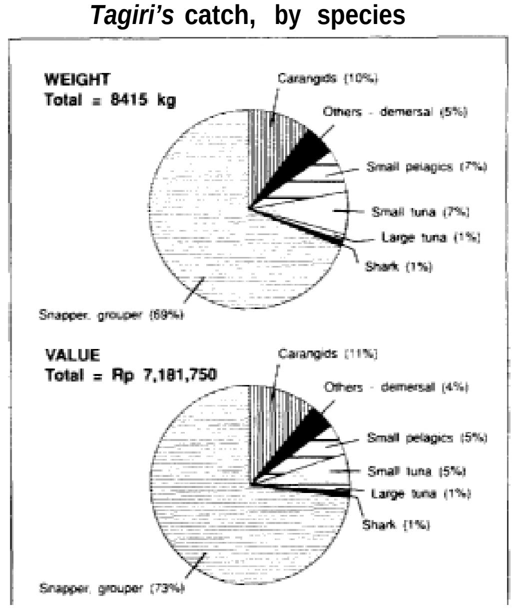


Fig. 11. Weight and value of the *Tagiri's* catch, by species



3.2 *INS-3*, Tuhu

INS-3 Tuhu

The outrigger canoe *Tuhu* was operated from Moawe village, 4 km north of Gunung Sitoli, from May 1989 to February 1990. The canoe, which was intended to fish for large pelagic species, used large mesh dnftnets and drift longlines for tuna, shark and billfish species in offshore waters. It was then shifted to Gomo village from March 1990 and operated together with *Tagiri,* mainly using handlines for demersal and pelagic species and trolling lines for pelagic species. Appendix II gives the results of the fishing trials from Moawe and Appendix III from Gomo, village. The results may be summarized as follows:

Average per month

	Moawe	*Gomo*
No. of fishing trips	13	16
Catch by weight	240 kg	1255 kg
Catch by value	Rp 160,000	Rp 1,027,000
Catch weight/trip	18 kg	79 kg
Catch value/trip	Rp 12,400	Rp 64,800

The catches were disappointingly low when operating from Moawe. Other boats from Gunung Sitoli using large mesh driftnets also experienced very low catches during this period. When *Tuhu* was transferred to Gomo, it started to do the same type of fishing as *Tagiri.* The distance of about 23 n miles to the fishing grounds made the use of an ice box to preserve the catch a necessity. *Tuhu* was fitted with an ice box of 0.27 m^3 net volume.

During the seven months fishing while in Gomo, *Tuhu* caught 8785 kg of fish valued at Rp 7.2 millions. It made 111 fishing trips, yielding an average catch 79 kg/trip.

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3.3 *INS-4* Turusi

***INS-4* Turusi**

Turusi was first operated from Botholakha village together with *Tagiri* from May 1989 to end September 1989. It was then shifted to Gomo and used until end March 1990. Due to continuous engine problems, the operation was then stopped. The results may be summarized as follows:

Average per month

	Botholakha	*Gomo*
No. of fishing trips	6	7
Catch by weight	76 kg	180 kg
Catch by value	Rp 60,000	Rp 186,000
Catch/trip-weight	15 kg	24 kg
Catch/trip-value	Rp 12,000	Rp 25,000

Although considerably better results were achieved when operating the outrigger canoe from Gomo, the economic return was still insufficient, due to the small number of trips per month and the high cost of maintenance, mainly due to breakdown of the aircooled petrol engine.

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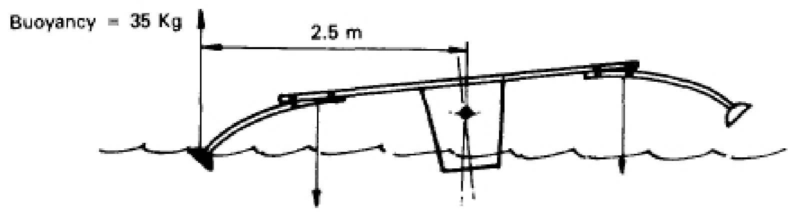
Fig. 12. Outrigger stability.

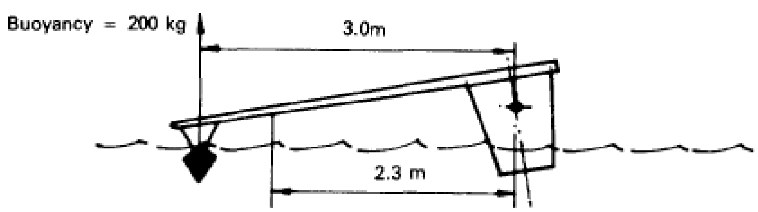
Traditional double outrigger



Weight of beams and outriggers cancels out

RIGHTING MOMENT = Buoyancy x Arm = 35 kg x 2.5 m = 88 kgm

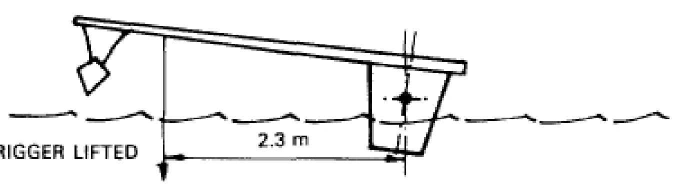
Single outrigger



OUTRIGGER SUBMERGED

Weight of outrigger and beams = 110 kg

RIGHTING MOMENT = (Buoyancy x arm) - (Weight x arm)
= (200 kg x 3.0 m) - (110 kg x 2.3 m) = 347 kgm



OUTRIGGER LIFTED

Weight of outrigger and beams = 110 kg

RIGHTING MOMENT = Weight x arm = 110 kg x 2.3 m = 253 kgm

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4. TECHNICAL EVALUATION

4.1 Type of craft

The assumption that the traditional type of outrigger canoe would be a more suitable base for developing a planked outrigger canoe than a monohull was proved to be justified. The fishermen like the new planked outrigger canoes because of the similarity in concept to their traditional outrigger canoes, because the outriggers dampen the rolling motion and because a good speed is achieved with low engine power.

Traditionally, all outrigger canoes in Nias have two outriggers. The 9.7 m outrigger canoe *Tuhu* was fitted with a single planked outrigger filled with polystyrene. This had the advantage of leaving one side clear of protruding beams that might interfere with the hauling and setting of the fishing gear. One large outrigger with high buoyancy would also give a higher stability than two small, traditional type outriggers.

The 8.0 outrigger canoe *Tagiri* was originally fitted with two traditional outriggers. This seemed to work to the satisfaction of the fishermen, but the stability was considered to be low by the BOBP staff and, so, after five months operation, the two traditional outriggers were replaced by one planked outrigger filled with polystyrene.

The fishermen is Gomo using *Tagiri* and *Tuhu,* however, still maintain that they prefer two traditional outriggers to one larger planked outrigger. They feel that the traditional outriggers would reduce the weight and make the outrigger canoes easier to haul out on the beach. They also believe it would be safer, because two outriggers give “double the safety” of one outrigger.

Safety, however, is connected with stability, and stability is measured in the righting moment, as illustrated in Figure 12 (See facing page). The case of the 8.0 m outrigger canoe *Tagiri* is used. As shown in the figure, *Tagiri,* with the present planked outrigger, has three times higher righting moment than with the traditional double outriggers. There is little doubt that when the engine alone is used, the stability of the traditional type of outriggers is satisfactory. The need for stability arises when heavy fishing gear or the emergency sail is used. In such cases the single outrigger is greatly superior. However, the smaller, traditional outrigger canoes, with their low stability and with a sail area almost as large as that of the *Tagiri,* do operate satisfactorily. This is largely due to the fishermen’s skill in handling outrigger canoes that, from an outsider’s point of view, would be considered unsafe.

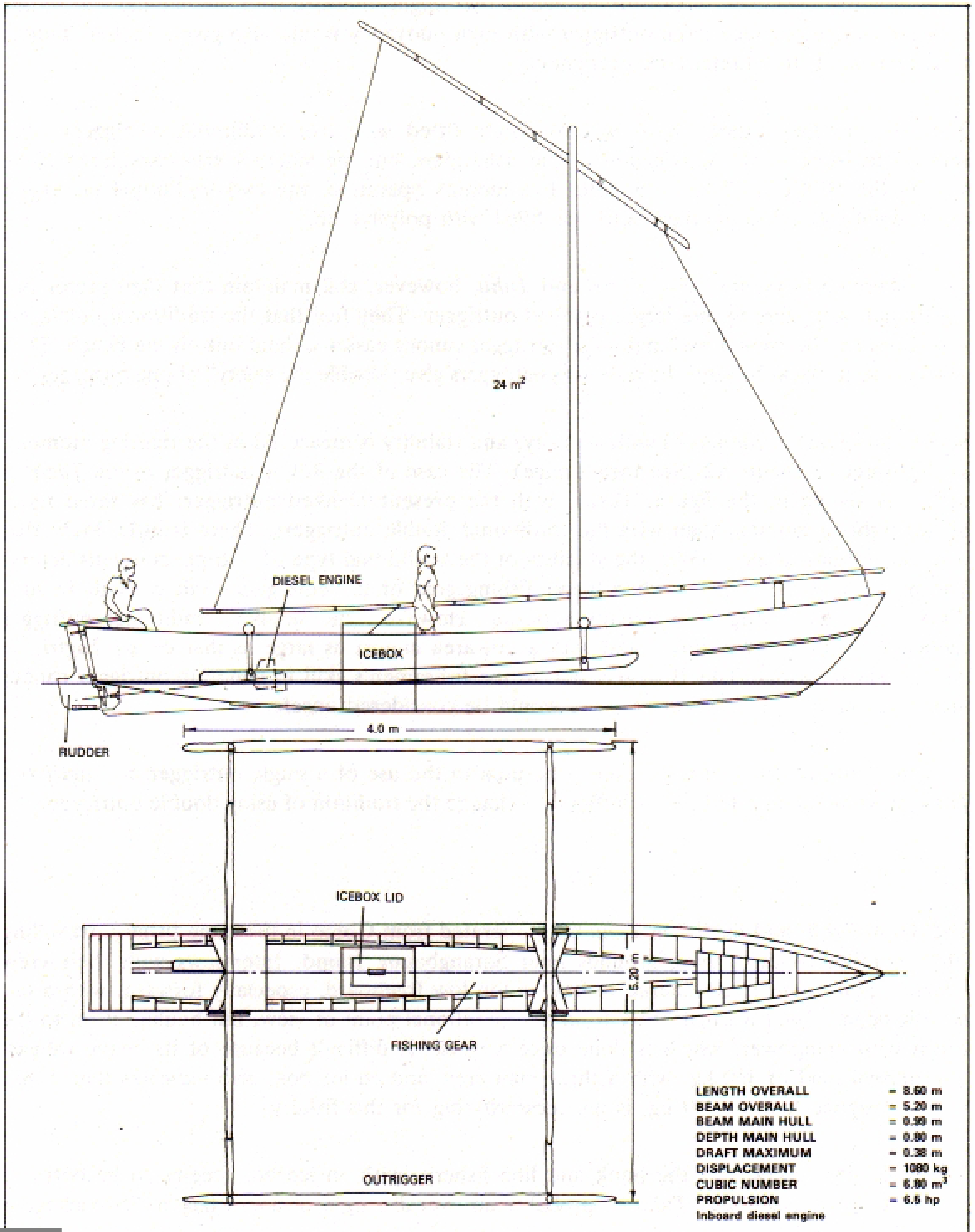
In view of the reaction of the Gomo fishermen to the use of a single outrigger on *Tagiri* and *Tuhu,* it would appear to be very difficult to change the tradition of using double outriggers.

4.2 Size

The 8.0 m *Tagiri* and the 9.7 m *Tuhu* both operated from Gomo in the same fishery, travelling 20-25 n miles to the fishing grounds near Sarangbaung Island. Interviews with their crew revealed that *Tagiri* is considered to have a too low freeboard, especially forward, with a too narrow beam. *Tuhu* is satisfactory from an operational point of view, but hauling it on to the beach with manpower, which is done once a week, is difficult because of its heavy weight. The normal load of 400 kg, with a three-man crew and an ice box, also indicates that *Tuhu,* with a designed load of 700 kg, is unnecessarily big for this fishery.

The ideal size of craft for the hook and line fishery, with an ice box, seems to lie between the sizes of the *Tagiri* and *Tuhu* — probably an overall length of about 8.6 m. Displacement

Fig. 13 INS-5, 8.6 m Planked outrigger canoe.



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with a load of 400 kg would be around 1000 kg (*Tagiri* = 800 kg. *Tuhu* = 1400 kg). Complete working drawings for this new version. called INS-S. have been prepared (See Figure 13 on facing page for one of these craft).

The 6.7 m *Turitsi* is too small for the bug range operation carried out by *Tagiri* and *Jutu*. It will be limited to fishing grounds closer to the base that are more heavily fished by the traditional oulrtgger canoes. It therefore does not offer the same potential for increased catches as the larger outrigger canoes.

4.3 Engine

The horizontal cylinder multipurpose diesel engitles used on *Tagiri* and *Tuhu* have proved to he very reliable. The *Tagiri's* 4.5 hp continuous duty engine and the *Tuhu's* 6.5 hp continuous duty engine give adequate service speeds of 6.5 knots when fitted with the correct propeller. The fuel consumption is about 1.0 litre per hour and the fuel consumption per nautical mile at a service speed of 6.5 knots is 0.16 litre, which is exceptionally low. The average fuel cost during a vear of operation is only 5 per cent of the gross return from the catch.

The question of engine size was discussed with the crew of *Tagiri* and *Tuhu*. The *Tagiri* crew was generally sattsfied with the performance of the engine, while the *Tuhu* crew wanted the engine power increased from 6.5 hp to 9.5 lip on the new outrigger canoes (INS-5). in order to extend operations even further north towards Kepulauan Banyak. south of Aceh Province. it was not realized that the increase in speed by using a 9.5 hp engine would only be about 0.5 khots. from 6.5 to 7.0 knots, which meant that the 23 n miles distance from Gotiio village to Saranghaung Island would take 3 hours 17 minutes instead of the current 3 hours 30 minutes. l'he gain iii time hardly balances tile increase in investment and fuel consumption.

For the future, an intermediate size 8.6 m outrigger canoe with a load of 400 kg. a displacement of 1000 kg and an engine of 6.5 hp is adequate. This engine (YANMAR TF 75 - 6.5 hp/2200 rpm). the same as is now fitted in *Tuhu,* has proved to be very economical and should, therefore, he the recommended engine for tile new outrigger canoe.

Some problems have been experienced with tile engine installation, such as wear on the propeller shaft and stern bush, the engine bed vibrating loose, leaks in exhaust pipe etc. These problems have been partly rectified, hut the followtng points should be considered for future boats:

- The stern tube and hearings should be made in a pattern with two 10 mm SS bolts instead of three small screws fixing the stern tube to the shaft log.

  A grease retainer, such as on the heachlanding craft in India, should be used to reduce entr of sand into the hearing.

- The steel engine bed should be made of the correct thickness according to the drawing. Bolts for the engine bed should he increased from 3/8" to 1/2".

  The goose neck of the exhaust ptpc should be taken higher to avoid any possibility of water entering the engine.

  'I'he skinfitting of tile exhaust should be fitted on the transom.

The 4.5 hp petrol engine used on *Turusi* was first fitted with a longtail propeller shaft. The engine was mounted on tile side of the outrigger ciuloe about midships and a long shaft was required to give sufficient immersion of the propeller. Although the 'longtail engine. which is very popular in Thailand and in Java, Indonesia, is not used in North Sumatera, it was considered to he a low cost alternative for *Turusi*

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The fishing trials in Botholakha, however, showed the weaknesses of the longtail arrangement for this type of craft:

- **A stability** problem, due to the weight of the engine being on one side and the traditional outrigger being of insufficient buoyancy;
- High wear on the propeller shaft bushes; and
- Exposure of the engine to spray.

It was concluded that the advantages of the 'longtail' arrangement were not sufficient to compensate for the problems experienced. The engine was, therefore, installed inboard, with the shaft going through a stern tube in the conventional way and with a rudder fixed behind the propeller. This arrangement worked well, but the engine developed serious overheating problems and breakdowns which considerably reduced the fishing time. A different **make of petrol** or kerosene engine could possibly have been located, but due to the high running cost and general vulnerability of the ignition system to wetness, it was decided to discontinue the trials with *Turusi.* On the east coast of Sumatera, there seems to be a definite trend away from petrol and kerosene engines and towards small, horizontal cylinder diesel engines. The positive experience with the diesel engines on *Tagiri* and ***Tuhu*** supported this view.

4.4 *Construction*

While the quality of workmanship of the local boatbuilders was good, none of them had any understanding of construction drawings. Due to limitation of time, they could not be trained in this. If, therefore, more craft are to he built, more training would be essential.

Initially, there was much scepticism about the new outrigger canoes among the local authorities because the outrigger canoes had no keel; it was strongly felt that they were, therefore, not sea-worthy. This scepticism has now disappeared and the performance of the outrigger canoes has proved that they are safe and seaworthy. Their watertightness has convinced the fishermen about the method of construction. After one and a half years of operation, there are no structural problems and it can be concluded that the method of construction is well proved.

The key to long service life of the outrigger canoes is the use of bolts and nails that have been hot-dip galvanized, not electroplated. There should be no compromise on this,.as fastenings are the weakest link in a wooden craft.

4.5 Maintenance

Tag/ri and *Tuhu* are hauled out of water once a week and the bottoms of their hulls and outriggers canoes scrubbed. The outrigger canoe lies on the beach for about 24 hours over the holiday, but this is probably not enough to kill toredo worms in the timber. Toredo attack was noticed on the rubbing strips. The following possibilities exist to protect a wooden craft against attack by toredo:

- Apply antifouling paint every four months.
- Moor the craft in a freshwater river between fishing trips.
- Haul the craft ashore once every second month and dry it out on the beach for a week to kill the worms.
- Apply a sheathing of copper, FRP. galvanized iron or aluminium.

The following observations need to he considered in connection with these protective methods:

Antifouling paint is not commonly used in Nias Island and has to be specially ordered. The cost is about 6000 Rp/litre. About 2-½ litres would be required to cover the hull. Applied every four months, this would cost 45,000 Rp/year. While this appears to be the cheapest alternative, the effectiveness of the local antifouling paint is not known. It is, however, found that the paint gets scraped off each time the outrigger canoe is hauled ashore or launched and. as a result, the rubbing strips have to he replaced frequently. An ordinary gloss paint is applied every two months on the 'speed boats' fitted *with* outboard mutors Sometimes a special poison, cally Tolly, which is available from pharmacies, is mixed into the paint. The 'speed boat' is normally used for driftnetting, and the hauling out and painting of the hull is done over a one-week period during Full Moon when driftnet catches are low.

Fresh water rivers which enter ihe sea and have i sufficient depth at the entrance are tew and far hetween. It also has io he ensured that the water is fresh such places and not brackish due to tidal effect.

Hauling ashore the outrigger canoe after EACH fishing trip would ensure that there are no toredo attacks. But with a craft weighing 600 kg (including ice box) this ts not practicable except where the beach is very flat. To haul it out every second intnth to dry out oil the beach for one week would cause too much loss of fishing time for the hook-md-line fisheries.

A sheathing of 0 30mm galvanized ron sheets is used on all dicsei powurvd boats in Nias that are too big to he hauled ashore regularly The cost is 6 6,600 Rp/m^2 Tar and paper from cement bags are applied to the hull and the sheathing is nailed on with galvanized tacks. The sheathing is then painted with red primer. The sheathing lasts for one to two years.

In India. aluminium sheathing, usually 24 SWG = 0.55 mm, fastened with galvanized tacks, is used on most wooden boats. A polyethylene plastic sheet is used instead of paper between the hull and the sheathing.

In Gunung Sitoli 0.5 mm aluminium sheets are available at a cost of 9,300 Rp/m^2 To sheath a 8.6 m outrigger canoe about 12 m^2 would be required. The cost of sheathing would be Rp 80,000 using galvanized sheets and Rp 112,000 using aluminium sheets,

FRP sheathing, such as is used in Sri Lanka on wooden boats, is not practical in Indonesia due to the high cost of polyester resin and glass mat. Copper sheathing is too expensive. A comparative trial should he made with one outrigger canoe using aluminum sheathing and another using galvanized iron sheathing.

The rubbing battens along the edges of the bottom and under the keel have to he placed outside the sheathing, nailed on and replaced when they become worm-eaten.

4.6 Icebox

The use of an ice box to preserve the catch on *Tagiri* and *Tuhu* was essential to allow the range of operation to be extended. Although the locally made ice boxes gave good service, several details should be changed in the future:

- The outside planking should be reduced from 15 mm to 9 mm to reduce weight.
- The ice box should sit on top of the chine battens and not on the bottom planking.
- The lid should be modified to reduce as much as possible the heat leak through air gaps. The frame around the opening should prevent rainwater from entering the box.
- In the inner aluminium sheathing, joints should be avoided in the middle portion of the bottom where the stresses are greatest.

5. *ECONOMICS*

5.1 *Evaluation of performance*

Complete data for one year's operation are available for *Tagiri* which operated from Gomo with a crew of three men and used hook-and-lines for denlersal and pelagic species.

Tuhu had a catch which was 43 per cent higher than that of *Tagiri* during April-October 1990. This is mainly due to the increase in the number of trips by alternating two crew of three men each and shows what a more intensive use of the outrigger canoe could achieve. *Tagiri* is, however, selected for the economic evaluation because data are available for a whole year and the use of one crew is considered more common. The economic evaluation is given in Appendix IV.

The evaluation is based on the following investment in *Tagiri* in 1990:

	Value	*Depreciation years*	*Depreciation per year Rp*
Outrigger canoe	1,000,000	10	100.000
Engine (4.5 hp)	2,100,000	6	350,000
Icebox	200,000	10	20.000
Fishing gear	400,000	2	200,000
Total	3,700,000		670.000

Appx. US $ 2,0 00

The yearly income of Rp 965,000 (US $ 520) per crew member of *Tagiri* is well above the average for traditional fishermen in the fishing villages where the trials were carried out. It can, therefore, he concluded that the objective of increasing the income per fisherman has been achieved.

The 49 per cent accounting rate of return is very satisfactory and should make the investment attractive for bank financing.

5.2 *Financing of new outrigger canoes*

The estimated cost of an intermediate size of 8.6 m outrigger canoe (November 1990) is as follows:

	Rp
Outrigger canoe	1.25 million (Appendix V)
Engine and engine installation	2.4 million (Appendix VI)
Icebox	0.25 million
Total	3.9 million (US $ 2100)

As shown in the evaluation of performance, the accounting rate of return, based on a one—year catch record for *Tagiri*, is 49 per cent. The outrigger canoes are, therefore, economically viable.

To obtain financing through the local branch of Bank Rakyat Indonesia (BRI) and Bank Pembangunan Daerah. Sumatera Utara (BPDSU). collateral in land is required. This will exclude many fishermen as they do not own land. Fishermen who do have land, hut do not possess a land certificate, would need to obtain one at an estimated cost of Rp 500.000. Interest paid on a loan is at a flat rate of 23 per cent and the total loan must he repaid by the end of the loan period.

Assuming that a loan for a complete outrigger canoe costing **Rp 3.9** million is required and **that the loan is repayable over a two-year period, the cost of this loan would he:**

	Rp
Loan	**3.9 million**
Interest (23 per cent over 2 years)	1.8 million
TOTAL	5.7 millions

The result from one year's operation of *Tagiri* shows that the net yearly return is Rp 1.8 million. If the money were deposited in a savings account, it would earn 17 per cent interest, or about Rp 0.6 million over two years, assuming a gradual accumulating deposit **over the two years. The total savings after two years** would he Rp. 4.2 million, which would **he insufficient to cover a loan of Rp. 5.7 million. If a land certificate, to** obtain the hank loan, is not available, an additional expense of Rp. 0.5 million would he involved.

Three alternatives exist:

1. Limiting of the loan to the cost of engine and installation i.e. Rp 2.4 million. The cost over two years would he:

	Rp.
Loan	2.4 million
Interest (23 per cent over 2 years)	1.1 million
Total	3.5 million

The net return over two years of Rp. 4.2 million would he sufficient to service this loan. It is assumed that the financing of the outrigger canoe and the icebox, to he built in the village, at a cost of Rp 1.5 million, could he arranged by savings or informal credit within the village.

2. A hire-purchase agreement with the engine dealer. If the dealer charges the same interest as the bank, the cost of the hire-purchase agreement over the two years would he less that that of the hank loan, because the dealer would presumably accept payment in instalments over two years. The need for a land certificate would also he obviated. To what extent the engine dealer would he willing to carry the risk and what his charges would he are, however, not known,

3. A revolving fund administered by a local hank. Such a loan would he the best alternative for fishermen without immovahle property. since the revolving fund would provide the guarantee. If the fisherman's contribution was to he the cost of the timber – approximately Rp 0.5 million – the loan would amount to **Rp 3.4 million.**

   With a loan repayment period of two years and assuming that a reduced interest of 10 per cent would he charged. the fisherman would he required to reimburse Rp 4.0 million over a two—year period. or ahout 1.8 niillioii Rp/year. This would he within the net return of 1.8 million Rp/year calculated for *Tagiri* To finance 15 outrigger canoes a year. a total revolving fund **of Rp** 100 million (US$ 54.000) would he required.

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6. *CONCLUSIONS AND RECOMMENDATIONS*

The project was intended to improve the productivity of the small scale fishing sector and the earning capacity and livelihood of the fisherfolk of Nias Island, Northern Sumatera, through the development of larger, plank-built outrigger canoes for more extensive fishing operations. The approach of the project was to base the fishing craft development on the most common type of traditional craft, the outrigger canoe, as there were greater chances of acceptance of the new craft by the small-scale fishermen if the new craft were similar in concept to their traditional craft.

Based on plans drawn up by a Consultant Naval Architect, three outrigger canoes were built under the supervision of a FAO master hoatbuilder training in the new construction method was given to six local hoatbuilders and carpenters.

Fishing trials were conducted with all three outrigger canoes and the following recommendations are made based on the conclusions reached:

- The use of an icebox, locally made for the outrigger canoe, is essential to preserve the catch on fishing trips of about 24 hours duration. Such iceboxes greatly extend the range of operations.
- The outrigger canoe with the best performance, considering all aspects of the fishing, appears to be one of 8.6 m with a 6.5 hp diesel engine.
- Future outrigger canoes should use the same construction methods as were used in the Project, since no structural problems were experienced with these outrigger canoes and their watertightness proved good.
- To reduce the fishing time lost due to hauling out, the application of sheathing as protection against toredo attack should he considered. This is recommended because, though the maintenance of the outrigger canoes during the project was good, they never got the opportunity to dry out long enough on the beach to kill the toredo worms.
- Some details of the engine installation need to he changed, based on the experience of the Project. During the Project's duration, no major breakdowns were experienced with the horizontal cylinder watercooled diesel engines used on *Tagiri* and *Tuhu*, but the aircooled petrol engine used on *Turusi* had a fuel cost that was very high and it also suffered from serious breakdowns. The petrol engine is not recommended for future use.
- Despite the considerably higher stability with the single planked outrigger that was designed and tested, the fisherfolk prefer two traditional type outriggers. The concept of the new planked outrigger canoes, however, is well accepted by them.
- The future introduction of the new planked outrigger canoe would depend on a suitable credit scheme accessible also to fishermen who do not own land and, consequently, are not eligible for financing by banks in Gunung Sitoli.

APPENDICES

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APPENDIX I

Fishing data of 8.0 m outrigger canoe *Tagiri* in Gomo

(November 1989 to October 1990)

		NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	TOTAL
PART I														
1. Fishing time														
— No of fishing trips		6	12	15	6	16	18	17	7	10	11	17	8	143
— No of fishing days		12	23	26	6	16	21	22	11	17	19	26	15	214
— Hours at sea		144	292	326	162	202	318	292	126	233	267	414	197	2973
— Hours fishing		103	177	208	107	123	184	165	75	143	168	261	127	1833
— Sail time eeng		41	115	126	55	79	134	127	51	90	99	153	70	1140
PART!!														
1. Gearwise catch and earnings														
— Handline (Demersal)	wgt:kg	227	635	636	48	251	829	697	586	844	867	1032	429	7081
	val:Rp	221500	725000	672000	57500	222000	600000	507000	463000	717500	735000	940000	418500	6279000
— Handline (Pelagic)	wgt:kg	30			8	6	91	363	80		2			580
	val:Rp	30800			9750	5000	32000	250000	49000		1008			376750
— Trolling line	wgt:kg			94	32	123	220	32	20	4	6	116	34	681
	vat:Rp			44000	21000	990)0	126000	25000	13080	2080	4080	93008	30500	457508
— Bottom Longline	wgt:kg					63	10							73
	val:Rp					60500	8000							65800
Total	wgt:kg	257	635	730	88	443	1150	1092	686	848	875	1148	463	8415
	val:Rp	251500	725000	716000	88250	386500	766000	782000	525000	719500	740000	1033000	449000	7181750
2. Specieswise catch and earnings														
— Small Tuna	wgt:kg				32	116	220	32	21	4	6	105	26	562
	val:Rp				21000	87000	126000	25000	13008	2000	4000	84000	22500	384500
— Large Tuna	wgt:kg			94								11	8	113
	val:Rp			44080								9000	8000	61800
— Shark	wgt:kg						16		35		8	20		79
	val:Rp						7500		19080		6000	8000		40500
— Small pelagics	wgt:kg	30			8		91	369	80		2			580
	val:Rp	30080			9750		32000	250000	49080		1000			371750
— Carangids	wgt:kg			382		100	185	53	37	13	44	14	8	836
	val:Rp			397000		94508	138500	44000	32508	11000	36080	18000	18008	781500
— Grouper/Snapper	wgt:kg	227	574	239	48	133	556	608	465	796	795	938	421	5800
	val:Rp	221500	656500	257500	57500	136580	422500	448000	397080	700500	681508	891500	408500	5279000
— Others (Demersal)	wgt:kg		61	15		94	82	30	48	35	20	60		445
	val:Rp		68500	17508		68500	39500	15000	14500	60(8)	11500	22500		263500
Total	wgt:kg	257	635	730	88	443	1150	1092	686	848	875	1148	463	8415
	val:Rp	251500	725000	716000	88250	386500	766000	782000	525000	719500	740000	1033000	449000	7181750
PART III														
1. Total sales value		251500	725000	716080	88250	386500	766080	782000	525000	719500	740000	1033000	449000	7181750
2. Variable operational costs														
— Fuel (diesel)		17325	36000	43650	17775	31050	52875	51925	26908	44550	45100	77825	31075	476050
— Fuel (kerosene)		1750	3325	1900	600	2850	8300	6250	3908	4400	6100	10500	2800	52675
— Lub Oil		4008	6908	3800	908	2700	3600	11608		10800	3600	9000		56900
— Food		6450	15808	19500	8850	10500	22800	21908	10500	15000	16508	25500	12000	185300
— Bait		18200	54750	54650	17800	18700	5000	7500		11750	23250	62850	36850	310500
— Ice		6000	17350	19500	9008	12500	27008	32500	19500	28500	29500	43408	19000	263750
— Others			900	4508			8725	9575	1600	6080	8708	8800	1208	50000
Total		53725	135025	147500	54125	78300	128300	141250	62400	121000	132750	237875	102925	1395175
3. Cashflow before payment to crew and boat owner (1-2)		197775	589975	568500	34125	308208	637700	640750	462600	598500	607250	795125	346075	5786575
4. Distiibution of cashflow to:														
— Crew members (50% of 3)		98887	294987	284250	17062	154100	318850	320375	231300	299250	303625	397562	173037	2893287
5. Gross cashflow to boat owner (50% of 3)		98887	294987	284250	17062	154108	318850	320375	231300	299250	303625	397562	173037	2893287
6. Repairs:														
— Craft			5808	4500			15500	13250	4500	37050		1500	13508	95600
— Fishing gear			13450	14508			5608	39650	17550	14850	18500	31150	15800	171050
— Engine							3508	750	5500	66800	62025	800		139375
— Sail				2508										
— Others					9080	33125	39408				5080			89025
Total			19250	21500	9000	33125	64000	53650	27550	118700	85525	33450	29300	495050
7. Nett cashflow to boat owner (5-6)		98887	275737	262750	8062	120975	254850	266725	203750	180550	218100	364112	143737	2398237

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APPENDIX II

Fishing data of 9.7 m outrigger canoe *Tuhu* in Moawe

(May 1989 to March 1990)

		MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	TOTAL
TOTAL													
PART!													
1. **Fishing** time													
Noofflshingtrips		11	5	21	14	19	7	14	17	18		10	136
Noofflshingdays		11	4	21	14	19	7	16	19	19		10	140
Hoursatsea		69	48	197	159	265	216	203	201	221		171	1750
Hoursfishing		40	36	143	114	195	156	147	139	157		96	1223
Sailtime eng		29	12	54	45	70	60	56	62	64		75	527
PART11													
1. **Gearwisecatchandearnings**													
— Driftnet	wgt:kg	47	67	144	163	259	105	119	338	110			1352
(Traditional)	val:Rp	25600	43500	93008	123508	247508	84508	111500	203080	77500			1009608
— Handline	wgt:kg								40			23	63
(Demersal)	val:Rp)								27008			14000	41000
— Handline	wgt:kg	136	36	418						79		229	898
(Pelagic)	val:Rp	97008	23508	259775						37580		147508	565275
— Trolling line	wgt:kg				10	23						61	94
	vat:Rp				11000	35250						25008	71250
Total	wgt:kg	183	103	562	173	282	105	119	378				2407
	val:Rp	122600	67000	352775	134500	282750	84500	111500	230000				1687125
2. **Specieswise catch** and **earnings**													
— Pelagicspp	wgt:kg	183	67	562	173	282	105	119	378	189		151	2209
	val:Rp	122608	43500	352775	134500	282750	84500	111508	230000	115008		66500	1543625
— Demersalspp	wgt:kg		36									162	198
	val:Rp		23500									12800)	143500
Total	wgt:kg	183	103	562	173	282	105	119	378	189		313	2407
	val:Rp	122600	67000	352775	134500	282750	84500	111500	230000	115000		186500	1687125
PARTI													
1. **Totalsalesvalue**		122600	67080	352770	134500	282750	84500	111500	230000	1115000		186500	1687120
2. **Variable** operationalcosts													
— F.uel (diesel)		6850	2900	10308	14600	23108	17600	18080	32608	*35000*		26808	187750
— Fuel(kerosene)								2100	2500	1800		4600	11000
— Lub oil		1008		3608		7200		3600	7200	3600			26208
— Food		5000	3500					21000	22508	21500			73500
— Bait										2500		18908	21408
— Ice										3000		14508	17500
— Others					700	2400	2250	2408	4500	3500		2608	18350
Total		12850	6400	13900	15300	32700	19850	47100	69300	70900		67400	355700
3. **Cashflow before paymenttocrew and boatowner(1-2)**		109750	60600	338870	119208	250050	64650	64408	160700	44108	-	119108	1331420
4. **Distributionof** cashflow **to: Crewmembers(50%of3)**		54875	30308	169435	59600	125025	32325	32208	80350	22050		59550	665710
5. Gross **cashflow toboat owner (50% of3)**		54875	30308	169435	59600	125025	32325	32200	80350	22050		59550	665710
6. **Repairs:**													
— Craft													
— Fishing gear										4508			4500
— Engine													
—Sail												3000	3080
— Others													
Total										4500		3000	7500
7. **Nettcashflowtoboatowners** (5-6)		54875	30300	169435	59600	125025	32325	32200	80350	17550		56550	658210

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APPENDIX III

Fishing data of 9.7 m outigger canoe *Tuhu* in Gomo

(April to October 1990)

		Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Part!									
Fishing time									
— No of fishing trips		18	22	14	15	16	17	9	111
— No of fishing days		20	23	14	20	25	22	16	140
— Hours at sea		324	394	298	358	389	404	222	2389
— Hours fishing		209	230	201	247	261	272	153	1573
— Sail time eng		115	164	97	111	128	132	69	816
Part II									
Gearwise catch and earnings									
— Handline	wgt:kg	453	539	928	1730	1548	1096	225	6519
(Demersat)	val:Rp	377080	323008	691508	1374450	1423100	1141800	2520000	5582850
— Handline	wgt:kg	90	409	348	43	73			963
(Pelagic)	val:Rp	55000	268225	237425	21250	54908			636808
— Trolling line	wgt:kg	427	312	136	69	22	227	110	1303
	val:Rp	246300	209400	101600	56300	20508	231650	106250	972800
Total	wgt:kg	970	1260	1412	1842	1643	1323	335	8785
	Val:Rp	678300	800625	1030525	1452000	1498500	1373450	358250	7191650
2. Sepecieswise catch and earnings									
— Small tuna	wgt:kg	427	312	136	69	22	227	110	1303
	val:Rp	246300	209400	101608	56300	20500	231650	106250	972008
— Small pelagics	wgt:kg	75	409	348	43	73			948
	val:Rp	45008	268225	237425	21250	54900			626808
— Carangids	wgt:kg	91	83	10	45	46	20	12	307
	val:Rp	79000	43508	7500	27000	39500	24008	14080	234508
— Grouper/Snapper	wgt:kg	257	417	905	1610	1475	1072	213	5949
	val:Rp	229508	252508	676500	1301450	1356600	1115800	238008	5170350
— Others (Demersal)	wgt:kg	120	39	13	75	27	4		278
	val:Rp	78508	27008	7508	46000	27000	2000		188000
Total	wgt:kg	970	1260	1412	1842	1643	1323	335	8785
	val:Rp	678300	800625	1030525	1452008	1498508	1373450	358250	7191650
Part III									
Total sales value		678308	808625	1030525	1452000	1498508	1373450	358250	7191650
2. Variable operational costs									
— Fuel (diesel)		39270	58995	50600	55080	66825	6737	46750	384815
— Fuel (kerosene/petrol)		6900	10150	9650	6150	9350	4800	2150	49150
— Lab oil		22500	9000	12600	14400	18080	10800	7200	94500
— Food		11250	17000	4000		4850	15550	8800	61450
— Bait		4500	400		3000	4000		6050	17950
— Ice		20500	30808	34008	46508	47780	46500	22575	248575
— Others		5508	13350	12625	2900	8575	5050	4800	52808
Total		110420	139695	123475	127950	159300	150075	98325	909240
3. Cashflow before payment to crew and boat owner (1-2)		567880	660930	907050	1324050	1339208	1223375	259925	6282410
4. Distribution of cashtlow to:									
— Crew members (50% of 3)		283940	330465	453525	662025	669600	611687	129962	3141205
5. Gross cashflow to boatowner: (50% of 3)		283940	330465	453525	662025	669600	611687	129962	3141205
6. Repairs:									
— Craft		15580	11725	7708	58850	650	650	2508	97575
— Fishing Gear		7175	68600	41150	14950	18875	23400	15375	189525
— Engine		59000	9950	8650	80900	31000	34650	127108	351250
— Sail									
— Others		42800	4208	5508	3000	7775	18750	4500	85725
Total		123675	94475	63000	157700	58300	77450	149475	724075
7. Nett cashflow to boatowner (5-6)		160265	235990	390525	504325	611300	534237	-19513	2417130

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APPENDIX IV

Economic evaluation: INS-2. 8.0 m outrigger canoe *Tagiri* operated from Gomo

1.	**Total investment**		**Rp** 3,700,000
2.	**Value of yearly catch**		**Rp** 7,182,000
3.	**Variable operational cost**		***Rp.***
	Fuel + Oil		**586,000**
	Food		185,000
	Bait		310,000
	Ice		264,000
	Others		50,000
		Total	**1,395,000**
4.	**Net income before payment to crew members (2 - 3)**		5,787,000
5.	**Crew share *(50%* of 4)**		*2,893,500*
	Income per crew member (three crew)		(964,000)
6.	**Boat-owner's share *(50%* of 4)**		2,893,500
7.	**Repairs**		
	Craft		74,000
	Engine		**152,000**
	Fithing gear		**136,000**
	Others		50,000
		Total	412,000
8.	**Net income to boat-owner (6 - 7)**		2,481,500
9.	**Depreciation**		**670,000**
10.	**Net yearly return (8** - *9)*		1,811,500
11.	**Accounting rate of return (10/1 x** 100)		**49%**

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APPENDIX V

Estimated cost of INS-S outrigger canoe (8.6 m)

(Based ***on quotation by Toko Kanya Baru, Gunung Sitoli, in Rp. (November 1990)***

Item	*Unit*	*Qty*	*Unit/Cost Rp.*	*Cost Rp.*
1. Timber	m^3	1.45	300,000	435,000
2. Machining charges	m^3	1.45	85,000	123,000
3. Hot dip galvanized nails:				
$1\text{-}^{3}/_{4}'' \times 10$ g	kg	8	4,000	32,000
$2'' \times 8$ g	kg	1.5	4,000	6,000
$3'' \times 8$ g	kg	1	4,000	4,000
4. Hot dip galvanized bolts – cup head with one nut:				
$1\text{-}^{1}/_{4}'' \times 1\text{-}^{1}/_{2}''$	pc	110	150	16,500
$^{3}/_{8}'' \times 3''$	pc	70	210	14,700
$^{3}/_{8}'' \times 5''$	PC	36	345	12,420
$^{3}/_{8}'' \times 6''$	pc	12	405	4,860
3. Hot dip galvanized round rod: $^{3}/_{8}''$	m	3.0	3,000	9,000
$^{1}/_{2}''$	m	1.0	4,000	4,000
4. Hot dip galvanized nuts: $^{3}/_{8}''$	pc	26	60	1560
$^{1}/_{2}''$	Pc	12	90	1080
5. Hot dip galvanized washers 3 mm thick:				
For $^{1}/_{4}''$ bolts	Pc	110	20	2,200
For $^{3}/_{8}''$ bolts	pc	150	30	4,500
For $^{1}/_{2}''$ bolts	PC	24	40	960
6. Hydroseal (Bitum comp)	kg	18	5,000	90,000
7. Damar (filler)	kg	*1.5*	600	900
8. Wood primer	It	12	4,800	57,600
9. Gloss paint	It	10	5,000	50,000
10. Turpentine	It	3	2,000	6,000
11. Traditional outriggers and beams			-	50,000
12. Tarpaulin $12m^2$				20,000
13. Sail $20m^2$				35,000
			Total materials	981,280
14. Labour two men for $1^{1}/_{2}$ months		72	***3,500***	252,000
Total cost (materials + labour)				1,233,280

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APPENDIX VI

Estimated cost of engine and engine installation of INS-S outrigger canoe (8.6 m)

(November 1990)

Item	*Unit*	*Qty*	*Unit/Cost Rp.*	*Cost Rp.*
1. Diesel engine YANMAR TF 75h di *6.5* hp/220 rpm	pc	1	1,950,000	1,950,000
2. Coupling shaft-propeller	pc	2	50,000	100,000
3. Propeller shaft SS 22 mm x 1600 mm	pc	1	90,000	90,000
4. Propeller bronze diameter: 9½" pitch 6½"	PC	–	20,000	20,000
5. Stern tube brass 1:800 mm between flanges	pc	1	75,000	75,000
6. Shaping and fitting of stern gear	–	–	–	30,000
7. Steel engine bed	PC	1	40,000	40,000
8. Exhaust pipe	pc	1	30,000	30,000
9. Skinfitting cooling pipe	pc	1	15,000	15,000
10. Rubber hose for cooling system, heatproof	m	6	4,000	24,000
11. Hose clamps	pc	4	500	2,000
12. Rudder pintles	set	1	20,000	20,000
13. Greasy hemp for stuffing box	m	0.5	2,000	1,000
Total cost of engine (with installation)				2,397,000

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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 members-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 of Bengal News*) which are issued quarterly and which onntain illustrated articles and features m non-technical style on BOBP work and related subjects.

Other publications which include books and other miscellaneous reports.

A list of publications from 1986 onwards is given below. 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 in Bwngladesh: A Partzcipatory Approach to Development.* P. Natpcacha, (Madras, May 1986.)
25. *Attempts to Stimulate Development 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: Result.s and Impact.* E. Drewes. (Madras, May 1986.)
29. *Towards Shared Learning: An Approach to Non-formal Aduft Educazion for Marine Fisherfolk 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-formai Primary Education for Children of Marine Fisherfolk in Orissa, India.* U. Tietze, Namita Ray. (Madras, December 1987.)
34. *The Coastal Set Bagnet Fisher of Bangladesh - Fishing Trials and Investigations.* S.E. Akerman. (Madras, November 1986.)
35. *Brackishwater Shrimp Culture Demonstration in Bangladesh.* M. Kanm. (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 the 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 the Advisory Committee.* Medan, 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 Fishing for Large Pelagic Species 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 Meetuag of the Advisory Committee.* Colombo, Sri Lanka, 28-30 January, 1991. (Madras, April 1991)
49. *Introduction of New Small Fishing Craft in Kerala.* O Gulbrandsen and M.R. Andersen. (Madras, January 1992.)
50. *Report of the Sixteenth Meeting of the Advisory Committee.* Phuket, Thailand, 20-23 January, 1992. (Madras, April 1992.)

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

38. *Credit for Fisherfolk: The Experience in Adirampattinam, Tamil Nadu, India.* R.S.Anbarasan, O (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 Technology for 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, O Gulbrandsen, G.Gowing. (Madras, July 1986.)

46. *Experimental Shrimp Farming in Ponds in Polekurru, Andhra Pradesh, India.* J.A.J.Janssen, T.Radhakrishna Murthy, B.V.Raghavulu, V.Sreekrishna. (Madras, July 1986.)

47. *Growth and Mortality of the Malaysian Cockle.* (Anadara granosa) *under Commerical Culture: Analysis: through Length-frequency Data.* NgFong Oon. (Madras, July 1986.)

48. *Fishing Trials with High-Opening Bottom Trawls from Chandipur, Orissa, India.* G.Pajot, B.B.Mohapatra. (Madras, October 1986.)

49. *Pen Culture of Shrimp by Fisherfolk: 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 Devices for 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 Fisherfolk 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 Vishakhapatnam District, Andhra Pradesh, India.* D.Tempelman. (Madras, August 1987.)

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

59. *Fishery Statistics in the Bay of Bengal.* T.Nishida. (Colombo, August 1988.)

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

61. *Development of Outrigger Canoes in Sri Lanka.* O 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 Conditions for 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* I.J.Clucas. (Madras, April 1991.)

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

69. *Agar and Alginate Production from 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 — A stock assessment and study of their potential for culture.* Dr. J.R. Barker. (Madras, December 1991.)

73. *Small-scale culture of the flat oyster* (Oysterfolium) *in Pulau Langkawi, Kedah, Malaysia.* Devakie Nair and Bjorn 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.)

77. *Development of Canoe Fisheries in Sumatera, Indonesia.* O Gulbrandsen and G. Pajot. (Madras, April 1992.)

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78. *The Fisheries and Fisherfolk of Nias island, Indonesia. A description of the fisheries and a socio-economic appraisal of the fisherfolk.* **Based on reports by G.Pajot and P.Townsley. (Madras, December 1991.)**

79. *Review of the Beche De Mer* **(Sea Cucumber)** *Fishery in the Maldives.* **Leslie Joseph. (Madras, April 1992.)**

80. *Reef Fish Resources Survey in the Maldives—Phase Two.* **R.C. Anderson, Z. Waheed, M. Rasheed and A. Arif (Madras, April 1992.)**

82. *Cleaner Fishery Harbours in the Bay of Bengal.* Compiled **by R. Ravikumar. (Madras, April 1992.)**

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

1. *Towards Shared Learning: Non-formal Adult Education for Marine Fisherfolk.* Trainers' **Manual. (Madras, June 1985.)**

2. *Towards Shared Learning: Non-formal Adult Education for Marine Fisherfolk.* **Animators' Guide. (Madras, June** 1985.)

3. *Fishery Statistics on the Microcomputer: A BASIC Version of Hasselbad'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 on resources management—in*** **'comic** book' style (English/Tamil/Telugu). **Kamala Chandrakant with K.Sivasubramaniam and Rathin Roy. (Madras, December 1991.)**

Information Documents (BOBP/INF/...)

9. *Food and Nutrition Status of Small-Scale Fisherfolk in India's East Coast States: A Desk Review and Resource Investigation.* **V.Bhavani. (Madras, April 1986.)**

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.)**

Newsletters (Bay of Bengal News)

Quarterly

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 O.Gulbrandsen. (Madras, November 1986.)**

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

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