

STOCK ASSESSMENT CONSULTATION
Volume 2

BANGLADESH
Status Paper on Coastal Fishery Resources

by

M. S. Mohiuddin
Golam Kibria
Md. Mokammel Hossain
Liaquat Ali (Ed.)



ABSTRACT

Coastal fisheries of Bangladesh have been described with reference to location, area and physico-chemical characteristics of coastal water, potential fishing grounds, extent of standing stock, yield, species composition, method of exploitation, fishing efforts, methodology of stock assessment and catch statistics with reference to vessels, gear and time.

Coastal area of Bangladesh is 37,000 km² lying between Lat. 20.4°N and 22.0°N, and Long. 89°E, which is no deeper than 50 m. Potential fishing grounds as have been charted by a resource survey are (i) South Patches (20.8°N - 21.4°N and 90°E - 91°E), (ii) Middle Ground (20.82°N - 21.65°N and 91°E - 91.8°E), (iii) Swatch of no ground (21.0°N - 21.6°N and 89.0°E - 91°E). The standing stock of the Bangladesh continental shelf has been estimated to be 552,500 tons (318,500 tons demersal fish, 200,000 tons pelagic fish, 9000 tons crustaceans and 25,000 tons others). Annual yield from the coastal waters has been estimated at 100,000 tons comprising 475 species of finfish and 25 species of shrimps. Of the total yield, 95% comes from small scale fishing and the rest from trawl catch. Dominant species of the catch by groups are catfish, Indian salmon, Bombay duck, shark and skates, jew-fish and eels. A total of 45,200 indigenous fishing boats and 1156 mechanised fishing boats are operated in the coastal belt of Bangladesh by about 156,000 fishermen directly engaged and 92,000 fishermen indirectly engaged in fishing. At present 17 trawlers are being operated by BFDC and 75 trawlers under joint venture with Thailand.

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Abbreviations used:

- (i) B.F.D.C. : Bangladesh Fisheries Development Corporation
- (ii) B.J.M.S.S. : Bangladesh Jatiya Matshaya-Jibi Sambaya Samiti
(Bangladesh National Fishermen's Co-operative Society)

1. Introduction

Bangladesh is endowed with vast marine and inland waters having high fisheries potential. The Republic has a 480 km long coastal line on the Southern Zone of the country and approximately 1.0 million hectares of territorial water extending up to 19 km up to the sea. The nation's economic zone extends 320 km out to the sea from the coast line. Geographically the entire coastal area lies within Lat. 20.4°N - 22.0°N and Long. 89.0°E-92.0°E.

The continental shelf of Bangladesh covers an area of 69,900 sq.km., of which 37,000 sq.km. is no deeper than 50 m. The bottom materials of the waters up to 40 m depth are mostly alluvial silt and mud. Sand bottom occurs in deeper waters. These waters are relatively rich and contain high oxygen (4.8 ppm at the surface and 4.0 ppm at 35 m depth), carbohydrates, nitrates and plankton, but relatively low salinity (17 - 18 ppt. in monsoon and 31 ppt. in the dry season). The coastal waters are usually turbid due to suspended particles carried by the rivers and due to wave action. The salinity and turbidity are influenced by the inflow of the Ganges system.

The coastal water of Bangladesh is one of the most productive zones in the world and is rich in fish, shellfish and other aquatic resources. The estimated standing stock of Bangladesh continental shelf is on the average 552,500 m tons, i.e. 264,000 - 373,000 m tons of demersal (West, 1973). 200,000 m tons of pelagic (Karim, 1978b), 9000 m tons of shrimp (West, 1973) and 25,000 m tons of others (Anon, 1974b). A survey conducted under UNCF/PAK-22 Project in 1967-68 (Anon, 1972) reveals that sustainable yield of 57,000 m tons of demersal fish are available for exploitation in addition to the present catch of approximately 100,000 m tons per annum.

The economy of the country is predominantly agricultural and the people depend largely on fish for animal protein. An average person requires about 25 grams of animal protein, but in Bangladesh per capita consumption of protein is hardly one third of the requirement and more than 80% of animal protein intake comes from fish alone. A review of the current literature on nutrition reveals that the average per capita consumption of fish intake has fallen from the 1962 level of 32.8 gms to 22.3 gms in 1976. The continental shelf of the country is almost 5 times the perennial inland waters. The ecology of the inland waters, particularly open waters, has been disturbed due to human interference like construction of irrigation and flood control structures, indiscriminate use of insecticides, etc. And due to heavy fishing pressure with increase of demand as a result of rapid population influx, the inland fisheries are on the verge of decline or have declined. On the other hand, the vast marine waters are virgin with untapped fisheries resources. With proper scientific management, the marine fisheries may make a significant contribution to animal protein supply and to the economy of this country by earning foreign exchange.

In this respect the development of small-scale coastal fishery which contributes about 95% of total marine catch, along with the development of deep sea fisheries, is of prime importance. It is possible to develop small-scale fisheries with less investment and effort, with which the fate of thousands of fishermen are linked. For development of the small-scale fisheries, knowledge on the present status of the fisheries is essential but this information is scanty and what is available is not properly presented and compiled. An attempt has therefore been made in this paper to present and compile the available information of the marine fisheries with particular reference to small-scale fisheries and its development.

1.1 Method of exploitation

Two principal methods of exploitation of coastal and off-shore waters are in practice at present: (i) Exploitation by traditional boats (non-mechanized and mechanized) at small-scale level and (ii) by trawlers at large-scale level. Three types of traditional fishing craft namely *Dinghi*,

Chandi and *Balam* are used in estuarine and marine waters of Bangladesh. The type *Balam* is exclusively used for marine waters, while the *Dinghi* and *Chandi* types are used in both estuarine and marine (inshore) waters.

(a) *Dinghi*: A plank-built shallow boat about 6 m - 8 m long, 1.0 m - 1.5 m wide, and 0.75 m - 1.5 m deep with pointed bow and stern. There are ribs and cross-beams to strengthen the hull. The decking consists of detachable and half split bamboo. They are propelled by long oars and/or by sail. A dinghi costs about Taka 2,000. It is operated by 2-3 persons. A large quantity of seine net is generally operated by a dinghi.

(b) *Chandi*: This is also a plank-built boat. Its length varies from 5 m to 26 m, beam from 1 m to 3 m and depth from 1.0 m to 1.5 m. It has a stern slightly higher than the bow. Part of the vessel is decked with planks; the rest may be decked with split bamboo. The mast is far forward and carries usually a square sail. It carries a crew of 7 to 15 people and is used extensively for laying *Chandi* jal (drift gillnet) for catching *Hilsa*.

(c) *Balam*: The hull is a dug-out. The bow and the stern are slightly raised. The sides are built up by fitting planks to the dug-out. These planks are tied with "rattan" and made water tight by plugging the joints with weeds; this is renewed every year. A small *balam* has no deck or hood. The bamboo mast carries a square sail. A large *balam* is 15 m to 20 m long, the medium ones are 10 m to 15 m. These boats are used for operating big *behundi* nets (fixed purse net-set bag nets) by the Chittagong fishermen and operated in the open sea off Cox's Bazar and Dubla Island. The number of crew varies from 10 to 20 according to the size of the boat.

(d) *Motorized traditional boats*: These crafts are usually of the Cox's Bazar type (*balam*) of a length between 12 m and 14 m, equipped with 15-23 hp engines. They mainly use gillnets, but also operate the *behundi* and/or *funda* nets. They carry 100 pieces of gillnets of a total length of 1,400 m on average. The number of crew is 8.

(e) *Trawlers*: The Bangladesh Fisheries Development Corporation at the moment owns a fleet of 17 trawlers. The particulars of these trawlers are given in Table 1.1.1.

Table 1 .1 .1

Particulars of trawlers owned by BFDC

No. of trawlers	Length of trawler (in metres)	Made in
1	17.7	Holland
2	18.3	U.K.
5	25.0	Thailand
3	27.0	U.S.S.R.
1	27.5	Thailand
3	30.5	Denmark
1	44.0	U.S.S.R.
1	44.0	Thailand

Since liberation in 1972, the Government has sanctioned so far about 140 trawlers for operation in the Bay of Bengal by private sector and the joint venture with other countries.

Gillnets, castnets, stakenets, set-bag nets, seines and longlines are common nets, of which, *Behundi* (bag nets) and *Funda* (stake nets) are largely used in coastal fishing.

(a) *Behundi net*: This is a fixed bag net with a 15 m - 30 m circular mouth. Wings are often attached on the two sides of the mouth which increase the total fishing areas of the nets. The net tapers from its mouth and ends in a bag 25 m to 30 m from the mouth. The mesh size decreases continuously from the mouth to the bag and the bag is of fine mesh ($\frac{1}{2}$ " - $3\frac{1}{2}$ ""). The mouth of the net is kept open by two vertical bamboo poles. The net is fixed by tying the two ends of its mouth to wooden poles driven into the bottom. Thus fish, which come with the current (tide), enters into the mouth and ends up in the bag. A *behundi* net has a life span of about 5 years, and costs Taka 2,500 to 10,000 depending on the size.

(b) *Funda net*: A *Fonda* net is 55 m long and 3 m - 4 m deep, with 10 cm meshes. It is a stake net used off Chittagong in the open sea from November to March for capturing *Bhekti* (Cock-up) and *Lukwa* (Indian salmon). The price of a *funda* net is in the order of Taka 6,000 and has an average life-span of 5 years.

1.2 Annual catches

A survey (1972) estimated the marine fish catch (excluding the estuarine catch) at 100,000 tons. Ninety-five per cent of the total marine catch is harvested from the near shore waters by small-scale fishermen, many of them fishing without boat. Presently 1-5 per cent of the total marine catch is harvested from the deeper waters by trawlers operated by BFDC and private parties and Thai-Bangladesh joint ventures.

7.3 Species composition

A total of 475 species of fishes and 25 species of shrimps have so far been identified from the marine waters of Bangladesh.

The quantitative estimation of the marine catch as a whole, species-wise, is not available. However, some statistics on the catch composition of BFDC trawlers, mechanized boats operated in the Cox's Bazaar zone, and stock assessment study data of the Irrigation Fisheries Development Project are represented in Table 1.3.1, 1.3.2 and 1.3.3 respectively.

Table 1.3.1
Percentage composition of the BFDC trawler catch

Group Name	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80 (up to March)
Mixed small fish	75.80	68.20	72.70	56.46	73.50	62.16	44.96	39.58
Sharks, skates, rays	3.60	3.52	5.20	3.89	6.01	3.50	5.87	5.25
Shrimp	0.80	0.80	0.70	0.58	0.22	2.42	0.89	1.89
Indian salmon	5.80	4.52	2.40	1.83	1.45	4.33	4.91	1.09
Pomf ret	1.20	1.62	0.80	0.31	1.00	0.76	1.59	1.27
Eel	3.60	3.80	3.60	4.15	4.20	5.40	3.59	1.40
Grunter, Croaker, Grouper, Red Snapper	4.87	5.20	5.10	1.18	1.82	2.34	2.50	1.08
Cat fish	2.40	7.14	8.50	22.00	5.53	14.60	25.69	37.32
Mixed big fish	1.93	5.20	1.00	9.60	6.27	4.49	10.10	11.12
Grand Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total Catch (Tons)	4766	2616	4034	1218	1356	1400	1100	1377

Source : BFDC

Table 1.3.2

**Important species of fishes and shrimps caught by the research vessel
Machhranga from the Meghna river estuary
and the Bay of Bengal during 1977-78**

Name of the species	Weight (kg)
Fishes	
Arius serratus	30.49
Muraesox Cenereus	23.20
Harpodon nehereus	14.77
Pangasius pangasius	4.64
Osteogehesis militaris	3.08
Pama pama	2.62
Sillaginopsis panijus	1.77
Arius Caelatus	1.20
Scoliodon walbeehmi	0.74
Trichiurus hanmela	0.45
Tachysurius gadora	0.37
Polydactylus indicus	0.32
Prawns	
Palaemon temuipes	1.49
Macrobrachium mirabilis	1.23
Palaemon styliferus	0.29
Parapenaeopsis sculptilis	0.26
Palaemon sp.	0.14

Source: Kibria and Rainboth, 1978 (data unpublished).

Table 1.3.3

**Comparative statement of species-wise catch of mechanised
boats at Cox's Bazar (% of weight)**

Name of species	1967-68	1968-69	1969-70	1970-71	1971-72
Hilsa ilisha	12.75	14.40	24.00	30.24	31.52
Hilsa kanagurta	05.62	04.20	08.10	07.30	05.70
Stromateus cinereus					
Stromateus chinensis					
Parastromateus niger	09.83	03.80	11.20	12.74	08.18
Cybiurn guttatum	20.80	15.60	14.00	10.21	10.00
Chirocentrus dorab	08.05	07.00	06.20	06.78	07.51
Chorinemus lysan	03.50	06.90	03.20	02.80	04.80
Jew fish	01.30	03.30	01.40	01.31	03.16
Sharks and Rays	14.75	14.70	04.90	00.84	00.30
Others	23.40	30.10	27.00	27.77	28.83
Total	100.00	100.00	100.00	100.00	100.00
Total catch (tons)	467	685	607	594	574

Source: BFDC

1.4 Commercial catch and effort data

Fishing effort can be described and measured by the following (Chong, 1979) :

- (a) Types and number of boats and their capacities (length).
- (b) Types and number of gear and their catching power.
- (c) Number and skill of fishermen.
- (d) Time spent in fishing.

1.4.a *Types and number of boats*: A survey carried out by BFDC (Bangladesh Fisheries Development Corporation) in collaboration with FAO/UNDP in 1967-68 indicated that about 9,563 sail boats and 41 mechanised boats were employed in the marine small-scale fisheries all along the coast of the country of which 2,170 were simple dug-out canoes and others were planked vessels of different types. Mechanization programmes became popular and at present about 1,400 mechanised boats operate all along the coast of the country but largely from bases at Cox's Bazar and Chittagong (Ali and Haque, 1980).

Another survey conducted by BJMSS (Bangladesh Jatiya Matshayajibi Sambaya Samity-Bangladesh National Fishermen's Cooperative Society) in 1974-75 gave an estimate of 45,199 non-mechanised boats and 1156 mechanised boats operating in the estuarine and marine waters (Table 1.4.1).

Table 1.4.1
Statistics of fishing crafts used in estuarine and coastal fishing

Fishing implement	1967/68 ¹	1974-75 ²
<i>Boats</i>		
Total number	9563	46,355
Dugouts	2170	45,199
Planked boats	7352	
Motorized boats	41	1,156
<i>Trawlers</i>		
25-50 ft.		3
51 -70 ft.		4
71-100 ft.		4
Above 100 ft.		9

- Note:* (1) Data relates to marine fisheries only.
 (2) Data relates to both estuarine and marine fisheries.
 (3) 1976 figures.

Source: BFDC and BJMSS

1.4.b *Types and number of gear and their catching power*: Six types of gear (gillnets, castnets, stakenets, setbag nets, seines and long lines) are used in the small-scale coastal fishery, of which setbag nets (*Behundi*) and stakenets (*Funda*) are largely used. All the six types contribute to a total of 22,905 pieces of different gears as detailed in Table 1.4.2. Among the gear types, setbag was found to be the most important fishing gear yielding more than 42% of the total marine catch. Set and drift gillnets were responsible for 33%, while seine nets, longlines, and castnets account for 7%, 6% and 6% respectively.

According to the survey conducted by BJMSS in 1974-75, a total of about 758,497 pieces of different types of nets are being used to fish in the riverine, estuarine and coastal areas of Bangladesh.

Table 1.4.2
Statistics of Gear used in coastal fishery

Fishing implements	1967 /68 pieces of gear	Total catch (tons)	Percentage of total catch
Gear Total	22,905	93,119	100.0
Gillnets	4,878	32,670	35.1
Setbag nets	4,808	41,580	44.6
Cast nets	4,906	5,643	6.0
Seine nets	2,601	7,227	7.8
Longlines	2,215	5,940	6.4
Miscellaneous	3,497	59	0.1

Source; BFDC and BJMSS

The catch figures per fishing unit per day are not available for the coastal fishery. However, some data from the Feni river estuary and Halda-Karnafuli river estuary are available from the survey results of the Irrigation Fishery Development Project of the Directorate of Fishery under the "Fishermen Economic and Catch Assessment Programme" (Table 1.4.3).

Table 1.4.3
**Commercial catch and effort data of the
Feni and Karnafuli river estuary (1967-68)**

	Average daily catch (kg) per fishing unit	Hrs. per day	Fishing effort		Species composition	
			Days per week	Weeks per year		
Feni	9.79	7.0	6.56	38.08	Hilsa ilisha	71%
					Macrobrachium sp.	17%
					Setipinna sp.	2%
Karnafuli	6.13	11.10	6.33	44.33	Macrobrachium sp.	76.6%
					Miscellaneous varieties	23.4%

Source: Morris, 1977

1.5 Resources Survey by National/International Agencies

Several surveys have been conducted to estimate the resource potential of the Bay of Bengal. These are :

- (1) Japanese research vessel Chosuimaru belonging to the Fisheries Training School of Nagasaki prefecture, Japan, in November-December, 1958.
- (2) Japanese research and survey vessel Kagawamaru in the first three months of 1960.
- (3) Investigation by Japanese vessel Kinkimaru during December 1961 to December 1965.
- (4) The research vessel Anton Brunn visited the Bay of Bengal in April 1963, in connection with the international Indian Ocean Expedition.
- (5) The research vessel Jalwa of the then Pakistan Marine Fisheries Department with the help of a FAO expert under the technical assistance programme from 1962-1966.

- (6) Pre-investment survey by research-cum-survey vessel *Sagar Sandhani* and *Meen Sandhani* under the United Nations Special Fund Assistance (1968-1971) known as FI: SF/PAK-22(FAO).
- (7) U.S.S.R. research vessel *Lesoni* from November 1969 to January 1970.
- (8) investigations by U.S.S.R. research vessel *Tamanog* and *SRTM 8-449* from June, 1972 to November 1972.
- (9) *R. V. Fisheries Research 2* of Thailand from 7th March to 19th March, 1979.
- (10) *R. V. Dr. Fridtjof Nansen* under FAO/NORAD Programme during November-December, 1979.

Among the surveys that have been conducted, the most comprehensive one was the UNSF/PAK-22 Project conducted by Bangladesh Fisheries Development Corporation in collaboration with FAO/UNDP (1968-71). The survey covered an area of about 26,000 km² mostly north of latitude 20°40'N (St. Martin's Island).

As a result of this survey three major fishing grounds could be charted in the Bay of Bengal viz. (1) South Patches (6,200 sq.km) lying between 20.8°N - 21.4°N and 90°E - 91°E; (2) Middle Ground (4,600 sq.km) between 20.82°N - 21.65°N and 91 °E - 91.8°E; (3) Swatch of no ground (3,800 sq.km) between 21 .0°N - 21.65°N and 89°E - 90°E (Illus. 2). Of the three fishing grounds, the South Patches was found the most productive with an estimated standing stock of 11.4-16.0 ton per square mile followed by 10.2-1 4.4 ton in the Swatch of no Ground, and 8.4-1 2.0 ton in the Middle Ground (Table 4.2).

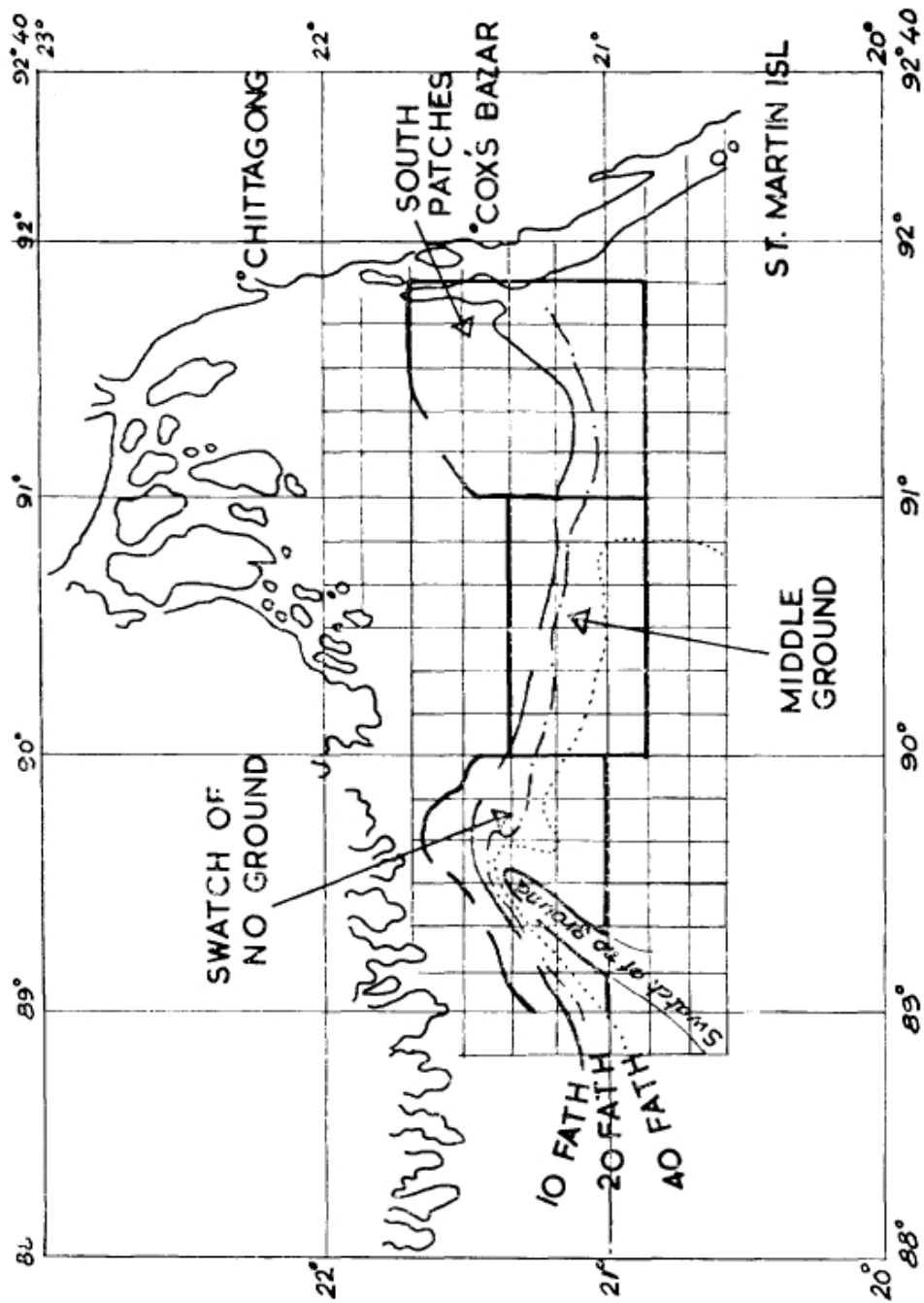
Another survey was undertaken by Norwegian research vessel *Fridtjof Nansen* during November-December 1979 which covered the area between 10 m and 200 m depth of the Bay of Bengal. According to this survey the shelf area of Bangladesh is estimated to be about 40,000 km² (10 m - 200 m depth) as shown in Table 1.5.1.

Table 1.5.1
Area of the shelf of Bangladesh (km²)

Depth zones	Area
10-24	8,400
25-49	4,800
50-74	5,580
75-99	13,410
100-199	10,250
Total	42,440

Source: Chowdhury *et al.* (1979)

The maximum average catch rates of 672 kg/hr occurred during this survey at 50-74 m depths. The highest densities of demersal fishes were observed off Cox's Bazar at 20-30 m depths and along the north eastern edge of Swatch of no Ground between 60 and 100 m depths. The dominant species in the area off Cox's Bazar were catfish and Bombay duck, *Harpodon nehereus*. In the depth zone 10-24 m, the catches were dominated by croakers, *Scianidae* sp., catfish and Bombay duck. Catfish and croakers were also among the important species at the 25-49 m depth zone. At 50-74 m depth, catfish contributed about 75% of the catch. This was mostly due to one large catch of 4000 kg/hr. At 75-99 m depth, the contribution of catfish to the total catches decreased sharply and the most important species appeared to be threadfin bream, *Nemipterus japonicus*, followed by bigeye, *Priecanthus hamrur*, and lizardfish, *Saurida* spp. At depths deeper than 100 m, these species also dominated the catches.



ILL 2 MAIN FISHING GROUNDS IN THE BAY OF BENGAL

The highest concentrations of pelagic fishes were found in approximate position N 20°15', E 91°20', which consisted of Indian mackerel, *Rastrelliger kanagurfa*. At depths of 10-24 m, most of the pelagic fish catches consisted of members of the clupeidae and Engraulidae families with *Sardine/a fimbriata* and *Setipinna taty* as dominant species. The most abundant species down to 75 m depth was *Carangoides malabaricus* while round scad, *Decapterus maruadsi* were dominant at 75-100 m. At depths deeper than 25 m, *Ilisha megaloptera* dominated catches of the clupeidae family. The most abundant species of the Scombridae and Leiognathidae families were *Rastrelliger kanagurta* and *Leiognathus bindus* respectively. Lantern fishes of Myctophidae dominated the pelagic trawl catches over bottom depths of more than 150 m.

The survey indicated that the standing stock of demersal fishes off Bangladesh is 150,000 tons and of pelagic fishes about 60,000 tons. The estimate is probably too low, as a large part of the shelf which is shallower than 10 m was not surveyed.

1.6 Organic productivity

Data on the organic productivity is not available as no surveys were made to determine the productivity of the Bangladesh coast.

2. Methodology for collection of catch statistics and the organisational set-up for collection and processing of catch statistics

The Directorate of Fisheries and the Fisheries Development Corporation are responsible for development, management and conservation of the fishery resources of Bangladesh. But no systematic method has so far been employed by these organisations for collection of catch statistics of the country. However, data on fish catch and landing for some particular fishery or region are collected by these organisations on a regular basis or on a sampling basis. Fish landing at Cox's Bazar from the catch in coastal waters and the Hilsa landing at Chandpur and Goalando are recorded regularly by the BFDC and the Directorate of Fisheries respectively. The catches of trawlers operated by BFDC in the Bay of Bengal are recorded and processed. Besides, catch statistics are sometimes collected for specific fisheries or regions from the study of fishing gear on sampling basis.

3. Catch Statistics with reference to species, seasons, areas, types of vessels and areas and fishing effort in hours

3.1 Catch statistics with reference to vessels and effort: According to the survey made by *Jalwa* (76 feet) in the Bay of Bengal (3-32 fathom), the catch per haul per hour along with the catch composition during the year from 1963-1966 for all seasons of the year, is as follows :

Table 3.1 .1
Catch rates of "Jalwa"

Year	Maximum catch per haul	Average catch per hour	Species composition
1963-64	1800 kg	125 kg	Catfish - 30 %
1964-65	2500 kg	190 kg	Sharks, skates - 16 %
1965-66	1010 kg	90 kg	Jew fish - 15 %
			Salmon - 14 %
			Ribbon fish - 07 %
			Bombay duck - 06 %
			Eel - 04 %
			Croakers - 04 %
			Pomfrets - 02 %
			Miscellaneous - 02 %

According to another survey by the vessel *Sagar Sandhani* (30 m) in Bay of Bengal during 1967 to 1971, an average landing of 35 kg per hour with a maximum of 450 kg per hour were recorded. The catch composition of the survey is given in Table 3.1.2.

Table 3.1.2
Catch composition of "Sagar Sandhani"

Indian salmon (<i>Polynemus indicus</i>)	- 8.1%
Eels	- 3.2%
Bombay duck (<i>Harpodon nehereus</i>)	- 11.0%
Cat fish (<i>Tachysurus</i> sp.)	- 11.0%
Sharks, rays, etc.	- 16.0%
Pomfrets	- 6.0%
Snappers	- 2.0%
Shrimp	- 0.7%
Miscellaneous	- 24.0%

Source: **Zobairi (1970)**

The survey conducted by Fridtjof Nansen employed both bottom and pelagic trawls.

Table 3.1.3 gives the average catch rates with bottom trawls at different depth zones. The maximum average catch rate of bottom trawl occurred at 50-70 m depth, reaching a value of 672 kg/hr. There was an abrupt change in the catch rate at a depth of more than 100 m which corresponded to the sharp decrease in oxygen content. The highest catch rate 4000 kg/hr was obtained with catfish, *Arius thalassinus*. Also the threadfin bream, *Namipterus japonicus*, contributed significantly to the higher catch rates.

The catch rates with pelagic trawl were Usually lower, varying between 10 and 100 kg/hr. The maximum catch rate was 170 kg/hr, of which the major contribution was the anchovy, *Stolephorus* sp.

Table 3.1.3
Distribution of average catch rates (kg/hr) from bottom trawl at different depth zones

No. of trawling stations	9	10	11	14	15
Depth zone	10-24	25-49	50-74	75-99	100-150
Pelagic fish	71.0	58.3	123.0	194.2	0.1
Demersal fish	173.5	185.3	537.6	258.8	13.7
Sharks/rays	18.4	3.7	7.3	2.5	—
Crustaceans	4.7	13.9	2.3	12.0	5.5
Squids	1.1	4.9	1.7	5.0	—
Total	268.7	266.1	671.9	472.5	19.3

Source: **Chowdhury et al. (1979)**

Of the seven longline operations that were carried out at depths between 10 and 95 m, the maximum catch was 12 kg/100 hooks.

3.2 *Catch composition with reference to gears.* The catch data relating to gear types particularly from the coastal areas of Bangladesh are not available.

4. Method of stock assessment employed, if any, and the results obtained

Several surveys have been made to assess the standing stock of finfishes and shellfishes in the Bay of Bengal by national/international agencies. But all the previous surveys were designed mainly for demersal fish and were mostly limited to day time. The previous surveys were made without considering the potential catch of pelagic fish. The available information of present standing stock of fish and shellfish of the Bay of Bengal are presented in Table 4.1 .1.

Table 4.1 .1
Estimates of present standing stock of finfishes and shellfishes in the Bay of Bengal (in thousand tons)

Demersal	Pelagic	Crustacean	Others
264-373@	200*	9@	25+

Source: @ West (1973)
* Karim (1978b)
+ Anon (1974b)

The survey conducted in 1967-71 under UNDP/FAP Project PAK-222 made an estimate of the standing stock of demersal fishes of the Bay of Bengal by using the following formula.

$$\text{Size of standing stock} = \frac{A \times C}{a}$$

where : A := total area under survey
a = area covered by trawl in one hour
C = catch per hour of trawling

The details of the estimates are furnished in Table 4.2.1.

The Irrigation Fisheries Development Project of the Directorate of Fisheries undertook a comprehensive programme on stock assessment during 1977-79 on the different habitats and as a part of this programme, the standing crop of ichthyomass (both finfish and shellfish) in terms of kilogramme per haul was determined for the Meghna river estuary and the Bay of Bengal. The results obtained are given in Table 4.3.1.

Table 4.2.1

Estimates of the standing stock of demersal fish in Bangladesh continental shelf waters

	South Patches and adjacent coast areas	Middle Ground	Swatch of No Ground	All Areas investigated	Total Shelf Area
Average catch/hr (kg)	522	388	468	447	447
Area under survey (square miles)	3000	1800	1600	11400	27000
Average trawling speed (knots)	3.5	same	same	same	same
Effective opening width between danlenos or swivels (feet)	85-120	same	same	same	same
Area covered by net in one hour (square miles)	0.0648 - 0.0914	same	same	same	same
Standing stocks (x 10 ³ tons)					
(i) assuming no escapement	17.1 - 24.2	7.6 - 10.8	8.2 - 11.6	54.8 - 78.6	132.0 - 186.3
density/square mile (tons)	5.7 - 8.0	4.2 - 6.0	5.1 - 7.2	4.9 - 6.9	4.9 - 6.9
(ii) assuming 50 per cent escapement	34.2 - 48.4	15.2 - 21.6	16.4 - 23.2	111.6 - 157.2	264.0 - 372.6
density/square mile (tons)	11.4- 16.0	8.4 - 12.0	10.2 - 14.4	9.8 - 13.8	9.8 - 13.8

Source: West (1973)

Table 4.3.1

Average standing crop (kg per ha) of the Meghna river estuary and the Bay of Bengal during March and April 1978

Stations	Standing Crop
<i>Meghna river estuary</i>	
Gazipur	9.35
Hatila	1.65
Sandwip	0.70
<i>Bay of Bengal</i>	
Off Karnafuli river mouth	2.46
Off Kutubdia island	14.55
Off Cox's Bazar	9.23

Source: Kibria and Rainboth, 1979 (data unpublished)

The survey made by *Fridtjof Nansen* estimated the abundance using the average catch rates on the assumption that catch per effort is a function of the stock density. The fish density was obtained from the mean catch rates and the areas swept by the trawl. The biomass of demersal fish calculated from bottom trawl catches is shown in Table 4.4.1

Table 4.4.1

Biomass of demersal fish calculated by means of bottom trawl catches

Depth zones (m)	Density (kg/km ²)	Stock (tonnes)
10-24	2082	17489
25-49	2223	10670
50-74	6451	35997
75-99	3105	41638
100-150	164	1681
Total		107475

$$B = \phi^p A^d A = C.M.A.$$

where B is the demersal fish biomass,
 PA the fish density expressed in weight per unit area,
 C is a conversion coefficient
 M is the average integrater reading, and
 A the corresponding area.

The numerical value of C applied in these calculations was: $C = \frac{L}{b}$ tons/mm.(n.m.)², where

L is the average length in cm.

An average length of 25 cm was chosen as a whole for the demersal stock which gives $C=5$ tonnes/mm (n.m.)². Under this assumption, the acoustic abundance estimated was about 40,000 tonnes. However, the acoustic estimate of demersal fish will usually be an underestimate (Chowdhury et al., 1979) due to the limitation of the echo sounder and integrator in making recordings very close to the bottom. The abundance of demersal stock off Bangladesh was suggested to be about 150,000 tonnes, and of pelagic fish, 60,000 tonnes.

5. Basic biological characteristics of major exploited coastal fishes and shrimps

5.1 *Hilsa ilisha* (Sable fish, River shad, *Ilish* or Hilsa): It is a medium sized (up to 60 cm) planktonivore, essentially an estuarine fish but it is abundantly caught in the Meghna, the Padma and some other rivers in Bangladesh. It shows a typical anadromous, migratory pattern ascending major rivers for spawning. It migrates to fresh water in two runs, in monsoon and in winter. The area from Chandpur to Hatia and Chandpur-Goalandu are the major Hilsa fishing grounds. Mature fishes are mostly caught in the Meghna and Padma rivers from middle of May to middle of October. The fingerlings, *Jatka*, are caught in the rivers Buriganga, Sitalakhya and Meghna from January to June. The growth rate of the species is more rapid during the hot season than in winter. Fry increases in length one inch per month. It generally attains maturity at the age of two years. It feeds on zooplankton and phytoplankton. From the rivers Meghna and Padma, *Hilsa* sp. are being caught by mainly *Chandi jal* (drift gillnet) and by *Shanla jal* (clapnet), *Kona* and *Bundh*. Each individual of *Hilsa* may carry 2,34,170 to 15,77,600 eggs (Hussain, 1971 ; Anon., 1974a ; Rainboth, 1978b).

5.2 *Hilsa kanagurta* (Sea shad or *Chandana ilish*): This fish almost resembles *H. ilisha* but it inhabits only the marine environment with its spawning and feeding ground in the sea. It grows to a maximum size of 52 cm. This fish is caught in large commercial quantities from the coastal waters of Bangladesh, particularly offshore waters of Cox's Bazaar. Different varieties of gillnets and local purse-seine nets are used to catch this fish (Hussain, 1971).

5.3 *Harpodon nehereus* (Bombay duck or *Loitta*): This fish is small to medium-sized (maximum 40 cm), a predator-cum-scavenger which ascends to the upper part of the estuarine zone. It is one of the important fishery species of the upper Bay of Bengal. The fish is caught in good quantities from the shallow waters of the estuaries, mainly in the river mouths by trawl and *behundi* nets. (Hussain, 1971 ; Rainboth, 1978a).

5.4 *Tachysurus* sp. (Catfish or *Kata machh*): This species is purely a marine form and found in large quantities in the estuaries and adjacent offshore waters. *Tachysurus thalassinus*, also called giant catfish, grows to a maximum of 150 cm. This is one of the important commercial species of the Bay of Bengal, caught by trawl nets (Hussain, 1971 ; Rainboth, 1978b).

5.5 *Polynemus indicus* (Indian salmon or *Lakhua*) : One of the most abundant commercial marine species which is caught in large quantities from "South Patches", "North Patches", and "Swatch of No Ground" areas by trawl nets and from the shallow estuarine waters by fixed gillnets. Average size of the species is 70-80 cms and the maximum size recorded is 142 cms (Hussain, 1971 ; Rainboth, 1978b).

5.6 *Lates calcarifer* (Cock-up or *Bhekti*): This is a large predatory fish, grows to 180 cms (6 feet) length and may weigh 90 kg (200 lbs). It frequents the mouths of rivers and occasionally ascends them for fair distances. It is usually taken by gillnets in good quantities from the near-shore shallow estuaries and river-mouths at depths up to 4-5 fathoms especially around Hatia, Barrichar, Rabnabod and Sandwip Islands. The species spawns in the high saline zone of the estuary from May to October and feeds on fishes, shrimps, snails and worms (Hussain, 1971 ; Rainboth, 1978b).

5.7 *Rastrelliger kanagurta* (Indian Mackerel or *Champa*): It is one of the most abundant commercial species of the Bay of Bengal. It is a column feeding planktonivore. Maximum size of the species is recorded at 35 cm length, but the most common size is 20-25 cm. The species is caught mainly by gillnets and purse seine nets (Jhingran, 1977).

5.8 *Palaemon (Exopalaemon) Styliforus (Gura chingri)*: It inhabits shallow coastal waters and brackishwaters of the estuaries. The maximum size of the species recorded is 100 mm. The breeding period extends from October to July. Hatching of the species occurs in the more saline zone of the estuary or inshore waters (Kibria, 1980).

5.9 *Penaeus indicus* (Indian prawn or *Chapda chingri*): The adults inhabit the sea, whereas fry and juveniles are carried into the estuary and inshore waters by the tide/current. It is the most important species of shrimps, on account of its great abundance both in the estuarine and open waters. It is a bottom feeder and omnivorous. The species is reported to have a deep water spawning habit (Kibria, 1980).

5.10 *Penaeus monodon* (Tiger prawn or *Bagda chingri*): This is a large 300 mm fish and one of the most important commercial shrimps of Bangladesh. Fry are reported to be available the year round from the estuarine area of Bangladesh. Adults and mature specimens are abundantly available in the Bay of Bengal off Cox's Bazaar. The species is omnivorous and a bottom feeder. The breeding period of the species extends from January to April. The spawning ground of the species seems to be the offshore of Cox's Bazaar. Chakria-Sundarban and Khulna-Sundarban estuaries are known as the main seed collecting centres in Bangladesh (Kibria, 1980).

5.11 *Metapeneus monoceros* (Sand shrimp or *Honye chingri*): It inhabits sea and brackish-water zones of the estuary. Juveniles are found in estuaries and backwaters of reduced salinity; adults occur in the sea. The species is reported to breed throughout the year with two peaks, one in July and August and the second in November and December. The adults are generally available in the sea in slightly deeper waters than the other species of *Metapenaeus*. It is recorded to grow up to 155 mm from Bangladesh waters (Kibria, 1980).

6. Yield trends over the years against fishing effort

Real statistics of fish production in Bangladesh are not available. Fishing activity is extremely scattered and varied, and there is no built-in method for collection of catch and effort data. Nearly all the marine catch is harvested from the coastal and estuarine waters by small-scale fishermen, and it is very difficult to get actual production data. However, different agencies have estimated the production figures of both freshwater and marine fish. Available production statistics are furnished in Table 6.1 .1.

Table 6.1 .1

Estimates of marine fish catch in Bangladesh (in thousand tons)

	1960	1962-63	1965	1967-68	1971	1972-73	1973	1974	1975	1978
Marine	55.4	55.0	66.9	99.0	63.0	90.0	85.0	90.0	90.0	100.0
Freshwater	—	—	—	—	—	732.0	—	734.0	732.0	—

Source: + Karim (1978)

* Anon (1974b)

The above estimates are of a conjectural nature rather than based on actual field surveys. However all the estimates consistently indicate that 80-90 per cent of the total catch is the contribution of inland waters, According to the nutrition survey carried out during the year 1962, fish production has been estimated at 677,000 tons. The scientists are of the opinion that fresh water fish production has either declined or at best remained static since 1962 due to various reasons. Marine catch, is however, estimated to have increased about two-fold. A survey conducted by the Bangladesh Fisheries Development Corporation (BFDC) in 1967-68 under FAO guidance

estimated the marine fish catch (excluding the estuarine catch) at approximately 99,000 tons. The district of Chittagong contributed the most to the total marine catch accounting for 70 per cent of the total marine harvest. The rest comes from Noakhali, Barisal, Patuakhali and Khulna districts.

Ninety five per cent of the total marine catch is harvested from nearshore water by small-scale fishermen, fishing with or without boats. Presently 3-4 per cent of the total marine catch is harvested from the deeper waters by trawlers operated by BFDC and a few private parties, Year-wise landings of marine fish by BFDC trawlers are furnished in Table 6.2.1.

Table 6.2.1
Marine fish landings by BFDC trawlers

Year	No. of trawlers in possession	Catch in tons
1972-73	11	4766
1973-74	11	2616
1974-75	14	4049
1975-76	14	1218
1976-77	14	1356
1977-78	10+ 7*	1400
1978-79	8+ 7*	1100
1979-80 (up to March)	10+ 7*	1377

Source: BFDC

*Thailand vessels referred to in Table 1 .1.1

The catch rates from October to January as worked out from the BFDC trawler operation are presented in Table 6.3.1.

Table 6.3.1
Average catch rates per hour: BFDC trawlers of various sizes
(Catch rates in kg. per hour)

Year	Trawler size — in metres					
	54	44	30	27	18	17.5
1972-73	559	542	—	329	—	—
1973-74	262	378	—	222	—	—
1974-75	331	288	319	171	155	89
1975-76	238	251	292	123	93	67
1976-77	212	327	281	183	88	49
1977-78	255	193	171	50	135	42
1978-79	—	299	299	134	169	87

Source: BFDC

The catch from the Cox's Bazar coastal region by the indigenous and mechanised boats with gillnet are landed in the BFDC landing centre and in the municipal landing centre on Cox's Bazar. Year-wise landing of the mechanised boats at the landing centre are furnished below in Table 6.4.1.

Table 6.4.1

Mechanised boat landings at Bangladesh Fisheries Development Corporation terminals at Cox's Bazar

Year	Quantity (tons)
1967-68	467
1968-69	685
1969-70	607
1970-71	594
1971-72	574
1972-73	1470
1973-74	1426
1974-75	1297
1975-76	1352
1976-77	1133
1977-78	1467
1978-79	925

Source: BFDC

Detailed qualitative, quantitative and statistical analysis on the gillnet catches of the mechanised boats landed at the Bangladesh Fisheries Development Corporation fish landing terminal at Cox's Bazar has been made under the Pre-Investment Survey Scheme of Bangladesh Fisheries Development Corporation during the years 1967-68 to 1971-72. A comparative statement of details of the above analysis is given in Table 6.5.1.

Table 6.5.1

Analysis of gillnet catch: Mechanised boats at Cox's Bazar

Particulars	1967-68	1968-69	1969-70	1970-71	1971-72
Average number of boats operated per day	32	42	29	29	41
Average number of fishermen	5.00	3.63	5.11	4.97	4.96
Average number of nets per boat	13	10	13	13	12.48
Average weight of nets (lbs) per day	221	170	221	221	221
Number of days counted for fishing	212	212	212	184	243
Actual number of fishing days	176	176	171	153	143
Annual total catch (kg)	466,660	684,200	607,400	594,346	574,100
Total catch per fishing day (kg)	2,561.5	3,887.5	3,582	3,884.6	4,014.7
Catch per boat per day (kg)	82.86	92.81	119.78	107.7	38.64
Catch per net per day (kg)	6.37	9.28	9.21	8.3	7.58
Catch per lb net per day	0.37	0.54	0.54	0.49	0.45

Source: BFDC

From Table 6.3.1 and Illustration 3 it appears that the catch per hour of trawling for different sizes of trawlers has significantly dropped in 1973-74 and thenceforth it is maintaining a more or less static level. The total catch of the BFDC trawlers shows a gradual decrease from 4766 tons in 1972-73 to 1100 tons in 1978-79, in spite of increasing the number of trawlers. A survey conducted by R.V. *Dr. Fridtjof* Nansen under the FAO/NORAD Programme over the entire Bay of Bengal in November-December 1979 gives a catch rate of 390 kg per hour (including trash fish). Another survey conducted in the Bay of Bengal by a Thai fishery research vessel under the Bangladesh-Thailand Agreement on Co-operation in Fisheries during March 7-18, 1979, yielded a catch of 649 kg per trawling hour, more than 50% of which comprised trash fish. The catch rate of good fish amounted to 325 kgs. The catch per trawling hour as estimated by these surveys is in close conformity with the catch of BFDC trawlers with reference to time and size of the trawlers. The reasons for the sudden fall in the catch rates in 1973-74, followed by a more or less static position thereafter, have not been investigated. This may be attributed to a decrease in gear efficiency or to change in stock abundance due to the effects of environmental factors. However, a systematic and exhaustive study of population dynamics of the fish and shellfish is very much needed to ascertain the status of fish stock so that the maximum sustainable yield can be obtained from the Bay.

The landings at Cox's Bazar from the catches in coastal waters near Cox's Bazar by mechanised boats over the period from 1967-68 to 1971-72 (Table 6.4) show that the catch increased suddenly to about 2½ times in the year 1972-73 and remained more or less in that state up to 1977-78, followed by a decrease in 1978-79. Total effort employed during this period is not available. So it is difficult to identify the reason for these trends in the catch. However, the increase and the fluctuations in the catch since 1972-73 may be due to addition of more fishing effort or due to changes in stock abundance affected by environmental factors.

7. Conclusion

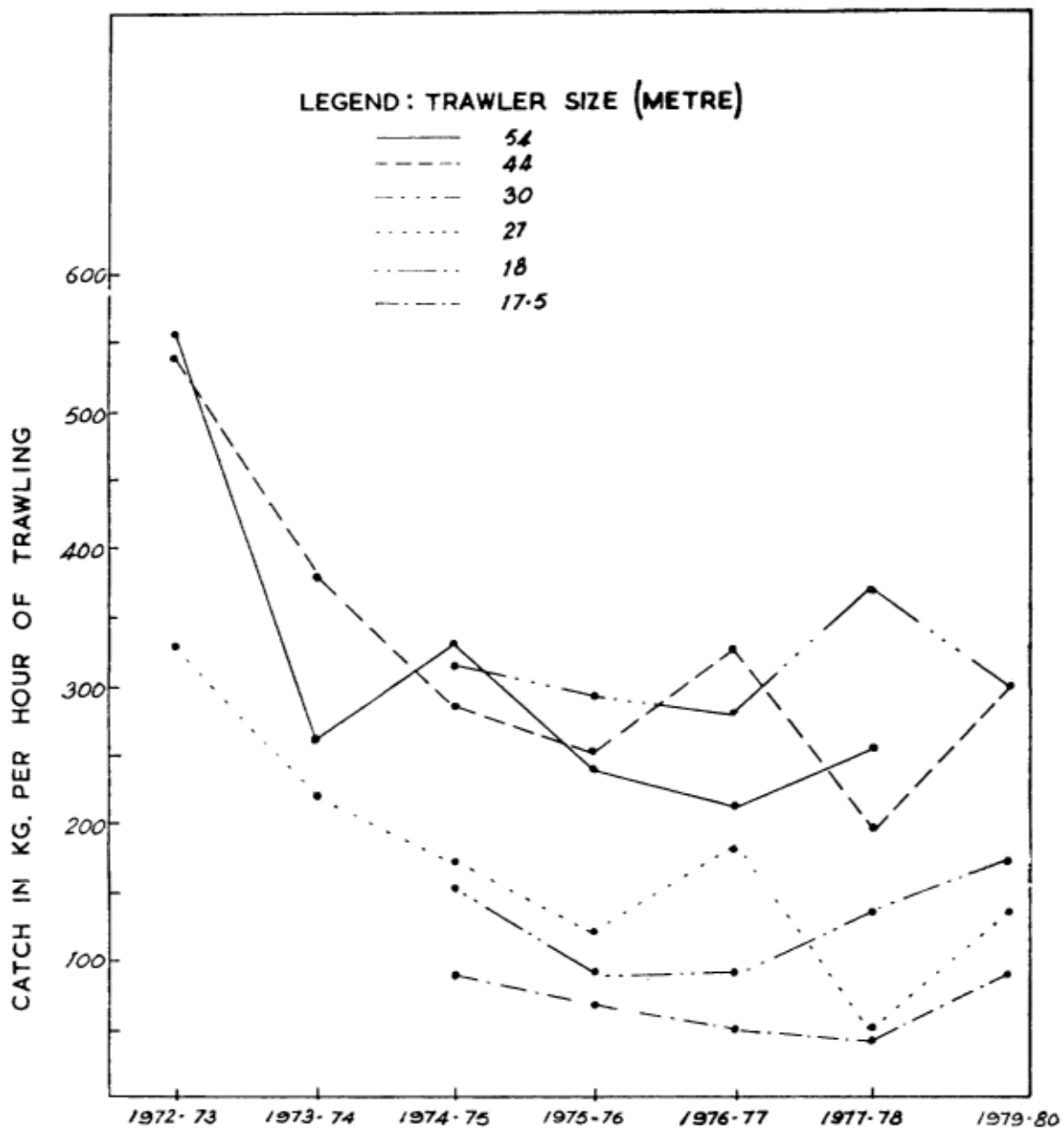
(Problems/constraints and solutions) : Information on fishery resources essential for management and development of coastal fishery is lacking. There is no built-in method for recording catch and the importance of statistics is inadequately appreciated.

Due to inadequate manpower, financial and other facilities, no programme exclusively for fishery resources survey and monitoring resource information in inland and marine waters, could be undertaken and as such no comprehensive data on fisheries resources could be built up in the country. However, the Directorate of Fisheries, BFDC and BJMSS have from time to time undertaken programmes for collection of fisheries statistics for some specific purpose from particular areas of the country but the reliability of this data is, perhaps, below the acceptance level due to various reasons, such as,

1. Shortage of adequate skilled manpower.
2. Shortage of transport for collecting fisheries statistics from the river, coastal zone and remote areas of the country.
3. Fishing activity is extremely scattered and varied and there are no specific fish landing centres in most areas and as such it is very difficult to put the fishing activity under a system for collection of data.
4. It is very difficult to collect actual information by interviewing the people concerned who generally conceal actual information out of fear of being taxed.

For assessment of standing stock of the Bay of Bengal, a number of exploratory surveys have been undertaken during the last decade but the investigations were restricted mostly to shallow water for part of the year from September to May and the areas investigated may not be more than one third of the continental shelf of Bangladesh.

Therefore, the need for undertaking surveys on the remaining portion of the shelf as well as in the deeper waters all round the year for assessment of fishable stock, studies on biological characteristics of the fish and shellfish, on organic productivity and on environmental parameters has been recognized. For the purpose of collecting and processing fisheries resources statistics,



ILL-3 CATCH PER HOUR OF TRAWLING BY DIFFERENT SIZES OF TRAWLERS OVER THE PERIOD FROM 1972-73 TO 1978-79

it is most essential to set up a separate division under the Directorate of Fisheries exclusively for assessment of fish stock in different habitats so as to facilitate proper planning of fisheries development programmes in the country. Skills of manpower as are now available under the Directorate of Fisheries and the BFDC may be utilized to initiate the programme. The remote sensing technology by Landsat may be used for assessing and monitoring oceanographic parameters in turbidity, up-welling zone and chlorophyll content. Skills and facilities in this field are also available in the country.

Under the programme, provision has to be made for adequate manpower, their training and other necessary inputs. Still there may be problems in getting actual data from the people concerned. However, this situation may be improved by tactfully convincing the people, providing them with help in the form of loan, fishing equipment, including mechanized boats, technical know-how, marketing facilities so that they can get actual value for their catch. Landing facilities are to be created where necessary so that landing data can be easily collected. For monitoring statistics of fish catch, effort and socio-economic conditions of the fishermen, regulation must be made to register each and every fishing unit of the country, but as the fishermen are illiterate it will not be possible to get the proforma filled by them for daily catch and other information. About 95% of the total marine catch is contributed by the small-scale fishermen of the coastal areas of the country. The fisherfolk in this country are generally poor and very little attention was given previously for improvement of their socio-economic condition. With the improvement of their fishing equipment and other facilities, the catch may be increased from the coastal waters. It is therefore necessary to provide the fishermen with equipment such as mechanized fishing boats, nets, twine, life safety measures, etc. so that the fishing efficiency is increased.

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