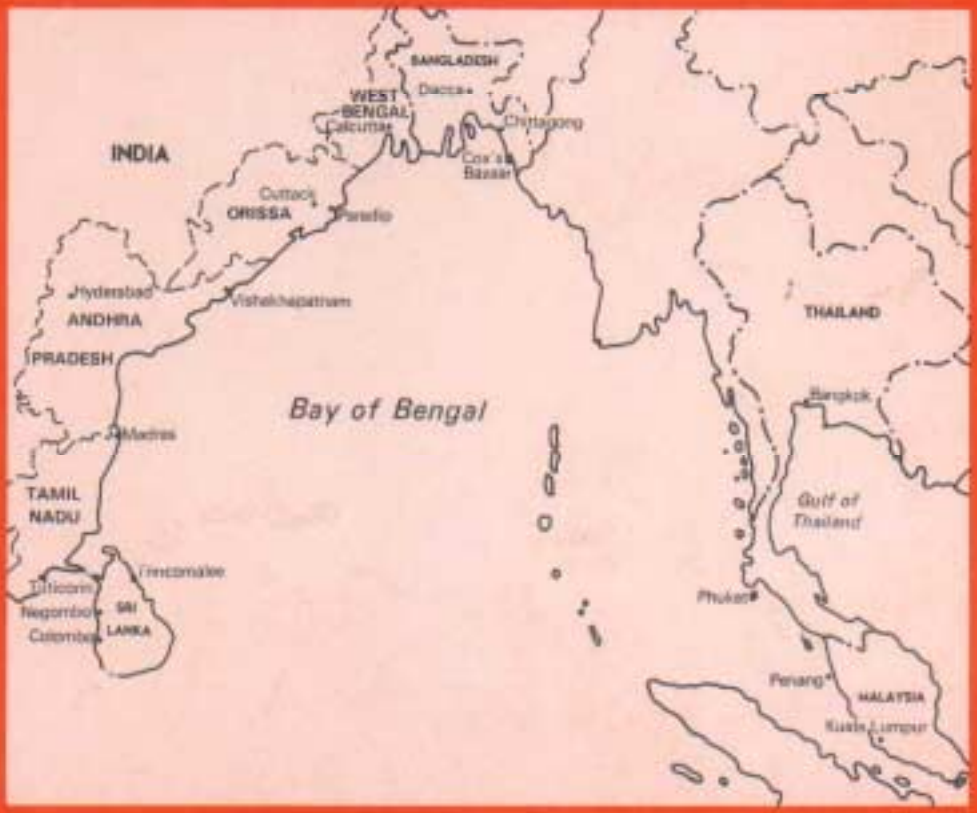
BAY OF BENGAL PROGRAMME
BOBP/REP/8
Development of Small-Scale Fisheries
(GCP/RAS/040/SWE)

# Pre-Feasibility Study of a Floating Fish Receiving and Distribution Unit for Dubla Char, Bangladesh




SWEDISH INTERNATIONAL DEVELOPMENT AUTHORITY
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

BAY OF BENGAL PROGRAMME BOBP/REP/8

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

# Pre-feasibility Study of a Floating Fish Receiving and Distribution Unit for Dubla Char, Bangladesh

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Funding Agency :

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Development of Small-Scale Fisheries in the Bay of Bengal
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## PREFACE

This document presents the findings of a two-member mission to Bangladesh during October-November 1979. The mission was fielded to conduct a pre-feasibility study concerning the establishment of floating fish receiving and distribution units of different types in the estuarine waters of Bangladesh. The study was to focus mainly on Dubla Char, a low-lying island in the Sundarbans region of Bangladesh situated to the east of the outer estuary of the Pusur river.

The document discusses the present status of fisheries in Bangladesh and the problems and the potential of existing fisheries systems in Dubla Char. It evaluates in detail the mechanics and the viability of the proposed floating fish receiving and distribution unit for Dubla Char. In the light of this evaluation, it discusses a possible alternative to the floating unit, and then presents a package of conclusions and recommendations.

The places visited by the mission in the course of their study included Chittagong, Barisal, Dacca, Dubla Char and Khulna. The mission held discussions with experts and officials of the Bangladesh Ministry of Fisheries and Livestock, the Directorate of Fisheries, the Planning Commission and the Bangladesh Fisheries Development Corporation; with officials of the Chittagong Fisheries Harbour, with experts of DANIDA (Danish International Development Agency) and the Sonali Bank (which has financed several *bahardars* or fishery entrepreneurs in Bangladesh). The mission also met and talked with a number of *bahardars* and fishermen.

The members of the mission were Mr. Gordon Eddie, former Technical Director of the White Fish Authority, United Kingdom, and Mr. M. T. Nathan, Fish Utilization and Distribution Specialist with the Bay of Bengal Programme.

The mission's study was an activity of the Bay of Bengal Programme (Development of Small-Scale Fisheries in the Bay of Bengal). This is a regional FAO Programme designed to improve the conditions of small-scale fishermen and the supply of fish from the small-scale sector in five countries bordering the Bay of Bengal — Bangladesh, India, Malaysia, Sri Lanka and Thailand. The Programme is financed by the Swedish International Development Authority (SIDA) and executed by the Food and Agriculture Organisation of the United Nations.



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## SUMMARY

Dubla Char is a low-lying island which forms the outermost area of the Sundarbans region of Bangladesh and is situated to the east of the outer estuary of the Pusur River. In the very shallow open waters of the Bay of Bengal to the south and east of the island, and up to twenty miles from it, two seasonal fisheries are prosecuted. One is a gillnet fishery, the catches of which are carried in ice by carrier launches directly to the wholesale fresh fish markets in Khulna and Barisal over 70 miles inland. The other type of fishery uses behundi-nets (fixed bag-nets) and the catches are taken ashore on Dubla Char and dried before being transported to Chittagong, 150 miles away.

The members of the mission were assigned to examine the feasibility of setting up a floating fish receiving and distribution unit in Dubla Char, which would facilitate the sending of the behundi-net catch to the fresh fish markets of Khulna and Barisal instead of the dried fish markets of Chittagong, thus increasing the incomes of the behundi-net fishermen.

One factor which has tended to inhibit the marketing of the behundi-net catch in fresh, iced form is that until recently the entrepreneurs concerned with catching and drying the fish were indebted to the wholesale dried fish merchants in Chittagong. In the last two seasons, following a Government initiative, the function of financing these entrepreneurs, the bahardars, has been largely taken over by the Sonali Bank. Another significant development is the growing use of motorized boats as carriers and auxiliaries, if not yet as catchers.

The feasibility of the proposed floating unit for Dubla Char and of a new marketing system for the ***behundi-net*** catch was examined in the light of what appeared to be the important technical and operational requirements :

- sorting the ***behundi-net*** fish catch and segregating the varieties at present acceptable to the fresh-fish market;
- avoiding excessive spoilage (compared with, for example, the gillnet catch) ;
- manufacture and storage of ice;
- emergency withdrawal of the floating unit to a more sheltered site in case of damage, fault or storm warning ;
- and local capability for operating such a unit on a remote site.

The study presents certain conclusions regarding the general form and specification of such a floating unit and its equipment; one conclusion is that it would have to be registered, operated and managed as a ship. Another is that the available managerial, professional and technical resources in the region are probably not sufficient to ensure successful operation. The floating fish receiving unit and the marketing system that goes with it would be unique and therefore experimental. A preliminary estimate of first costs is at least US $ one million for a unit or units capable of handling 2,000-3,000 tons of fish in a year.

An alternative scheme is proposed for marketing the behundi-net fish in fresh form. Under this system, carrier launches will serve the catching units directly, exchanging boxes filled with crushed ice for boxes of selected, iced fish. The number of carrier launches required is probably only two more than for the floating unit; two launches would cost much less to procure and to



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operate than the floating unit. This system would require detailed development of both physical and commercial aspects and an experimental trial, extending over at least two fishing seasons. International technical assistance in the form of two experts, one in marketing and one in fish handling, would also be required.

Because of the lack of statistics, there is considerable uncertainity about the size of the annual fish catch and the proportion of this that would at present be acceptable in the fresh fish market. The quantity that could be utilized fresh instead of dried is estimated at no more than 2,000 to 3,000 tons a year.

In view of these factors, the case for expending scarce resources on the floating unit is hardly a strong one, unless it is regarded as part of a more important and far-reaching enterprise: the development of the fishery on the Swatch of No Ground, at present very little exploited, and of which the Dubla Char fishing grounds constitute only the northernmost edge, nearest the coast. Any vessels, equipment and methods developed for the Dubla Char fishery should therefore be suitable for use further offshore. If a choice has to be made between diverting 2,000-3,000 tons per year of fish from one market to another and increasing total supplies by equipping the artisanal fleet to exploit the Swatch of No Ground more fully, priority should be given to the latter.

The establishment of a group of engineers to carry out field trials, including technical development of the Swatch of No Ground to the stage when it is usable by the artisanal fleets, is highly desirable. This group would constitute a corps of national counterparts to the international experts carrying out the programme envisaged above. One of the species or groups of species in the behundi-net catch is shrimp, of marketable size; at present these are dried like the rest of the catch. The Bangladesh Fisheries Development Corporation should consider the practicability of collecting and freezing the shrimp, using means already at their disposal.



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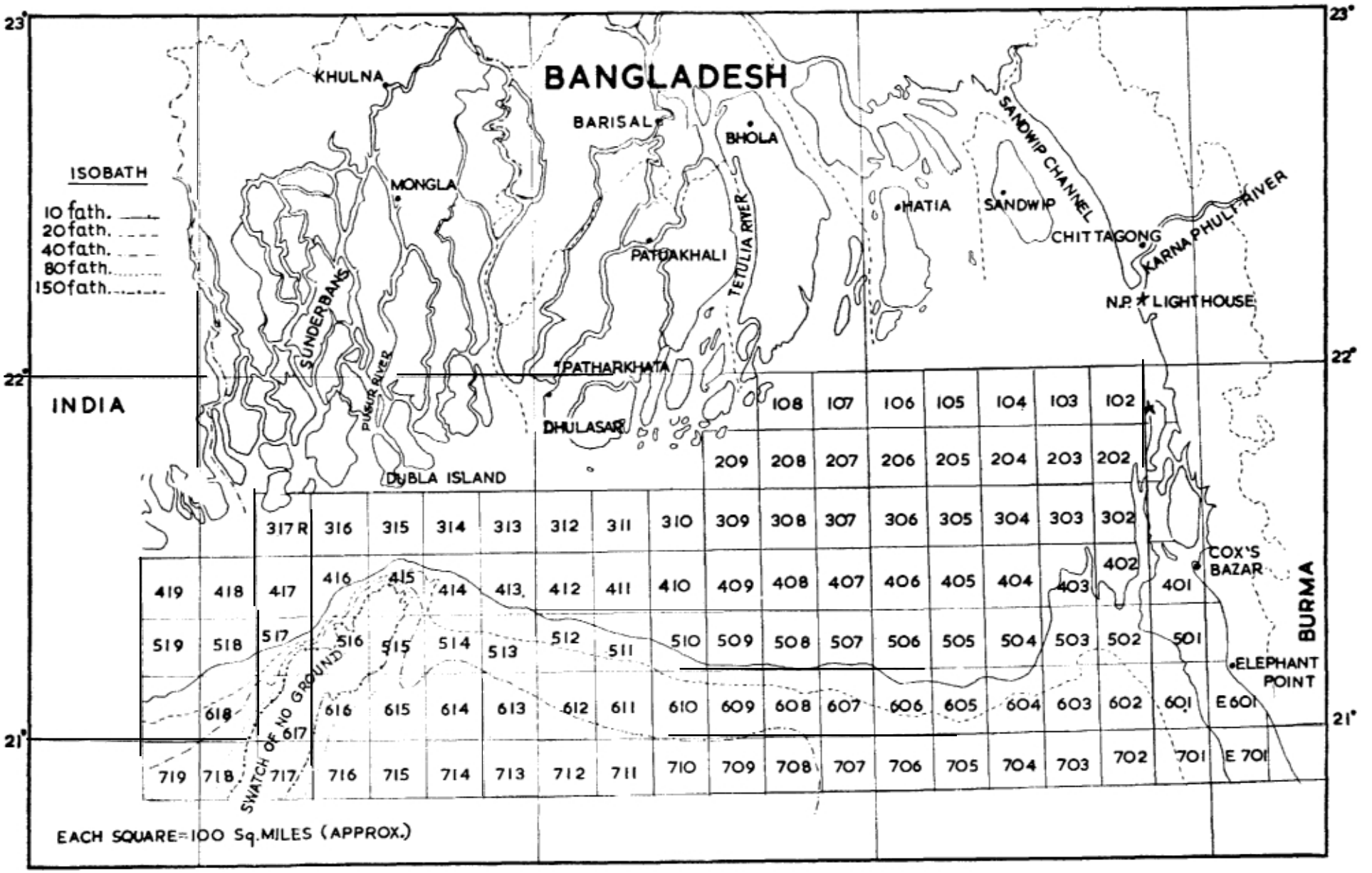
# NORTH EAST PART OF THE BAY OF BENGAL





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# PRESENT STATUS OF BANGLADESH FISHERIES, WITH PARTICULAR RELEVANCE TO THE DUBLA CHAR PROPOSAL

## *1.1 The fisheries*

1.1 .1 Although complete and accurate statistics on fish production and consumption in Bangladesh are not available, a good deal of published information does exist, including several reports and proposals regarding the Dubla Char fishery itself. A list of the main documents consulted is given in Appendix A. The following is a summary of the points of relevance to the study.

1.1.2 According to the latest edition of the FAO Fishery Country Profile, annual production of fish in Bangladesh is almost 740,000 tons live weight equivalent, of which some 3,500 tons (mainly shrimp and frogs' legs) are exported; imports are very small. Per capita supply is declining because of rapid population growth and is at present about IO kg/year; fish represents about 80% of the animal protein consumed in Bangladesh.

1.1.3 About 90% of the present production comes from inland waters, and there is potential for further development of these fresh water fisheries including aquaculture.

1.1.4 The continental shelf area is about 40,000 $km^2$. During the FAO survey of the late 1960s four potential new fishing grounds were identified within about 40 miles of the nearest point of the coast. One of these lies to the west, north and east of the Swatch of No Ground, a deep trench in the otherwise shallow area of the Bay of Bengal off the mouths of the rivers Ganges and Brahmaputra. It is the northern edge of this fishing ground, nearest the coast, which is exploited in the Dubla Char fishery. In the map (page 1) the identified area of good fishing extends over squares 313-317,413-418,513-518 and 614-618, but the present fishery does not extend much beyond squares 313, 314 and 315.

Most of the artisanal marine fishing in Bangladesh is coastal and confined to the good-weather season. Further offshore, the marine resources are as yet only lightly exploited, mainly by the small trawler fleet operated out of Chittagong by the Bangladesh Fisheries Development Corporation (BFDC), by foreign vessels operating under joint venture agreements, and by three Danish vessels operating out of Chittagong under the joint auspices of DANIDA and BFDC.

Most of the vessels engaged in the coastal and estuarine artisanal fisheries are "country" boats : that is to say, of traditional local design and construction. Motorization has begun, partly through the introduction of new boats of exotic design and construction, although in most areas these are being used as fish carriers and in other auxiliary roles rather than as catchers.

1.1.5 Marine and anadromous species are readily acceptable in the inland markets, especially in the northern districts. In the wet fish trade, the acceptable species are nearly all characterized by the large size of individual specimens (a quarter of a kilogram up to several kilograms) ; they include Indian salmon, eel, jewfish, catfish, pomfret, red snapper, Bombay duck and shrimp, and also ribbon fish, mackerel, hilsa species and silver jewfish in season. Not all of these species are present in the Dubla Char fishery.

1.1.6 Fish caught by small-scale and artisanal operations in the rivers, estuaries and coastal areas and intended for distribution as fresh fish is collected by motor launches from various fixed points, stored in ice and brought to the wholesalers in such centres as Khulna, Dacca and

Barisal, from where it is despatched to centres of consumption by motor lorry, after repacking and re-icing. Fish-ice ratios are stated to be 1 : 1. Ice (both the block-ice and rapid-ice types) is produced by numerous small plants operated by private enterprises and by BFDC, but temporary local shortages often occur and prices fluctuate accordingly. A statement of costs of a typical carrier launch, according to the operator, is given in Appendix B.

1.1.7 The BFDC, with the assistance of DANIDA, is establishing a number of new "landing centres" on the lower courses of the rivers and in the delta, at each of which there will be a covered wholesale market, water supply, ice plant, refrigerated storage space and workshop. Onward transport of catches will still be by launch and truck. Because of the unstable nature of the banks of the rivers and channels, expensive (and probably uneconomic) civil engineering works would have to be undertaken. In the more difficult locations in the Sundarbans and on the coast, the idea of floating "landing centres" is being considered. The size of the facilities to be provided at the "landing centres" and the output of the ice plants are not based on a detailed knowledge of present catches but on estimates of possible catch after fishermen buy mechanised boats with Government loans.

The landing centres are regarded as an essential service to fisheries rather than as self-financing enterprises.

### 1.2 *Government bodies and development organisations*

1.2.1 Central economic planning is the responsibility of a separate department of Government, the Planning Commission, which incorporates a fisheries section. This co-operates closely with the Ministry of Fisheries and Livestock and the Bangladesh Fisheries Development Corporation.

1.2.2 The Directorate of Fisheries in the Ministry of Fisheries and Livestock executes the usual functions of Government fisheries departments, including research, but not full-scale technical development. Traditionally the marine fisheries have been of very minor importance; the Directorate has only begun building up its strength on this side. Staff and other resources needed to collect statistics or perform extension work are meagre; the only government officials present in Dubla Char are from the Forestry Department and not from Fisheries.

1.2.3 The Rural Co-operative Department is active in fisheries; the main function of fishermen's cooperatives is to facilitate duty-free import and distribution of synthetic twines and other equipment of foreign origin. There are no marketing cooperatives. The Dubla Fishermen's Group is used by the commercial banks (in the absence of suitable cooperative) to assist in decisions on issue of loans to individuals. It is not a part of the official cooperative organization.

1.2.4 The Bangladesh Fisheries Development Corporation is a parastatal body or state corporation which carries out several kinds of activities: commercial trawling, freezing of fishery products, ice manufacture, fish marketing and distribution; building and operation of wholesale fish markets; provision of "landing centres" (see above) ; building and distribution of motorized boats. Some of these activities entail heavy financial losses. Some activities are regarded as services to industry that need not generate profits. The commercial and operational performance of the BFDC trawler fleet is not at all impressive: the rate of construction of the new shrimp freezing complex near Mongla Port has been very slow. Apart from the difficulties that state corporations in many part of the world operate under and which arise from civil service attitudes and the application of government financial and administrative procedures, the BFDC suffers from a dearth of professional engineers, so that positions that would normally be occupied by experienced marine or mechanical engineers are occupied by food technologists and biologists. In certain limited areas DANIDA has provided reinforcements. The reason for this

state of affairs is said to be that BFDC (and also the Inland Water Transport Authority) cannot compete in the market for experienced and well-qualified engineers with the oil-rich countries of the Gulf.

It is therefore not surprising that the general policy of BFDC appears to be that new ventures are not willingly undertaken unless there is substantial and solid outside support – like that provided in certain limited and specialized area by DANIDA. In particular, new enterprises of a commercial nature are regarded as better left to the private sector, although it is recognized by some such body as BFDC. As indicated above, BFDC are not well-placed at present, either financially or managerially, to carry out such development work. Nor are they well-placed to operate, especially, at remote sites, units or systems requiring the supervision of engineers – particularly marine engineers.

### *1.3 Fisheries policy*

1.3.1 In summary, the general objectives in the fisheries sector of the forthcoming five-year plan were stated to be:

- self-sufficiency in fish supplies
- provision of employment opportunities
- improvement in socio-economic conditions of fishermen
- accelerated development of selected aquatic products for export
- improvement of traditional technologies as well as introduction of tested, employment-oriented, new technologies
- acceleration of scientific utilization of local resources.

1.3.2 Prime importance is accorded in Bangladesh to fish culture and to coastal fisheries.

### 1.4 *The Dubla Char fishery*

1.4.1 The Dubla fishing grounds exploited by the existing artisanal fisheries extend, as mentioned earlier, over squares 313, 314 and the north-east corner of 315 (see map on page 1). The nearest permanent settlements with cultivation are 25-30 miles away; the fish markets of Khulna and Barisal are 70 miles beyond the Sundarbans, the area of the outer delta covered by forest. Chittagong is about 150 miles away. There is a house and radio mast on Dubla Char near the shore at Pusur Point. On the opposite coast of the estuary is a complex of large buildings belonging to the Mongla Port Authority, again only a few feet above normal sea level. The whole area is subject to flooding and inundation. This is caused sometimes by freshets and sometimes by storm waves.

1.4.2 At the time of the visit of the study team the fishing units were spread over an elliptical area (about 20 miles east-to-west and eight miles north-to-south) to the south and east of Dubla Char and not extending further west than the latitude of Pusur Point, the southern most tip of Dubla Char. About 80 catcher vessels could be seen; spacing ranged from half-a-mile to two or three miles, the average spacing being 1½ miles.

Charted depths in this area are generally less than 5 metres. Current is strong, 2 to 4 knots, with a very short period of slack water.



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Two very different fishing activities take place at Dubla, involving two fleets operated by two separate and distinct groups of people, although the vessels of the two fleets intermingle on the fishing grounds.

1.4.3 The smaller of the two fleets, comprising some 24 catcher vessels at the time of the study team's visit, is of boats from Khulna district, the nearest area of settled mainland. These operate gillnets and encircling nets; the principal species in the catches are hilsa, which is of the commonest and most highly appreciated species on the wet fish market. The catches are transferred directly, in the open sea, to carrier launches which carry the fish in ice to Khulna, and bring back supplies for the crews of the catching boats. This fleet does not use Dubla Island as a base.

1.4.4 The larger of the two fleets is based at Chittagong and comprises over 80 units. Each consists of a catcher vessel with an auxiliary vessel or vessels, a carrier vessel to take the catch to Dubla Island and ferry out supplies to the fishing unit, and a long-distance carrier to take the dried and sorted catch back to Chittagong and bring out fresh supplies. Each unit is under the control of a *bahardar* (one or sometimes two units to a *bahardar)* who has a temporary camp on Dubla Island where the catches are sorted and dried in the sun before despatch to Chittagong. The fishing units remain at sea for the entire season, as do their crews. The work on Dubla Island is done by a separate group of labourers. The season lasts about 100 days, beginning in late October.

The method of capture is by *behundi* net, a fixed bag-shaped net set facing the current; each catcher unit operates ten or twelve nets. The nets are emptied and reversed in direction at slack water so that, on average, the fish has been in the net for over three hours by the time it is brought aboard. This method can be operated only in water that is shallow enough for a man to dive and fix into the sea bed the stakes to which the net is attached. The fleet therefore cannot fish the further offshore areas of the Swatch of No Ground. The same locations are chosen year after year and "belong" to that particular fisherman. Because of this, and the passive method of fishing, there is not much scope for the exercise of flair or skill in hunting and catching fish; the fishermen are in fact paid fixed salaries, with no bonus pegged to catch.

A small proportion of the catch is hung up to dry on the catching vessel, but most of it is put into the open hold without any means of preservation. (It is however, protected from the direct heat of the sun.) It is assembled for transport to Dubla Island once a day or, if fishing is good, twice a day. Although there is ample labour, space and time to sort the high-prized varieties aboard the catching vessel, this is not done. Since no boxes or baskets are used, the sorted varieties would form one lot again when loaded into and discharged from the carrier vessel.

*1.4.5* The *behundi* net tends to catch only those species and sizes of fish that drift with the current or that do not swim strongly enough to maintain a fixed position in relation to the sea bed. A few predator species are caught more or less by accident. Thus the catches are composed mainly of small-sized fish such as ribbon-fish and Bombay duck which are not highly prized in the wet fish market. In the absence of reliable statistics on the species composition of the catches (and this may vary from season to season), it is difficult to estimate the proportion of the *behundi* net catch on the Dubla grounds that is readily marketable in fresh form. One *bahardar* suggested that it is as much as 50% during certain times of the season, but an experienced biologist familiar with the fish resources of the area is of the opinion that the average is more likely to be about 15% by weight, and very unlikely to be more than 20%. Direct observation on the days the team visited the fishery suggested an even smaller percentage. It should be added that a significant proportion of the catch is shrimp; on the days the team visited the fishery the count (heads-off) was in the range of 40 to 60 per pound. This, like most of the *behundi* net catch, is at present dried.

1.4.6 The total quantities of fish catch that could be marketed as fresh fish are also difficult to assess. Estimates based on the records of the Forestry Department, who levy taxes on the basis of the weight of fish said to be produced -and use the local convention that the fish are dried to 40 per cent of their original weight-are almost certainly far too low at 3,000-4,000 tons per year net weight equivalent.

Some people have estimated the fish catch from behundi nets at 8,000-l 0,000 tons per year, others believe it might be as high as 20,000 tons per year. The production seems to have been rising over the last three or four years.

The mission attempted to make an independent estimate in three ways, assuming a 100-day season : first, by estimating the size of the catch on board one of the fishing boats and discussing with the master-fisherman how it might vary during the lunar cycle and the season and at other positions on the ground; second, by questioning the *bahardar;* third, by estimating the landings on the beach and discussing how they might vary during the season.

These procedures are vulnerable to error; the team's estimate is therefore not at all reliable, but is perhaps as reliable as estimates made in the past. Thus, the annual catch might be as much as 30,000 tons and not less than 10,000 tons; the "most likely" figure, in the team's opinion, was 15,000 tons per year. It should be added that reliable and fairly accurate statistics of species composition and weight would be easy to compile if a competent officer were stationed on Dubla Char for one lunar cycle and thereafter visited the island periodically during the season, with cross-checks on the dried fish at Chittagong.

1.4.7 The estimate of the weight of fish available for marketing as fresh fish, derived from the above figures, varies very widely. It might be as much as 15,000 tons per year or as little as 1,500 tons per year, while in the team's opinion it is likely to be 2,000-3,000 tons per year.

It should be added that a small quantity of this fish is already sold by some catchers to the carrier launches sewing the gillnet fishery — despite the contractual arrangements ~between the *bahardars* and the dried-fish wholesale merchants *(aratdars)* in Chittagong, shortly to be described (1.4.9 below).

1.4.8 The Dubla Char fishery ends in February, more than a month before what is usually regarded as the beginning of the bad weather season (April). Various reasons are adduced for this early end : growing discomfort and risk of disease in the camp ; a feeling on the part of the fishermen that they have been at sea long enough; difficulty in drying the fish because of overcast skies; the possibility that the voyage to Chittagong in a traditional sailing craft may take many days, and has to be completed before really bad weather sets in.

Among the fishermen and *bahardars* at Dubla, however, the reason normally adduced was the onset of sea conditions too rough for comfort and safety. (According to the Bay of Bengal Pilot, the percentage of frequency of storms of Beaufort Force 8 or above is 1 or less from January to March, rising to 5 in April and 8 in May- but it is 19 in October, 18 in November and 8 in December. From November to January, winds are predominantly northerly or easterly in the mornings; afternoon winds are variable but 69% are calm at Calcutta in November and December. The winds are variable in February; in March south-westerly or 'southerly winds begin to predominate. The southwest monsoon becomes established in June and lasts until September. During October to January the average wind does not exceed Force 3. During April to August the majority of winds are Force 4 or more. Cyclones are possible in October, November and December as well as in April, May and June. Violent squalls from the northwest, sometimes with very strong winds, are possible from March to early June.)



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One conclusion is that the Dubla fishery is terminated by end-February because there is better or easier fishing elsewhere. The possibility that the Dubla season can be extended in time as well as in space by the use of better methods and equipment may therefore be a real one. A question remains: Are fish available for capture on these grounds in commercial quantities during February, March, April? Evidence from trawling operations indicates that catches are there to be had on the Swatch of No Ground throughout the monsoon period despite the dramatic change in hydrographic conditions.

*1.4.9* The *bahardar* hires his fleet of boats (often from an *aratdar),* and borrows his working capital (including the money for salaries, food and stores) for the early part of the season. Traditionally he borrows this money from the *aratdar,* who also stands by him during financial emergencies and during the off-season. This relationship between the fisherman and the middleman is found in many parts of the world.

Much has been said about the large share of the proceeds of the entire enterprise that the *aratdar* arrogates to himself. Part of the objective of changing the system so that some of the catch would be marketed as fresh fish, is to improve the earnings of the fishermen. This assumes that the increased earnings would be passed on to the fishermen. (One may note in passing that several factors — the high organizing ability represented by the *bahardars'* fleet and camps, the scale and complexity of equipment, the skill shown in erecting shore facilities and the energetic activities of the workmen -indicate that the fishermen's community in Dubla Char is not as downtrodden as in some other parts of the world. The daily salary paid to a Dubla fisherman is said to be about one-and-a-half times the wage paid to a skilled craftsman in *Chinagong.* However, the Dubla season lasts only about 100 days.)

The main consequence of the financing system in Dubla Char in relation to this study, is that the *bahardar* is bound to deliver his catch to the *aratdar* who finances him. There are over 80 *bahardars;the* entire Dubla dried-fish trade is said to be controlled by no more than seven *aratdars* in Chittagong. So long as this system remain intact, there is little prospect of any of the catch entering the wet fish market — unless the *aratdar* branches out into the wet fish trade. This, indeed, was not practicable until the very recent introduction of motorized carriers.

1.4.10 In 1977, however the Directorate of Fisheries, in pursuance of its scheme to rehabilitate small-scale fishermen, formed a committee to consider financing the fishermen of Dubla Island. Membership included representatives of the commercial banks, the national rural cooperatives organization (BJ MSS) and the Directorate. As a result of the work of this committee and an oral undertaking by the Government to provide partial compensation for bad debts if necessary, the Sonali Bank entered the business of financing *bahardars* in the 1978/79 season. After some initial suspicion and reluctance, over 50 of the 84 *bahardars* accepted loans from the bank. During the 1979/80 season the number of borrowings has increased to 78 and the Bank has expressed satisfaction with the progress of the scheme and with the level of repayments to date (November 1979).

The Bank is fully aware that the real collateral in the fishing industry is the skill and the reputation of the fisherman, and consults the Dubla Fishermen's Group regarding the suitability and reliability of individual applicants for loans. It also requires a formal guarantor of the loan.

So far, this has been the *aratdar.* However, the Bank expresses itself as equally wilting to accept a wet fish trader as part guarantor, provided that some accommodation can be arrived at between him, the *aratdar* and the bahardar.

Meanwhile, the Bank is considering the possibility of financing a group of *bahardars* who may wish to retain ownership of the dried fish and store it in Chittagong until the off-season when prices are higher. If the seven *aratdars* who are said to control the dried fish trade oppose this

project, and maintain a united front, the bank may not succeed. If it does succeed, the bahardars would have been brought more directly into the business of marketing their catches; they might then be prepared to take the initiative over that part of the catch that yields more income as fresh fish.

1.4.11 One way or the other, it is now possible that the complete control over the disposal of the catches, at present exercised by the *aratdars,* can be broken if the *bahardars* are given the necessary financial, technical and operational support. A small part of the catch already goes (unofficially) to the wet fish market and an increasing amount may be so disposed of in the next few years without any external stimulus, as the *bahardar* and the Bank gain confidence and experience. Whether a deliberate effort should be made in the near future to bring this about, which would involve the Government and probably also international or bilateral aid, is a matter for decision. The relevant arguments are presented in sections 2 and 3 of this report.

### *1.5 Allied matters and current proposals*

1.5.1 Several other features of the Dubla Char fishery seem to require improvement.

One of these is the supply of potable water, which is obtained by digging shallow wells or "tanks". A larger reservoir was constructed two or three seasons ago but the water became saline as a result of inundation. There is apparently no prospect of striking fresh water by deep drilling. The Mongla Port Authority's complex of buildings on the other side of the estuary apparently gets its drinking water by barge.

Another feature, commented on in earlier surveys, was the lack of medical services in Dubla Char island ; they are now provided by the Government. Yet another was the danger of robbery by armed gangs *(dacoits* or jungli *bihenni)* but there have been no incidents since the army began stationing a small garrison on the island five years ago.

1.5.2 All proposals for a floating fish receiving and distribution unit at Dubla Char (or some other system performing the same functions) have assumed that a major item of equipment would be a plant for the manufacture of ice with associated insulated storage for reserve supplies of ice. Indeed the unit is much more frequently referred to as "the floating ice-plant" than as "the floating fish receiving and distribution unit".

1.5.3 Some floating unit proposals have included suggestions that a few other facilities and services should also be incorporated in the unit. More recently, with the advent of motorization, these suggestions have included a workshop for the repair of engines and accommodation for extension officers. There has, however, been no suggestion of facilities for local research and development work or statistics collection as distinct from extension work.

The proposals have also included facilities or equipment intended to improve living conditions, such as a first-aid centre and sick bay, a post office, a bank, rest and recreation facilities, a storm shelter, telecommunications and storm warning services.

1.5.4 Wherever a floating unit has been envisaged, the proposal has usually included provision for its withdrawal in the bad weather season and the suggestion that it could be employed usefully in the estuaries and in the Sundarbans. There may in any event be a case for providing landing centres in these areas, at places where engineering works to provide a stable platform for a land-based installation would be too costly.



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# 2 FLOATING UNIT: SOME TECHNICAL, ORGANIZATIONAL AND ECONOMIC ASPECTS

## 2.1 *Introductory remarks*

**2.1.1 The proposals made in the past for a floating fish receiving and distribution unit, or floating ice-plant, or some other facility performing the same functions, have not discussed in any detail certain technical and operational aspects that have a bearing on the design and operation of the system. These include**

- **provision for the sorting and selection of the catch;**
- **details of how the catch is to be subsequently handled and stowed until it is put aboard the leng-distance carrier;**
- **the provision of potable water for ice-making;**
- **the storage of ice;**
- **the implications of the fact that the proposed unit is a *floating* one, virtually in the open sea;**
- **provision for the movement of the floating unit, including withdrawal at the end of the season ;**
- **provision for emergency withdrawal of the unit on occasions of damage, fault or storm warning.**

**These and other aspects are discussed below.**

**2.1.2 An alternative system, using carrier vessels and not requiring any means of producing ice locally, is also put forward in this study and the two systems have been compared. Certain immediate conclusions have been presented.**

**2.1.3 In section 3, some more general considerations are put forward which relate to policy and the general direction of development of the coastal marine fisheries. A further brief examination of costs and benefits is made. Final conclusions are drawn and suggestions offered. Section 4 sets out concrete recommendations.**

## *2.2 Handling, stowage and preservation of the catch*

**2.2.1 The fish brought to the wholesale markets in Khulna, Barisal and Dacca by carrier launches is stowed in bulk (without shelves) in ice, and all species and sizes are mixed together. Sorting and selection take place during the process of unloading the carrier. However, these catches are composed predominantly of species highly acceptable on the wet fish market. This is not true of the *behundi-net* catch at Dubla Char, where perhaps only 15 per cent of the total is acceptable.**

**At present, the catches are sorted and selected for size on the beach at Dubla while being exposed to the direct heat of the sun. By this time they have been handled (thrown, tipped or dropped) four times since being taken out of the water, perhaps about 20 hours earlier; before that, some fish may have lain suffocated in the cod-end of the net for up to six hours. To put**



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them into a long-distance carrier after landing on the beach at Dubla Char and sorting and selecting them there would require them to be handled once or twice more-five or six times in all. By contrast, the gill-net catch is probably in slightly better condition when it is taken out of the water, is handled again only once while being put aboard the carrier and is not exposed to the heat of the sun for any significant time.

To bring the behundi-net fish on to an equal footing with the gill-net catch as regards quality and hence shelf-life and market value (and probably even to ensure an adequate shelf-life), it is necessary to eliminate some of the handling and the exposure to the sun and also to provide a method of handling and stowage that reduces the delay before the fish is iced. This applies both to the shrimp and to the other species acceptable on the fresh fish market. If sorting and selection of these varieties is delayed until the catches are on the beaches of Dubla, the objective of quality improvement cannot be achieved.

2.2.2 The same objections hold for a hypothetical system in which the catches would be sorted and the varieties selected on board or alongside a floating pontoon acting as a fish receiving unit. The slight advantages of such units would be that they could be achored at various points on the fishing grounds, the *bahardar's* carrier boats would reach them quicker (say one hour) than Dubla Char (say three hours). However, sorting the catches and separating out only one-fifth or less would be impracticable on board the *bahadars'* carrier boats; the alternative in this case would be sorting on the deck of the pontoon or pontoons. On an average day this would mean sorting 150 tons of catch in order to select some 20-30 tons of it, and there is no reason to suppose that the task can be spread evenly over the 24 hours-indeed it is desirable that the fish to be dried reach the beaches of Dubla Char during daylight. A clear deck space of some hundreds of square metres would be required or else some fairly complicated system of conveyors and sorting belts.

2.2.3 In any case, if the catches are sorted on the Dubla beaches or on floating pontoons only immediately before storing the selected varieties while they await the arrival of the long-distance carriers it would seem to be unnecessary to manufacture ice on the spot. The carriers could bring it with them as they do already in all the other fisheries they serve, including the savars' gill-net fishery at Dubla.

However, such a system -delaying the process of sorting, selecting and icing until after the fish has been taken away from the catching units by the *bahardars'* carrier boats — is, as noted in 2.2.1 above, not good enough from the standpoint of quality, shelf-life and preservation of the value of the selected species.

2.2.4 There is space, time and labour available on board the "mother" boats of the catching units to sort and select the catch provided that the selected varieties can be kept segregated by stowing them in baskets or in boxes. This would also reduce the number of times this fish was handled from five or six to two or three. All that seems to be required is the provision of baskets or boxes and some incentive payment to the fishermen. These, then are the essential requirements of any scheme for diversion of the selected varieties to better markets.

2.2.5 The selected varieties could then be taken in their baskets or boxes ashore on Dubla Char or on the proposed pontoon, or (as suggested below) transferred directly to long-distance carriers. The fish could of course be iced on arrival ashore on Dubla (with locally-made ice) or at the pontoon but it would be difficult to ensure in practice that it was properly iced at this point; the inevitable tendency would be to top-ice it without taking it out of the box or basket in which it arrived. Or else the fish could be iced while being put aboard the carrier. Such systems, however, as noted in 2.2.1 above, are unlikely to ensure adequate shelf-life and preservation of the market value; it is desirable to chill the selected fish at an earlier stage. This can be achieved by delivering boxes to the catching units — not empty but full of ice.

2.2.6 Should the long-distance carriers transport the selected varieties to the wholesale fresh market in the boxes? This is desirable in so far as it avoids further handling of fish. But the answer will depend partly upon whether the fish will need re-icing when it comes aboard the long-distance carrier and this would have to be settled by practical observation and trial.

A typical carrier launch can stow about 800 maunds of fish (30 tons)in bulk stowage in ice in three holds (although average loads are a good deal less and the minimum economic load is only a fraction of the maximum capacity.) If the launch carried the fish in boxes, its capacity would be reduced to a maximum of 20 tons or less; in newly-built carriers with holds designed for the purpose, an improvement on this figure should be attainable without significantly adding to the capital cost of the vessel.

## 2.3 Water treatment

2.3.1 Manufacture of ice in the vicinity of Dubla Char requires a supply of clean water. Since at least some of the selected varieties (the shrimp) are likely to be exported, the highest hygienicat, chemical and organoleptic standards are required. Whether untreated water taken from the sea in the vicinity of Oubla Char would meet these standards has not been acertained; research would be required to examine whether treatment would be necessary to lower turbidity and microbiological loads or whether at certain stages of the tide and at positions sufficiently remote from the beach camps and the fishing units, the raw water is satisfactory even during river floods. Even if it is, there is a further question to be answered regarding chemical content and the possibility of discoloration or off-flavours in processed products (especially shrimp) during storage. There would always remain the risk that the floating unit(s) would sooner or later be ahchored too near the beaches or the fishing units.

Also, since the cleanest water available in the area is more or less saline according to the season and state of the tide, the ice made from raw water would be more or less salt-water ice. This is not objectionable from the standpoint of the food scientist and technologist but it could be from that of the marine engineer and operator. Salt-water ice is more liable to congeal in storage (see below) and less easy to break up again ; also, in storage, concentrated brine drains out of the stack and could accelerate corrosion to the hull, piping and pumping systems of a floating unit.

2.3.2 One therefore has to conclude that the designer of a floating ice plant for service at Dubla Char should include provision for water treatment, preferably incorporating desalination.

2.3.3 Water treatment could in theory take several forms: filtration followed by sterilisation using injection of chlorine (or hypochlorite solution) or ultraviolet rays; sand filters or pressure filters. All of these methods invite objections-they require supplies of expendable materials, they involve automatic devices, they may be operated wrongly, endangering the vessel or affecting the quality of water. It appears that the safest method of treatment is the one normally used to produce drinking water on board ship; it is understood by seagoing engineers and engine-room attendants and is least likely to produce inadequately treated water: the salt-water evaporator.

This would produce fresh water of potable quality and could have a rated throughput sufficient to provide supplies of drinking water to the fishermen and shore camps as well as for the manufacture of ice. The only expendable supplies needed in quality are fuel oil ; part of the energy could be supplied by engine exhaust gases in a waste-heat boiler.

The requirements of fresh water, including both ice-making and drinking water, would average over 40 tons/day on the basis of these assumptions:

— The number of fishermen is 8,000;

— The annual catch is 15,000 tons;

— 15% of the catch is iced, at a fish-ice ratio of 1 : 1 ;

— The season is 100 days long.

Note: Ice-making alone would require 20 tons of water per day.

*2.4 Ice manufacture, storage and handling*

2.4.1 An average total output of 20-30 tons/day of ice would be needed on the assumptions outlined above. Some storage facilities would be required to take care of peak demands and breakdowns.

2.4.2 Block-ice plants are for a number of reasons unsuitable for use on board a floating vessel in a seaway. Some kind of rapid-ice plant would therefore be required.

2.4.3 It is tempting to specify plants of the flake-ice type, producing sub-cooled ice which, if stored at low enough temperatures, remain free-flowing and easily handled; it can be conveyed pneumatically. This has attractions if the ice store is in the hull of the vessel, since it would be necessary to lift the ice in order to discharge it to a receiving vessel alongside.

However, to maintain adequately low temperatures throughout the stack of ice in order to maintain its free-flowing qualities would, in the prevailing conditions, require the storage room to be provided with a refrigerated jacketspace in the floor and at the sides. This would have to be fairly elaborate and costly if it were to work well and withstand abuse; even so, sooner or later the refrigerating system will inadvertently come to a stop and the stack of ice will congeal.

2.4.4 The same will happen, only sooner, to any stack of crushed ice produced without sub-cooling, and is therefore wet, as are many types of rapid-ice (tube-ice, plate-ice). It would also apply to sea-water ice.

The usual remedy is to attack the stack of congealed ice with axes or similar tools which is all very well in a land-based storage room or in the hold of a large ocean-going trawler but liable to be dangerous and to cause damage to linings, deckhead fittings, cooling surfaces and other equipment when done in a small space with limited headroom.

The safest ice-storage system in these circumstances is stowage in boxes. As already seen in 2.2 above, boxes (or baskets) are an essential requirement of a practical system of separating out the desired varieties of fish ; delivery of ice to the catcher units in boxes is highly desirable. If the ice congeals in the box it does not matter; the fisherman will apply the usual simple remedy of hitting it with a piece of wood.

*2.5 Naval architecture, marine engineering and nautical matters*

2.5.1 The foregoing leads to a concept of a floating unit or units that would carry a water treatment plant, ice-making plant, storage space for water and ice and perhaps also storage space for boxed and iced fish depending upon the system actually adopted for handling the fish.

The floating unit would need, on an average, 40 tons of water per day. At least three days' requirements should be stored. Average requirements for ice are assumed at 20-25 tons/day; again, three days' storage would be desirable.



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The refrigerating compressors would absorb about 120 hp in the running condition (80 KW/ton of ice). If diesel engines driving the compressors directly were used, they would need to be of at least 150 hp combined output at continuous (marine) rating with stand-by power of half that amount.

Steam generating capacity of about 2 tons/hr would be required.

Living accommodation would be required for, say, 6 to 10 men per unit. Fuel oil consumption (neglecting the use of waste heat) would be about 4.5 tons/day and 100 tons would ensure a three-week supply.

2.5.2 On the basis of these figures, and other factors -such as the value of dead weight/ displacement ratio likely to be achieved, the block coefficient, the length/breadth and length/ draft ratio likely to be favoured by the naval architect-a first rough estimate of the size of such a unit can be made. In what follows, it has been assumed that the unit(s) would not take aboard the boxed iced fish.

The calculations suggest that a single barge-shaped unit providing the above facilities would be perhaps 30 meters in overall length; two units might be each perhaps 24 metres; and four units each perhaps 20 meters long.

Such calculations assume that the design is weight-limited rather than space-limited. If it is space-limited, as it could well be, the units would be even larger (as they would be if they had to receive the fish and stow it on board).

2.5.3 To make units of this size "unsinkable" by provision of impenetrable buoyancy cells would be difficult and expensive and would add again very considerably to their size. The more practical approach would be to assume that they would in this respect be orthodox and depend for maintenance of buoyancy on the systems design and pumping arrangements that are customary for ships. For safe operation of such systems, each crew would have to include two well-trained technicians. They should have at least senior petty-officer level experience in a sea-going ship's engine-room. They would have to be supervised by a qualified marine engineer in the headquarters staff of the organization operating the unit(s).

This point is somewhat reinforced by the need (explained below) for the unit(s) to be self-propelled. This would obviously be best accomplished by using the diesel engines already required for driving the refrigerating compressors, rather than by attaching large outboard propulsion units of the "Harbourmaster" or similar type which would be an additional expense. The corollary, however, is that the unit(s) would have propeller shaft and stern gear, the maintenance and safe operation of which would again require experienced seagoing engineers under proper supervision.

The conclusion is that the unit(s) cannot be manned by semi-skilled plant attendants with the kind of experience and qualifications appropriate to operating the machinery of a small ice-plant on shore. In this respect the unit(s) would have to be regarded essentially as ships; they would probably have to be registered and insured as ships and they would have to be manned and operated accordingly.

This is further reinforced by a point made quite emphatically by the technical staff in BFDC: in the tropical humid atmospheric conditions in Bangladesh, automatic relays, solenoid valves and other electrical control equipment give a great deal of trouble and could be expected to give even more trouble at sea. It would therefore be most unwise to assume that the floating units should be equipped with automatic controls requiring only that a semi-skilled operator push a button to start or stop the ice-making process. Hand-started and to a large extent hand-controlled equipment would be more practicable. This requires operators of the intelligence and



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experience already indicated and especially with the experience of ships' engine rooms that gives them sufficient knowledge and understanding to avoid inadvertently endangering the vessel.

Moreover, any mechanical equipment of the types envisaged, in more or less continuous operation for 100 days, would need intelligent servicing, maintenance and probably emergency repairs. Skilled sea-going mechanics would be required, not semi-skilled operators, and they would need support and supervision from a qualified marine engineer as already indicated.

The appropriate model for the floating unit, from the engineering standpoint, is the floating light-house-vessel (light-ship) rather than the shore ice-plant.

2.5.4 Various proposals have envisaged the floating unit as a dumb barge, that is to say, without means of self-propulsion. The assumption has been that if the unit(s) had to be evacuated from the area in an emergency -such as a storm warning or a fault in the equipment that upsets stability — evacuation of the unit could be effected by tug. However, there does not seem to be any other requirement for tugs in the Sundarbans area or on the coast in the vicinity of Dubla Char. Moreover, the depths of water on the Dubla fishing grounds are generally very shallow (R.V. MACHRANGA, drawing six feet of water, had to run due south into the open Bay for an hour, due west for a second hour and north for a third hour, in order to gain the mouth of the Pusur river from the vicinity of the fishing camps-and she left shortly after high tide; similar precautions had been taken earlier in coming from Barisal). Any tug capable of handling the envisaged units would have to take one of the same routes. It would therefore take a tug some eight hours to reach the Dubla grounds and a further six to nine hours to tow the unit into the mouth of one of the main rivers so that even if the tug were readily available, the rescue operation might take 15 to 20 hours from the time her services were requested. This does not seem to be a practical solution.

However, there are several makes of marine diesel engine in the likely power range required for driving the refrigerating compressors that can deliver full power from either end of the crankshaft. It would therefore be simple enough to fit reverse/reduction gearboxes and propeller shafts to the other end of one or more of the engines used to drive the refrigerating compressors. This, of course, reinforces the requirement for competent engineers. It also makes it necessary for one member of the crew to be a competent navigator in local waters. The unit would then inevitably have to be regarded as a ship.

2.5.5 The floating unit would have to be designed by naval architects cooperating closely with engineers familiar with ice-making plants and the use of ice in the fishery industry. A number of shipbuilding enterprises in Bangladesh could build the hulls in steel and fit them out. The existing ferro-cement building yard probably will not be able to handle hulls of the required size and weight since their method of construction would probably result in a rather poor dead-weight-to-displacement ratio in the type of vessel required.

2.5.6 The main conclusion to be drawn from the comments above is that, since the requirement for a floating unit is unique, any design will be experimental. The system of handling and despatching fish to the market envisaged by the designer may in practice need to be modified; or the quantities of ice and the methods of handling ice may need adjustment. In either case, physical modification of the unit may be necessary. One can avoid technical failure of the unit — but only if designs, materials and systems familiar to Bangladesh engineers and mariners are adopted.

2.5.7 Costs of the unit are difficult to estimate at this stage; it might amount to US $1 to 1.3 million, depending on whether one unit were chosen or four.



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2.5.8 The costs of ice (and water) produced by such a unit are almost bound to be higher than the costs of ice and water brought from Khulna and Barisal by otherwise empty fish carrier vessels. The costs of operation of the unit would therefore have to be largely written off as a "service to industry" as in the case of the "landing centres".

For this reason as well as technical reasons the only organization geared to own and operate such units would be BFDC. However, BFDC has difficulty in recruiting and retaining competent and experienced marine engineers and technicians: the readiness-for-sea record of their trawler fleet based on Chittagong — where they have workshops, slipways and other services — is poor, and their engineering staff will be increasingly under strain in the next few years to complete the freezing complex near Mongla Port and to construct and operate the "landing centres". It must therefore be concluded that the prospects for keeping a floating ice plant in continuous operation at Dubla Char throughout the season and for successive seasons are not good.

*2.6 The alternative solution*

2.6.1 Fortunately, the alternative solution spelled out below poses no such difficulties and is for cheaper to experiment with and develop.

2.6.2 While developing the arguments 2.2 to 2.5 above it has been hard to escape the conclusion that the floating ice plant is an unnecessary complication if the long-distance carrier vessels from Khulna and Barisal can supply ice and boxes (and also drinking water) to the fishing grounds and exchange these directly with the catcher boats for boxes of iced fish, In other words, the obvious "fish receiving and distribution unit" is a long-distance carrier vessel such as already *serves* the *savar* (gill-net) fishery at Dubla.

2.6.3 Such a system would constitute an innovation in the behundi-net fishery at present producing dried fish for Chittangong *aratdars* and would require trial and development.

The main aims of development would be :

(1) to establish a system of incentive payments to the fishermen to sort the catches on board the "mother"-boats, select the desired species and box them with ice;

(2) to train the fishermen to do so ;

(3) to evolve and prove a suitable design of box;

(4) to establish whether and at what stage the fish would require to be re-iced;

(5) to establish whether the fish should be taken to market in the carriers in bulk or in boxes and, if the latter, to establish practical methods of handling and stowage of boxes of ice and boxes of iced fish on board the carriers;

(6) to develop, as necessary, new designs of carrier (or rather new designs of hold) especially suited to the carriage of boxed fish, and with wing tanks for transport of potable water;

(7) to establish a method of payment for the fish acceptable to the *bahardars;*

(8) to monitor the subsequent handling and marketing of the fish and modify the system as may be necessary or desirable;

(9) to provide guarantees requested during the experimental period by the bank financing the *bahardar* and



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(10) to bring about an agreement between the bank, the *bahardar,* the *aratdar* (if he is providing a part or all of the guarantee for the bank loan) and the wet fish trader, without which the experiment cannot be undertaken.

On this last score, agreement might be easier if the *aratdar* received some assurance that his total supplies or their value would not be affected. This might be possible if the experiment were undertaken as part of a general programme of development of boats and gears intended to improve catches.

2.6.4 The concept of a floating ice-making plant at Dubla was explained to one *bahardar.* He understood it, but apprehended such problems as queuing for ice and supplies breaking down. If there was no alternative to an ice-making plant, he preferred relying on private supplies of ice from Khulna or Barisal. He regarded this as more convenient.

2.6.5 It was noted earlier that an existing carrier launch capable of holding 30 tons of iced fish in bulk would take only about 20 tons of fish iced in boxes; this would be with all holds full. There is not much space on deck and it would not be practicable to operate the proposed system with all holds full, since too much time and labour would be spent in exchanging boxes of iced fish for boxes of ice. Some empty space is needed to immediately store the first batch of boxed fish. Thus, the working capacity of such a carrier launch would be reduced to, say, 15 tons.

Whether this would be acceptable would be one of the questions to be answered by the experimental trial, as suggested in 2.6.3 above. If not, additional carrier capacity would have to be hired as a temporary measure by those conducting the trial. But the costs of this would not be included *in* toto in the economic assessment of the system on the ground that new and more suitable carriers would be designed and built (and presumably additional carriers would in any case be needed to exploit this "new" source of fish for the fresh fish market).

The new design of carrier would have a hull form leading itself to a "squared-off" form of hold suitable for carrying boxed fish. In the unused space between the side linings of the hold and the ship's sides, tanks to carry drinking water could be fitted. The design of the new carriers should of course, await two decisions. First, whether the fish should be transported to the market in boxes or in bulk; in the latter case, the boxes or baskets would be used only for outward transport of ice to the catcher boats and for stowage of fish on board the catcher, and would be stacked on the deck of the carrier for the return journey. The second decision to be made before designing new carriers, which follows the first, is a suitable design of box. Only when this is settled could the new carrier be designed.

2.6.6 As remarked earlier (2.6.5), presumably some additional carriers would be needed to cope with the additional supplies of fish for the fresh market, but there may also be space for an extra 20 odd tons of fish on a normal day in the carriers serving the *savars'* gillnet fleet. Be that as it may, the capital cost of the alternative to the floating ice-making plant would pay for a large number of carriers. The running costs of the additional carriers would be far less than those of the floating ice-making plant – even after the latter is credited with the costs of the ice and fresh water it would produce.

A tentative estimate can be made of the number of long-distance carriers required. It will be assumed that a carrier launch leaves Khulna in the evening in time to arrive on the fishing grounds at daybreak. If it is to return to Khulna at daybreak the following day, say a 12-hour run against the river current, it can spend about 12 hours on the grounds collecting fish. It will now be assumed that the best day's catch during the season is double the average, so that on the average day the carrier will take on board only half as much fish as there is hold space for. On the peak day the catch to be collected would then total about 45 tons distributed over 85 catching units, an average of 0.53 tons per unit (14 maunds). A box containing half-a-maund of fish and

half-a-maund of ice would be a reasonable load for two men on a boat in a seaway (total weight say 45 kg) ; 28 such boxes would have to be transferred each way on the peak day. At the fairly slow rate of four boxes per minute (four boxes each way) the operation would take about ten minutes.

If the average spacing of the fishing units is 1½ miles, the carrier launch might take another 15 minutes to disengage, proceed to the next catcher and moor alongside. Thus, a carrier should take an average of no more than 25 minutes to serve one catcher unit. Allowing an hour for waiting time because some catchers are not ready to receive the carrier, and also some time for meals, a carrier should be able to serve 25 catchers. In the process it would take on board approximately 15 tons of fish on the assumed peak day, which suggests that the present type of carrier may be adequate.

A total of three or four carriers would therefore be operating to serve 85 catching units. The operating cycle, allowing some reserve capacity, would be three days and with additional crew it could be only two days. Thus, no more than eight to 12 carrier launches would be needed — or, say ten.

If alternatively all the fish for the fresh fish market was assembled on board "floating fish receiving and distribution units" ready for collection by the carriers, the time taken for the carrier to proceed from catcher to catcher could be saved. Three carriers with a capacity of 15 tons of fish each could load in under four hours. The operating cycle could be 27 hours and allowing for reserves, a total of eight carriers would suffice-a saving on the alternative system of two to four carriers. But the capital and operating costs of the "floating fish receiving and distribution unit(s)" would be far greater than those of two *or* even four additional carrier launches.

*2.7 Other services*

2.7.1 Of the other facilities and services suggested in previous reports most now seem to be provided -with two exceptions: drinking water supply, and storm warnings to the catching units anchored anything up to 20 miles off Dubla Char in the open sea. As regards supplies of drinking water, two different solutions are suggested above, one for the system incorporating a floating ice plant, another for the system using only carriers.

2.7.2 As regards storm warnings an effective radio broadcast service seems to have been in operation at least since the days of the FAO Survey for the Development of the Fisheries of East Pakistan. It is therefore assumed that the problem is the purely local one of communicating the warning to the catcher units anchored below the horizon from Dubla Char.

It is also believed that the problem has eased considerably since the adoption of motorized boats to carry the catches to the beaches. The remotest catcher is now only about three hours away. There are such things as signal rockets and Verey pistols, and a small transistorized radio receiver for each catcher unit is not beyond the means of a *bahardar.*

*2.8 Further action*

2.8.1 As suggested elsewhere in the report, a suitable system of receiving and distribution may evolve in due course of time without any direct stimulus from Government. If, however, this system is considered urgent; and if the Government is expected to ease the financial stra in of the *bahardars,* the traders or the bank; and if the system is to be technically and operationally suitable for an expanded Swatch of No Ground fishery - an experimental project such as outlined in 2.6.3 above should be embarked upon.



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2.8.2 International technical assistance would be required: one expert in fish marketing and one in fish handling. They should have national counterparts. But no such organization — concentrating on experimental work and technical development in direct cooperation with industry — exists at present.

The other main inputs required would be (a) prototype boxes (b) prototypes for the fish carrier launch of new design, if required. (c) Funds would also have to be set aside to compensate launch operators and *bahardars* for possible losses in the experimental stages of the project. (d) The BFDC might act, at least in a first phase, as the participating wet-fish trader and part-guarantor of the *bahardars* if no participant could be located in the private sector. A small consultative (not managerial) committee consisting of representatives of the Dubla Fishermen's Group, the Bank, BFDC, the wet-fish traders, and the international development agency would be useful. The experimental trial should extend over at least two seasons.

2.8.3 The proposed activities would be best undertaken as part of the activities of an integrated project for the development of the Swatch of No Ground fishing for exploitation by the artisanal fleet including development of suitable fishing vessels (perhaps suitably equipped boats of the DANIDA type) and improved methods of capture. The effort to develop a system merely for existing conditions, equipment and methods at Dubla Char seems scarcely worthwhile when all it can do is to direct some 2000-3000 tons of fish a year to a different market. The broader approach would also, if considered necessary, compensate the dried fish *aratdars* for the loss of nearly one-fifth of their supplies by providing increased supplies from the enlarged fishing fleet and new fishing grounds.

2.8.4 It is believed that a special initiative might be possible in one particular area : the collection of shrimp directly from the fishing units. This might be done by carrier launches using ice but the possibility of using one of the larger carrier vessels owned by BFDC should not be ignored. These vessels are designed to carry frozen fish. If one of them could be equipped with a small self-contained horizontal plate freezer, the shrimp might be frozen on board on the fishing grounds, thus avoiding the risk of loss of quality during transport to a shore-freezing plant.

2.8.5 Following implementation of the proposed system, the way would be open to popularize some of the other varieties in the *behundi-net* catch not at present acceptable in the wet-fish market. Such a step would be desirable if, for instance, the catches on the Swatch of No Ground yielded more than the dried fish market could absorb and if, at the same time, the national demand for fish was continuing to grow.

# 3 DISCUSSION AND CONCLUSIONS

### *3.1 General assumptions and scope of discussion*

**3.1.1 The Dubla Char fishery was last examined by the 1977-78 committee on financing fishermen (1.4.10 above), The last detailed proposal for the introduction of new equipment and methods of handling and distribution was in November 1978; it was based upon field observations made somewhat earlier. Its findings and recommendations may have been valid then but the situation has now changed; and has to be examined afresh.**

**The most significant changes are the increasing demand for fish from a growing population so that the per capita availability of this principal animal protein foodstuff in Bangladesh is declining ; the introduction of the Sonali Bank's loan scheme (1.4.10 above) ; the increasing use of motorized boats, especially for transport of catches; and the programme for development of country boats and fishing gear which has just started.**

**3.1.2 In arriving at conclusions and recommendations, due consideration has been given to the fact that the Government is keen on increasing national fish supplies, on stepping up export earnings, and on improving the incomes and living conditions of the fishermen.**

**3.1.3 Of the various development projects proposed in the field of fisheries, the Government will be able to undertake only a few — even with external technical assistance and financial aid. It is assumed that those selected will be allocated priorities in accordance with the policies outlined earlier and also that projects and priorities will be governed by the avaliability of finance, expertise, personnel and infrastructure.**

**The importance of the floating unit proposal is discussed below in the light of stated Government policies and available inputs.**

**3.1.4 This study has already discussed the technical, operational and organizational aspects of possible proposals, and the preferred solutions, Some discussion of benefits and costs now follows.**

### *3.2 Potential benefits*

**3.2.1 To divert a proportion of the Dubla catch from the dried fish market to the wet-fish market would in itself do very little to increase supplies; it would only reduce spoilage and some loss in nutritional value caused by the drying of 2,000-3.000 tons of fish. It would divert supplies from one set of consumers to another, and present them in fresh instead of dried form.**

**3.2.2 The shrimp, however, could be channelled into the export market instead of being dried. It is difficult to estimate the potential value of the catch; data are not readily available about the frequency of occurrence of shrimp and their sizes at various locations on the fishing grounds, and at various times of the lunar cycle and the season. Daily catch per fishing unit might be 30 kg of a count of 60 to the pound or better. If the assumption is made that this can be achieved in half the season, the total would still be 120 tons of shrimp. If the *bahardar* gets US $ 1,000 per ton more for fresh shrimp than for dried shrimp, his income may go up by US $ 1,500 per season or TK 24,000; this is an improvement of over 10% on income and about one-third on gross operating profit (see Appendix 3 for costs and earnings of *bahardars).***



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*3.2.3* The bahardar would also derive additional income from the fish diverted for consumption in fresh form within Bangladesh. Owing to the lack of comprehensive statistics on prices (at the point of collection from the catcher), and of quantities and species composition of catches, it is difficult to arrive at an estimate of increase in income. Assuming that the increase in price averages TK 1 per kg, the average earnings might go up by about TK 24,000 for a bahardar; that is a net profit increase of 16%.

3.2.4 Development need not necessarily await availability of accurate statistics, but if the system of fishery chosen comprises a single large unit it would be necessary to assess its likely costs and benefits more accurately before deciding to invest. If on the other hand it comprises a number of smaller independent units, an experimental approach could be adopted by constructing a prototype unit system. From the resulting experience, costs and benefits could be confidently predicted. The experimental project proposed in section 2 meets this requirement.

3.2.5 How much any increases in the bahardars'earnings would be passed on to the fishermen is difficult to say.

3.2.6 Other benefits which earlier proposals envisaged depended on the proposed unit being equipped with such facilities as workshops for repair of engines, water treatment plants and accommodation for extension workers, collectors of statistics and the like.

Each proposal for the provision of a facility or service at Dubla Char should be examined on its own merits. It might be sensible to incorporate a large-sized water treatment plant into a unit carrying ice-making equipment so that potable water is available to the fishermen. It might also be sensible to attach a workshop for the repair of engines since this also requires supervision by engineers and the services of mechanics. It is not immediately obvious that the same complex should include other kinds of facilities and services; the Forestry Department officers, the medical services and the army are already separately housed, presumably in locations which best suit their particular functions.

3.2.7 Despite the potential for profits, the cost-benefit ratio of a floating fish receiving and distribution unit with associated ice plant may be much less attractive than some advocates have suggested. This could be proved only after detailed castings that are outside the scope of a pre-feasibility study, but such studies are unnecessary.

3.2.8 However, as noted in Section 2, a floating fish receiving and distribution unit is neither the most practical nor the cheapest system in the circumstances that prevail in Bangladesh. There is one obvious alternative already used by the gillnet *savars* — direct use of carrier launches.

Before coming to a final conclusion, however, it is necessary to draw attention to other, more general, considerations — including the possible lines of future development.

## 3.3. Possible future developments

3.3.1 As noted in section 1 above, the Dubla Char fishery at present exploits only the nearest part of the Swatch of No Ground fishing grounds. It is to be expected that a fishery will develop in the next few years over the whole of these grounds and that they will be largely exploited by artisanal fishermen. This expansion would depend upon the introduction of vessels of improved types, almost certainly motorized, and of improved or new types of gear (modifications to the behundigear that would make it usable in deeper water). Such a development would increase supplies. With improved boats and gear it may also be possible to extend the fishing season and further increase supplies provided that a new generation of fishermen can be trained to work in rough weather.



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**3.3.2** Various observers have remarked that Bengali fishermen are not accustomed to rough weather and that many, but by no means all, are still apprehensive about operating out of sight of land. It may therefore be counter-productive to carry out any development that would tend to reinforce or confirm a belief that any fishing activity in the area must be based on a convenient island such as Dubla Char or that there must be present with the fleet some kind of "mother-ship" such as the proposed floating fish receiving and distribution unit.

As fishing takes place further offshore, the cost and the operational difficulties of such "mother-ships" will increase. There is scarcely any other fishery in the world within 40 miles of the coast where they are found to be necessary. The apparent major exception, the fish-receiving barges of the British Columbia salmon and herring fisheries, is *a* response to special circumstances. There the shoals are fast-moving, the methods of capture are active and there is therefore a strong incentive for each catcher to maintain contact with a productive shoal even though he has already filled his hold ; transfer of the catch to the barge makes this possible and also saves a good deal of time forfishing that would otherwise be lost in running to port and back again. In similar fisheries elsewhere, however, the catchers operate in small groups and take turns to carry the combined catches to port. Yet elsewhere, including the fishery of West Bengal, the chosen system is the use of special carrier launches which, as noted earlier, is also common in Bangladesh and already in use in the Dubla fishery.

**3.3.3** As and when better boats and methods of capture become available to Chittagong fishermen, they may find it more convenient and profitable to exploit offshore grounds nearer to Chittagong than Dubla Char. In that case, the behundi net fishery using traditional boats at Dubla may decline leaving these grounds to be exploited by fishermen from Khulna and Barisal districts. In some ways this development would be welcome. In any case, with the advent of better boats and gear there is reason to suspect that the Dubla Char *behundi* net fishery may not continue in its present form for many years. It may be wise to limit expenditure on it.

**3.3.4** It is hard to avoid the conclusion that the main effort should focus on developing the new fishing ground (by encouraging suitable artisanal boats and methods of capture) rather than on better handling of a small part of the catch in the fishery close to Dubla Char. The presence of the savar gillnet fleet and a new fleet further offshore, both served by fish carriers of one sort or another, would by itself probably divert the acceptable portion of the *behundi* net catch on the present grounds to the fresh fish market-especially if the supplies of dried fish to the *aratdars* were maintained at their present level. If the bank's proposal to assist the bahardars market their own catches materializes, this development is even more likely.

**3.3.5** The conclusions in section 2 suggest that the amount of development effort required to establish, operate and maintain a system of floating units, including the *services* of engineers, may well be as great as would be required to develop improved fishing boats and gear to exploit the Swatch of No Ground. In the first case the achievement would only be the diversion of about 2% of the national fish supplies (and probably only one-third of 1%) from one domestic market to another with some financial benefits to the *bahardars* but at some cost, arising from operation of the floating units. In the second case, the development of Swatch of No Ground fishery, there would be an increase in fish supplies and no continuing costs *to* the Government. If one has to choose between these two projects because of resource constraints, the second project should receive higher priority.

## 4 RECOMMENDATIONS

4.1 No further action should be taken regarding the development and provision of floating ice-making plants for Dubla Char or the Sundarbans until a competent, practical and thorough trial of the alternative proposal outlined below has been carried out and conclusive results obtained.

4.2 In marketing the Dubla behundi fleet's catch, systems valid only for today, not useful for the improved vessels of tomorrow and not applicable in the Swatch of No Ground area further offshore, should not be pursued.

4.3 A system should be tried out under which carrier launches operate directly between the *behundi-net catcher units on the Dubla grounds and the wholesale fresh fish market at Khulna* or Barisal. This should form part of an integrated project for the development of the Swatch of No Ground fishery by the artisanal fishing fleet, using improved boats (like the DANIDA boats) and improved methods of capture.

4.4 If resource constraints force a choice between developing improved boats and gear for the Swatch of No Ground fishery and trying to market a portion of the ***behundi*** catch as fresh fish, the government should go in for the former.

4.5 Essential features of the proposed marketing-by-carrier launch system are: first, the carriage of ice in fish boxes from Khulna or Barisal to the catcher units; second, the sorting and selection of marketable varieties in "fresh" form on board the "mother" boats of the catching units ; third, the stowage of the selected varieties in the fish boxes, where they await the carriers.

4.6 The experiment should be carried out as outlined in sections 2.6.3 and 2.8.2 of this report. International technical assistance should be secured to carry it out in the recommended manner.

4.7 A group of development engineers should be established to conduct field experiments in close conjunction with artisanal fishermen and to carry out technical development immediately applicable to the artisanal fleet. One of the group's first tasks should be to take part in the experimental trials recommended above and also in the integrated development project for the Swatch of No Ground fisheries.

4.8 BFDC should consider whether, with the means already at its disposal, it would be practicable to collect and freeze the shrimp caught by behundi-nets without waiting for implementation of the proposed experimental trial for marketing of iced fish.

4.9 The long-term possibility of a project to popularize some of the behundi-net catch not marketable at present in fresh form should be borne in mind.



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## Appendix A

### LIST OF PRINCIPAL DOCUMENTS CONSULTED


1. FAO Fishery Country Profile : Bangladesh
   Draft of New Edition (1979)
2. Project for the Development of Small-Scale Fisheries in the Bay of Bengal — Preparatory Phase. FAO : IOFC/DEV/78/44.1, Rome, July 1978.
3. General Description of Marine Small-Scale Fisheries : Bangladesh
   FAO : RAS/74/031 -Working paper No. 3 (Rev. 1) June 1977.
4. Status and Potential of Bangladesh Fisheries:
   Mahmudul Karim, Ministry of Fisheries and Livestock, Dacca, 1978.
5. Survey for the Development of Fisheries in East Pakistan :
   Report on Project Conclusions and Recommendations. FAO/FI : SF/PAK 22 Terminal Report, Rome, September 1972.
6. Marine and Estuarine Fisheries of East Pakistan with particular reference to Trawling, M. Muzaffar Hussain, Transactions of the Fish Protein Concentrate Seminar, November 7-8, 1967, reprinted by the Fisheries Development Corporation, Chittagong.
7. The Commercial Fisheries of the Bay of Bengal :
   M.M. Hussain, UNDP Project PAK 22 (Survey for the Development of Fisheries in East Pakistan) Project Publication No. 1, Chittagong, September 1971.
8. Precept List of Commercial Fishes of the North-East Part of the Bay of Bengal: M. M. Hussain, Marine Fisheries and Oceanographic Laboratory, Chittagong, June 1969.
9. Report to the Government of Bangladesh :
   Fish Marketing Development, F. H. Meyer, Denmark Funds-in-Trust, FAO/TF/BG D4 (DEN) ; FAO, Rome 1978.
10. The Dubla Fishery : an "Aide Memoire"
    FAO Development of Small-Scale Fisheries in Southwest Asia RAS/74/031 — AA/HC ; May 26,1977.
11. A Proposal for the Development of Marine Small-Scale Fisheries in the Khulna District of Bangladesh, FAO Project for Small-Scale Fisheries Promotion in South Asia, draft of, 1979.
12. Reports of the Committee on Training of Fishermen of Dubla Island, and Minutes of the Meeting held on 29th June 1978 in the Board Room of Sonali Bank Head Office, to discuss the Draft Report of the Committee: Hafizul Islam and A. Q. Siddiqi, Sonali Bank, Dacca, 29 June 1978.
13. Proposal for Floating Fish Receiving Barges with Plate Ice Machine :
    A/S Nymo, Grimstad, November 1978.
14. Bay of Bengal Pilot (Ninth Edition) :
    The Hydrographer of the Navy; London 1966.
15. Report of Assignment in Dacca, Bangladesh (to assess national shipbuilding capabilities) : R. S. Seneviratne, FAO/UNDP Fleet Management Unit, 29 March 1979.




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## Appendix B

# COSTS OF FISH CARRIER LAUNCH

**I. Capital Cost**

| | |
|---|---|
| Estimated cost of a new boat (42' x 16' x 5') made of teak wood | TK 150,000 |
| Estimated cost of a diesel engine 100/1 25 hp and filaments | TK 200,000 |
| Total capital cost of a boat | TK 350,000 |

**II. Operating cost of the above boat in Bangladesh**

A. Fixed Costs (yearly)

| | |
|---|---|
| 1. Cost of crew<br>1 captain at the rate of 600 TK/month<br>1 Engine driver at the rate of 600 TK/month<br>Crew (8) at the rate of 300 TK/person/month | TK 43,200 |
| 2. Depreciation at 10% | TK 35,000 |
| 3. Interest on capital deployed at any one time on average basis to yield 5% of original investment | TK 17,500 |
| 4. Annual maintenance (ad hoc) | TK 20,000 |
| | TK 115,700 |
| The cost per trip (30 trips/year) : | TK 3,850 |

$$= \frac{115{,}700}{30} \qquad TK = 3{,}850 \text{ TK}$$

B. Variable costs (per trip)

| | | |
|---|---|---|
| 1. Cost of diesel oil at 4 gallons/running hour, i.e. 220 gallons per each return trip from Barisal/Khulna to fishing grounds at 12.50 TK/gallon | TK | 2,750 |
| 2. Cost of lubricants for 4 gallons/running trip at 35 TK/gallon | TK | 140 |
| 3. Miscellaneous | TK | 110 |
| 4. Cost of ice of 100 blocks (110-120 kg each) generally carried in each trip by the boat to the fishing grounds at 30 TK/block | TK | 3,000 |
| TOTAL | TK | 6,000 |

C. Total costs

| | | |
|---|---|---|
| 1. Therefore the total cost per trip is | TK | 9,850 |
| 2. The cost of carrying 1 kg of fish (the average load per trip is of the order of 8.5 tons) | TK | 1.20 |



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## Appendix C

### COSTS AND EARNINGS OF A BAHARDAR

**The following is based on the Report of the Committee on the Financing of Dubla Island Fishermen.**

1. **Capital assets and working capital required by an individual *bahardar:***

| | |
|---|---|
| One boat 40 ft/22 hp | TK 75,000 |
| Registration fee | 500 |
| Two country boats | 30,000 |
| Radio | 300 |
| Compass | loo |
| Nylon twine 800 lb | 16,000 |
| Nylon rope 400 lb. | 5,000 |
| 600 synthetic floats | 5,000 |
| Working capital | 17,500 |
| | TK 149,400 |

**The working capital is used to pay advance wages to fishermen and labourers, Government dues and taxes, and to purchase stores required to set up fishing operations and a shore camp including initial supplies of food.**

**The capital assets listed above are in addition to what is normally already owned by the *bahardar* or is the subject of separate financial arrangements.**

2. **Operating costs for one *bahardar's* unit during one season :**

**The unit comprises two motorised boats, two large and three small country boats and 50 workers.**

| | |
|---|---|
| Salary of Master | TK 6,000 |
| Salary of Engine driver | 3,000 |
| Wages | 45,000 |
| Rations | 25,000 |
| Fuel and lubricants | 15,000 |
| Repairs and maintenance | 18,500 |
| Sub-total | TK 113,000 |

3. **Capital costs (one season)**

| | |
|---|---|
| Interest on TK 150,000 | TK 22,500 |
| Depreciation (5 years) | 30,000 |
| Sub-total | TK 52,500 |

| | |
|---|---|
| 4. Total costs (one season) | TK 165,500 |
| 5. Earnings (one season) | TK 180,000 |

**The figure for earnings (TK 180,000) assumes a production of 600 maunds of dried fish per unit at an average selling price of TK 300 per maund.**

6. **Net profit** TK 14,500



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## Appendix D

## DIARY AND ITINERARY OF MISSION

| | | |
|---|---|---|
| 13 October 1979 | | Gordon Eddie takes up appointment in Rome |
| 13 - 15 October 1979 | : | Briefing in Rome |
| 16 - 17 October 1979 | : | Gordon Eddie travels Rome - Madras |
| 18 - 21 October 1979 | : | Briefing in Madras |
| 21 - 22 October 1979 | : | Mission travels Madras - Dacca |
| 23 October 1979 | | First meeting with Government Representatives. Meeting with Secretary of Fisheries and Livestock. |
| 24 October 1979 | : | Discussions with BFDC, Planning Commission, and Fisheries Directorate; visit to wholesale fresh fish market. |
| 25 October 1979 | : | Travel to Chittagong by road. Discussions with General Manager of Fisheries Harbour, representatives of BJMSS, and bahardar. Visits to ferro-cement boatyard and dried fish wholesalers. |
| 26 October 1979 | | Visit to Fishery Harbour, Chittagong, including boatyard, workshops and processing plant. Discussions with General Manager and his staff, and with fishing and boatbuilding experts of DANIDA. Return to Dacca by road. |
| 27 - 30 October 1979 | : | Further discussions with Fisheries Directorate, BFDC and Planning Commission. |
| 31 October 1979 | | Discussions with Sonali Bank and DANIDA. |
| 04 November 1979 | | Eid-ul-Azha holiday |
| 05 November 1979 | | Travel Dacca - Chandipur by river steamer. Mission joined by Mr. Muzaffar Hussain. Embark on R. V. MACHRANGA. Proceed to Barisal. Anchor for night. |
| 06 November 1979 | | Visit fish carrier launches, wholesale fish market, workshops, ice plants, prawn processing plant and administrative offices in Barisal. |
| 07 November 1979 | | Inspect site of future "Landing Centre" and village fish market. Proceed to Dubla fishing grounds. Inspect fish carrier and behundi-net catcher unit; discussions with fishermen. Survey fleet dispositions. Anchor off Dubla Char. |



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|---|---|
| 08 November 1979 | : Visit bahardars' shore camps. Discussions with bahardars. Depart for Pusur River ; en route visit gillnetter ; discussions with fishermen ; survey fleet dispositions. Anchor upstream of Mongla Port. |
| OS November 1979 | : Visit BFDC processing plant under construction. Proceed to Khulna. Anchor at Khulna. |
| 10 November 1979 | : Visit wholesale fresh fish market at Khulna. Mission disembarks from R. V. MACHRANGA and proceeds to Jessore airport by road. Fly to Dacca. |
| 11 - 14 November 1979 | : Further discussions with BFDC. Visits to wholesale fish markets. |
| 15 November 1979 | : Meeting chaired by Secretary, Fisheries and Livestock, attended by Joint Secretary (Fisheries) and staff of Fisheries Directorate; Chairman, BFDC and staff, including Mr. M. Muzaffar Hussain; Mr. A. Q. Siddiqui (Sonali Bank) ; Mr. D. P. Butcher (FAO Country Representative) and members of the Mission. Oral report of mission findings and conclusions ; discussions on fisheries development. |
| 16 November 1979 | : Mission returns to Madras |
| 17 November-<br>06 December 1979 | : Discussions and writing of draft report. |
| 07 - 8 December 1979 | : Gordon Eddie travels Madras - Rome. |
| 10 - 17 December 1979 | : De-briefing in Rome |
| 18 December 1979 | : Mission ends. |



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

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

***Reports (BOBO/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.
4. Role of Women in Small-Scale Fisheries in Countries Bordering the Bay of Bengal.
5. Report of the Workshop on Social Feasibility in Small-Scale Fisheries Development, Madras, India, 3-8 September 1979. Madras, February 1980.
6. Report of the Workshop on Extension Service Requirements in Small-Scale Fisheries, Colombo, Sri Lanka, 8-12 October, 1979. (In preparation)
7. Report of the Fourth Meeting of the Advisory Committee, Phuket, Thailand, 27-30 November, 1979. Madras, February 1980.
8. Pre-feasibility Study of a Floating Fish Receiving and Distribution Unit for Dubla Char, Bangladesh. Madras, April 1980.

***Working Papers (BOBP/ WP/ . . . . )***

1. Investment Reduction and Increase in Service Life of Kattumaram Logs. Balan, R. Madras, 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. (In preparation)

Published by the Bay of Bengal Programme, FAO, 91, St. Mary's Road, Abhiramapuram, Madras – 600 018, India. Printed at Amra Press, Madras 600 041.

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