

INTEGRATED RESOURCE DEVELOPMENT
OF THE SUNDARBANS RESERVED FOREST

FAO/UNDP PROJECT

BANGLADESH

REPORT

ON

FISHERY HARVESTING AND MARKETING

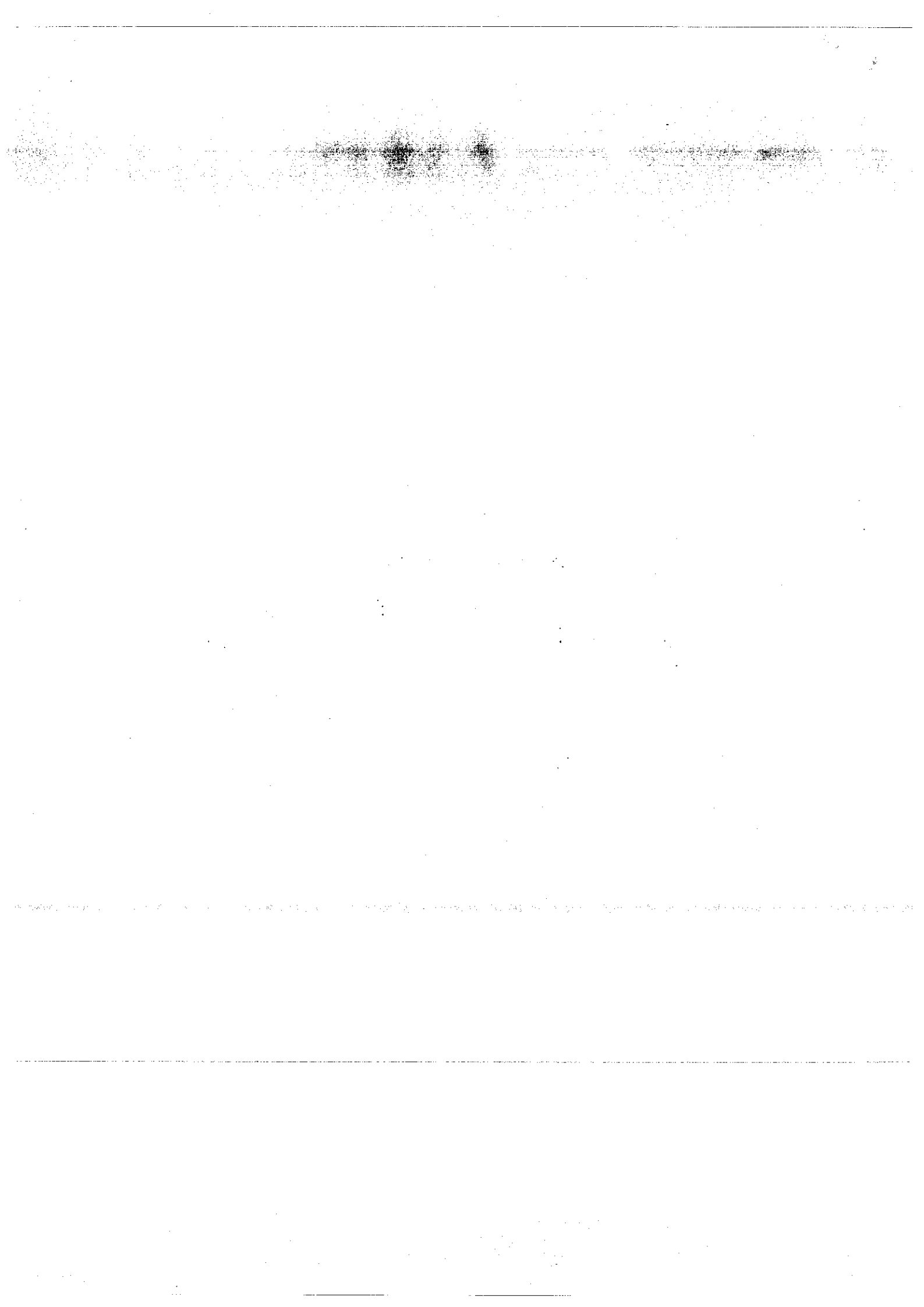
by



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PREFACE

The Consultant was appointed to the BGD/84/056 UNDP/FAO for a period of six weeks effective from May 2, 1995.

The Sundarbans fishery constitutes a year-round fishery within the SRF area and a seasonal fishery between October and February, outside the SRF in marine waters, popularly known as Dubla Island fishery, which contributes around 70 percent of the total harvest.

The Consultant's assignment fell beyond the period of main fish harvesting and marketing season, needed information was not possible to collect from the fish harvesting and marketing sites, nor were the facilities made available to visit those sites in the Sundarbans.

The report prepared based on interim report left by the former Fishery Harvest and Marketing Specialist and also the reports of other Consultants of the Project BGD/84/056, and the studies undertaken by the Scientists of the Department of Fisheries, especially the Marine Fisheries Survey Management and Development Project, and by the Consultant while he was in active service with the Department of Fisheries and thereafter when he worked as Fisheries Expert under South-West Area Water Resources Management Project (FAF4).

The report represents the fish Harvesting and Marketing of the Khulna-Sundarbans fishery in general and Sundarbans fishery in particular. This report focusses on the different parameters of fish harvesting and marketing, past and present status with recommendations for further development, including socio-economic conditions for the fishermen involved.

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EXECUTIVE SUMMARY

1. The common commercial species of fish and shellfish harvested are Hilsa (*Hilsa ilisha*), Ribbonfish (*Lirichirus spp*), Seabass (*Lates calcarifer*), Catfish (*Pangasius pangasius*), White Grunter (*Pamadasys hasta*), Silver Jewfish (*Lohnilus argentatus*), Sole fish (*Cynoglossus spp*), Mullet (*Mugil spp*), Sharks (*Scoliodon spp*), Bagda chingri (*Penaeus monodon*), Chamma chingri (*Penaeus indicus*), Lallia chingri (*Metapenaeus monoceros*), Kucho chingri (*Metapenaeus brevicornis*) and Golda chingri (*Macrobrachium rosenbergii*), Mud crab (*Scylla serrata*), Giant oyster (*Crassostrea gigas*) and Gastropod (Univalves). Besides, post-larvae of Bagda chingri (*Penaeus monodon*) and Golda chingri (*Macrobrachium rosenbergii*) collected in a large scale.
2. In greater Khulna and the SRF area overall annual yield increased to 66,745 mt in 1992/93, from 31,939 mt in 1983/84. Yield increased by 109 per cent over the decade. This is due to increase yield in pond fish culture (270%) and brackish water shrimp culture (470%).
3. Fish production from rivers and estuaries of coastal districts, such as Noakhali, Barisal, Patuakhali and Khulna combined, reduced to 77,399 mt in 1992/93 from 105,296 mt in 1983/84 but revenue oriented fish production records of Sundarbans as maintained by the Divisional Forest Office, Khulna does not reflect any declining trend.
4. Floodplain/beel fisheries have been reduced due to implementation of a large number of FCD or irrigation projects. In consequence, the fishermen have been forced to concentrate on catching riverine fish.
5. Pond fish farming yielded nearly 9,318 mt of fish during 1992/93 and made steady progress in recent years and expected production by the end of next decade would be around 20 thousands metric tonnes.
6. Brackishwater shrimp, *Penaeus monodon* and fresh water giant prawn, *Macrobrachium rosenbergii* farming presently dependent on the collection of shrimp/prawn fry from the wild (Sundarbans and adjoining rivers/canals) for release into ponds or bunded enclosures known as "bheries" or "ghers" where they grow to marketable size. Shrimp/prawn farming expanded very rapidly in recent years under the stimulus of keen export market demand and especially favorable local conditions.
7. The collection of shrimp/prawn post-larvae from saline tidal areas, lagoons, and khals provides an important livelihood and source of income for more than 120 thousands residents of adjoining areas of Sundarbans, including women and children. But for catching one Bagda post-larvae, they destroy another 99 post-larvae of other shrimp and fish species.
8. Post-larvae catch together with the offshore trawl catch of adult shrimp of the same species, may be subjecting the stocks to an excessive degree of exploitation. Percentage of tiger shrimp in off shore trawl catch reduced, from 23% of the catch in 1981/82 to only 8% in 1993/94.
9. The coastal mangrove forest habitats considered to be the most productive of all natural habitats of the world, especially for fisheries resources. The plants and vegetations of Sundarbans provides food and shelters for fish, crustaceans, molluscs and other aquatic lives. The Sundarbans and the adjoining areas of brackish and marine waters are used as breeding, nursery and growing habitats by the varieties of fishes, crustaceans and molluscs. The resident and migratory fishes and prawns and post-larvae and juveniles of shrimps and prawns constitute the fishery, but not only the juveniles as observed by Pena (1994).

10. Fishing is a more or less year-round activities inside the SRF but outside at sea, fishing is seasonal, between October to February, the fishermen from Chittagong, Cox's Bazar, Barisal, Pirojpur, Bagerhat, Khulna, Satkhira and Jessore carry out fishing and marketing activities establishing temporary base at Dubla and other chars, and this seasonal fishing at sea popularly known as Dublar char fishery.

11. The yield of Sundarbans as shown in the DOF annual publication, "Fish Catch Statistics of Bangladesh" has been provided by the Forest Department. The Sundarbans fish harvest data includes the quantity of fish, shrimps, crabs and molluscs harvested from inside the SRF and outside the SRF in marine waters up to a depth of about 30 meters.

12. The Divisional Forest Office, Khulna records show that current (1994/95) yield of shrimp/prawn, Hilsa, and misc fishes inside the SRF are 298 mt, 314 mt and 1509 mt respectively and the number of Bagda fry collected around 382 millions (data for May and June not available). But total catch of the Sundarbans estimated at 11,786 mt, (3053 mt from inside the SRF and 8733 mt from marine waters outside the SRF) (Chantarasri 1994), at 38,000 mt (Liaquat Ali 1988) and at 50,000 mt (Ahsanullah 1995).

13. As the same fishing unit obtains permit several times in a year from the Forest Office for fishing in the SRF area, the revenue oriented records of boats/permits and number of fishermen as maintained by them can not give correct estimate of the fishing units and fishermen engaged in fishing. However, estimated number of fishermen engaged in fishing in 1993 ranged from 198,308 (Chantarasri 1994) to 297,000 (Silva, 1994).

14. In fifties/sixties, Hilsa was in abundance in the rivers and estuaries of greater Khulna district and Sundarbans, contributed 13.5 percent of the total catch. The current yield of Hilsa is poor. Hilsa production declined to 4909 mt in 1991-92, from 16,530 mt during late fifties, declined by 70% percent. But the records maintained by the Divisional Forest Office do not show any such phenomenon.

15. Production of big shrimp/prawn reduced to 307 mt in 1992/93, from 540 mt in 1987/88, declined by 43 per cent. Annual rate of decline in yield has been around 7 per cent. High exploitation pressure combined with collection of wild post-larvae resulted depletion of stock.

16. Only 15 mt of crabs harvested in 1987/88 but in 1992/93 harvested quantity increased to 492 mt, exploitation pressure has been increasingly high.

17. The set bagnet is the most common gear employed in the Sundarbans fishery, and constitute 75 per cent of the total. There are two types of bagnets, (i) estuarine set bagnet (ESBN) and (ii) marine set bagnet (MSBN). Number of set bagnet used in 1988 was 4740 but increased to 5312 in 1991. This is an efficient gear for harvesting a wide range of fin fish and shell fish and at the same time captures a wide size-range of these resources, including juveniles. 185 species or groups of finfish and shell-fish identified in the ESBN catches. Sciaenide (croaker), crabs, shrimp/prawn, anchovies dominate the catch.

18. The cost and average life of an ESBN varies from place to place, size and materials used. There are four size categories of set bagnet such as Gla, Glb, Glc and Gld having area of month $<15\text{ m}^2$, $15-50\text{ m}^2$, $50-90\text{ m}^2$ and $>90\text{ m}^2$. The cost varies from Tk 15,000 to Tk 85,000 depending on category and place.

19. The annual marine fish production in Bangladesh was 250,500 mt in 1992/93. The small-scale (artisanal) fisheries contributed 05 per cent (238,300 mt), of which 28 per cent (66,700 mt) came from set bagnet fishery.

20. In the MSBN of Dubla Island fishery finfishes, such as Bombay Duck (52.3), Ribbon fish (21%) and Anchovy (9%), and shellfishes, such as Rainbow shrimp, Yellow shrimp, and *M. rudis*, dominate the catch. Share of finfish is 85% per cent and that of shellfish 11 percent. 13,203 mt fish and shrimp harvested by MSBN of Dubla Island fishery in 1990-91.

21. The size range of major penaeids shrimp and finfish caught in the MSBN fishery show that penaeids are mostly 3-17 cm in length, except for Tiger Shrimp and Banana Shrimp, which occurred at sizes 19-20 cm and 15-16 cm respectively. Length range of Brown Shrimp is 6-13 cm with predominant size of 9-13 cm. Fish size ranges from 2-43 cm, except Ribbonfish which occurs in the size range of 14-103 cm, predominant sizes being 20-32 cm and 60-68 cm. Size of Bombay Duck, Silver Pomfret and Croaker ranges from 4-32 cm, 9-35 cm and 2-33 cm respectively with the predominant sizes of 8-14 and 22 cm, 22-24 cm and 5-10 cm respectively.

22. The prices of Indian white shrimp (*P. Indicus*), brown shrimp (*Metapenaeus spp*) and pink shrimp (*P. merguensis*) in Dubla island is less by 33 %, 53 %, and 46 % respectively than the prices of the same species in Sonadia and Mohipur. This is due to the location of landing and processing places far away from the catching centres and absence of facilities in the form of ice, cold storage and quick transportation in Dubla. The price of white shrimp was Tk 30.00, brown shrimp Tk 14.00 and pink shrimp Tk 15.00 and sergestid shrimp Tk 8.00 in 1991.

23. Both motorized and non-motorized craft are used in the MSBN fishery. The motorized craft are used for fishing and as carrier boats. Average life of a boat is 5-10 years. Cost of a MSBN motorized boat or country craft ranged between Tk 400,000-550,000 and SNB craft (non motorized) ranged from Tk 40,000-55,000 (1990 estimate).

24. The owner of a SBN and supporting craft is locally known as a Bahardar, who organizes the fishing unit using his own craft and gear or hires craft and other equipment for the fishing season. At Sonadia, remuneration based on a share system but at Mohipur and Dubla, both share and wages systems exist. In the share system at Sonadia the bahardar gets 33 shares and a crew of 40 gets 41 shares. Net revenue earned by a seasonal MSBN in 1991 was Tk 262,000, income of the bahardar Tk 116,850 and income per crew member was Tk 53,120.

25. More than 60 per cent of MSBN units come from Chittagang and Cox's Bazar for seasonal fishing in Sundarbans, hire ordinary boats with crew and fishermen needed for the units locally at a cheap rate. An ordinarily local fishermen receives only Tk 5,000-6,000 in a season.

26. The annual catch of marine fisheries (1992/93) was around 250,500 mt, only 12,230 mt contributed by the industrial fisheries (Trawl fisheries) and the rest (238,270 mt) contributed by the artisanal fisheries. The most effective gears used in the artisanal fishery are Gill Nets and Set Bagnet, the two combined contributed around 85 per cent of the total artisanal catch. Gill nets contributes 57 per cent and set bagnets 28 per cent.

27. The Tiger Shrimp (Bagda), *Penaeus monodon* spawn in offshore waters but the larval and post larval stages of this species live in the coastal mangrove areas, which constitute the nursery grounds. The fresh water giant prawn (*Golda*), *Macrobrachium rosenbergii* migrates to brackish water for breeding, the larval and post larval stages live and grow in the same habitat and then migrate up to the freshwater for further growth and development. Taking the advantage of the life cycle of both the species, the post-larvae/fry are collected from Sundarbans and the adjoining rivers and canals by three types of gears, such as fixed bagnet, pushnet and dragnet for stocking ghers/ponds. In 1994/95, an estimated quantity of 385 million post-larvae collected from the Sundarbans area.

28. In early eighties, the price of 1000 post-larvae of Bagda was 120-150 and Goida was Tk 120-150 respectively but in 1995 price increased to Tk 1200-1800 and Tk 1500-200 respectively.

29. In recent years, semi-intensive shrimp culture expanding rapidly and the post-larvae collected from wild is much less than the post-larvae needed for stocking. Further, wild post-larvae population gradually depleting.

30. Recent studies by the Marine Fisheries project (1990) show that 120,000-200,100 persons engaged in shrimp fry collection during March/April in the county. In Khulna-Sundarbans area the number of shrimp fry - collectors ranged from 42,000-180,000.

31. In Khulna-Sundarbans shrimp fry collected year round but abundance of fry found maximum between January and April when 70-75 per cent of the total fry collected.

32. The annual earning from the PN is Tk 494 in Khulna and Tk 791 in Satkhira, but annual income per FBN in Khulna Tk 2,056 and in Satkhira Tk 3,344.

33. There is no landing facilities in any temporary village/char in Sundarbans area. Every bahardar constructs a temporary hut on char land having enough space for fish drying. Catch is landed in open space on the coast/char close to the Khal. But during low tide, the boats can not reach the bank of the Khals, the catch then is carried in a basket on head to the fish drying yards. Most of the finfish caught is dried and only a little quantity of quality fish sorted out and send to Khulna for marketing through faria and aratdars.

1. INTRODUCTION

Fisheries in the greater Khulna district of Bangladesh comprise inland open water capture fisheries in river, estuaries, beels and floodlands, marine capture fisheries along the coast and culture fisheries, mainly for carp production in fresh water ponds and other closed water bodies and brackish water shrimp and fresh water prawn farming. The only detailed sequence of data covering these fisheries are the annual fish production statistical bulletins published by the Department of Fisheries (DOF), which are considered to be assessments of at least the correct orders of magnitude and a reasonably accurate reflection of production trends and changes in fish stock abundance during recent years. The most recent year of which a full set of data is available is 1991/92. However, partial information has been obtained on 1992/93 fish and shellfish production, along with 1993/94 shrimp farming results. Fishing area data and a summary of greater Khulna fish production statistics for the ten years from 1983/84 to 1992/93 are shown in Table 1 and 2.

MPO (Technical Report No. 17, 1986) and other sources, the most recent of which is the FAP-12 Agriculture Impact Evaluation Study), have identified fisheries as one of the sectors worst affected by flood control developments throughout Bangladesh. The negative impacts arise mainly because flood control structures also block the spawning and feeding migrations of many species of fish and shellfish to and from the flood plains, beels, rivers and tidal khals and have thus reduced the breeding stocks and reproduction to a stage where several species of fish and shellfish may be verging on extinction. In the interests of increasing the area of rice land inside FCD projects boundaries, many permanently flooded beel areas have also been completely drained or converted to seasonal floodland which dries out during the winter months, thus causing the destruction of resident breeding stocks of fish. River flows have been altered, in terms of both depth and duration of flooding and the pattern of siltation has changed to the probable detriment of riverine fish species or the food organisms on which they depend. Fishermen's catches and earnings have inevitably been badly affected by these changes and consequently some erstwhile fulltime fishermen have had to seek other work or move elsewhere. But the positive and processing industries in the country, especially at Khulna.

The aquatic resources of the Sundarbans Reserved Forest (SRF) impacted by the FCD interventions in Satkhira and Khulna Districts. The SRF area extends from Raimangal river of Satkhira District to the west to Haringhata rivers of Bagerhat Districts in the east. The area of SRF is 577285 hectares including 175600 hectares of rivers rich in fisheries resources.

Table 1: Inland Water Areas by New Districts

(Rounded to Nearest 10 hectares)

New District	Rivers and Estuaries	Beels	Baors	Ponds	Shrimp Farms	Floodland
Satkhira	10010	-	-	1460	29543	47240
Khulna	9010	365	330	2650	35137	43440
Bagerhat	9090	-	-	1280	45835	42930
Sundarbans	175600	-	-	-	-	-
TOTAL	203710	365	330	5390	110515	133610

Based on: DOF Fisheries Information Bulletin, Vol 3 No. 1, December 1986, SPARRSO (1982-84), DOF Shrimp Survey 1994 and FAP 4 Estimates.

Table 2: Greater Khulna and SRF area - Fish Production by Sub-sectors, 1983/84 - 1992/93

(Rounded to nearest Metric tons)

Fishery/Year	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93
A. Capture Fishery										
1 Rivers	4472	7600	12074	5382	4908	2280	5442	5523	4909	4394
2 Sundarbans	7783	6825	7114	6035	8068	8418	6383	6651	627	6939
3 Beels	163	78	80	89	125	106	93	84	78	77
4 Flood Lands	9464	10002	6395	8981	8973	9688	8484	12350	15969	18180
Total Capture Fish	21883	24505	25861	20487	21972	18470	20412	24808	27251	29570
B. Culture Fishery										
5 Pond fish	5144	5121	5418	4662	5896	7012	8251	8464	9169	9318
6 Beels	44	58	43	59	55	62	64	71	79	88
7 Shrimp farms	4868	6829	16448	17338	19557	21987	22098	23237	24895	27769
8 Molluscs	2514	4878	12016	11361	13493	15049	15193	15951	16685	-
9 Fish	2354	1951	4432	5977	6064	6938	6905	7286	826	-
Total Culture Fish	10056	12008	21909	22058	28308	29081	30413	31772	34143	37178
Overall Total	31939	36513	47570	42780	47280	47531	50825	56380	61394	66748

Source: DOF Fish Catch Statistics of Bangladesh 1984/1993

2. TERMS OF REFERENCE

The Consultant was appointed to the BGD/84/056 UNDP/FAO Project to accomplish the task of Fishery Harvest and Marketing Specialist under the following terms of reference.

Under the guidance of the Chief Technical Adviser and the National Project Director, the Fishery Harvest and Marketing Specialist will carry out the following:

1. He will be responsible for completing the planning and co-ordination of the Fishery Harvest and Marketing component of the project for which an interim Report has already been prepared;
2. His subject matter responsibilities will be to complete studies on fishery harvest, landing and marketing systems relating to the project area;
3. To define the status of the fish, crustacean, mollusc and crab landing and marketing system in the project area and to provide an assessment for future development planning to improve the quality of the local industry for the benefit of all people involved in harvesting and marketing with special emphasis on disadvantaged groups;
4. To study quantitatively the Socio-economic condition of fishermen and aquatic resources traders in the project area in collaboration with the Socio-economic study and Non-wood Forest Products study;
5. To study the economic and catch assessment, especially market prices, costs of harvesting, seasonal changes and trends in production of finfish, crustaceans, mollusc and crabs in the Sundarbans area;

6. To formulate harvesting, landing and marketing strategy in the project area for long term sustainable production for the Sundarbans fishery;
7. Prepare a report on the findings of the assignment which will be discussed fully with counterparts and supervisor(s) including FAO Representative and UNDP Resident Representative where appropriate, the report is to be presented in draft form to FAO 15 days before the end of the assignment.

3. FISHERIES IN THE NATIONAL SETTING

The fisheries of Bangladesh can be classified in to three basic production system.

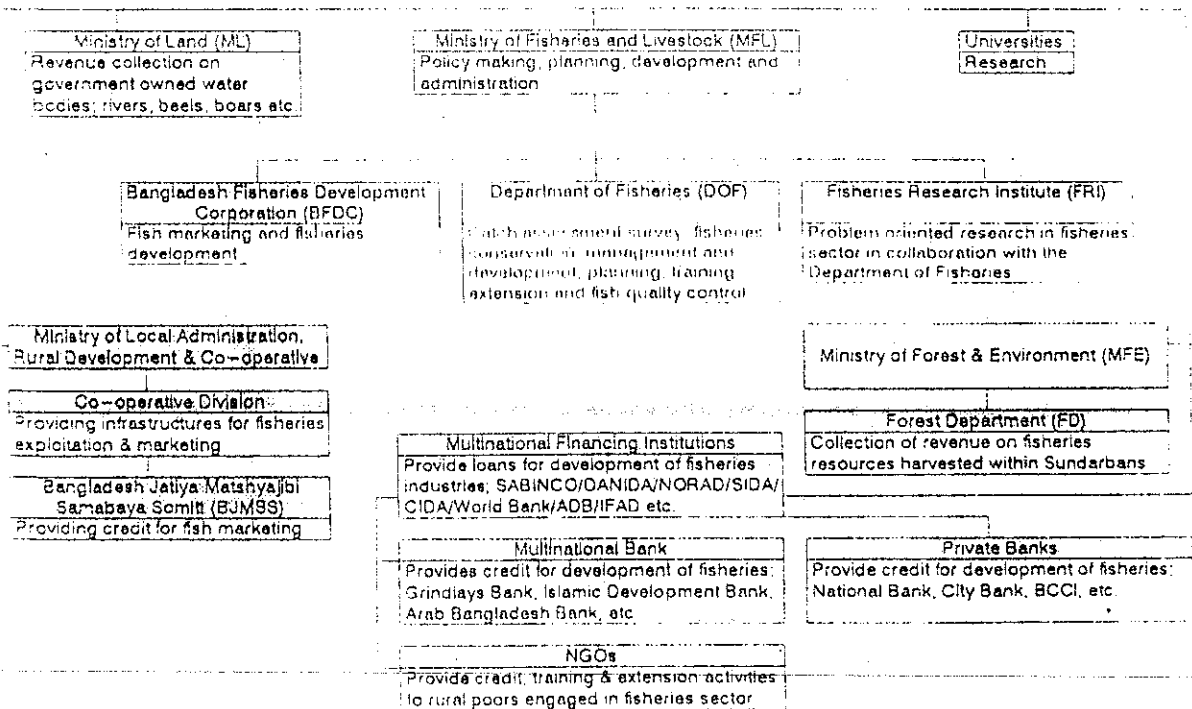
1. Open Water Capture Fishery (Inland)
2. Closed Water Culture Fishery (Inland)
3. Marine Fishery.

Fish production in the inland waters represents 74% of the fish harvested annually from Bangladesh waters. Of the total inland harvest, nearly 68% comes from the open water capture fishery and the rest from the closed water culture fishery.

Fish play a more important role in the diet and life of the Bangladeshi people than with most other people of South Asia. In Bangladesh, fish supplies an estimated 70% of the total animal portion. The population on the whole prefer fish, particularly fresh water fish. Most of the inland fresh water fish are consumed within the country while most of the shrimp/prawn and salt water fish are exported.

The organizations which are concerned with the fisheries sector are shown at Table 3.

Table 3. ORGANOGRAM
Fisheries Sector



4. INLAND CAPTURE FISHERIES

4.1 Fish Resources

Inland waters of Khulna-Sundarbans are believed to contain at least 200 of the 260 species of fresh water and *aradromous* fish which have been recorded for the whole of Bangladesh. Nearly all of these fish are commercially marketed although some have always been quite rare.

Shellfish are represented by 16 species of fresh water prawn of which one, *Golda chingri* *Macrobrachium resenbergi*, is of especial commercial importance. There are about 44 species of marine shrimp some of which, Bagda chingri *Penaeus monodon*, Chamma chingri *Penaeus indicus*, Lallia chingri *Metapenaeus monoceros* and Kucho chingri *Metapenaeus brevicornis* are the principal target of a substantial offshore trawling industry and also inshore/offshore set bagnet fishery.

Capture fishing takes place in the rivers, beel and floodplain areas. It is the subsector most severely affected by FCD works because of the obstruction of fish spawning and feeding migrations, the draining of many formerly productive beel fisheries, the consequent reduction in recruitment and natural annual restocking of the floodplain and the enforced concentration of artiganal fishing effort in to the already diminished river fisheries.

4.2 River Fisheries

DOF's data for coastal districts riverine and estuarine production figures are combined and unfortunately this serves to divert attention from the virtual collapse of fresh water river fish stocks because estuarine fish are not so directly affected (Table 4).

Table 4: Fish Production from Rivers and Estuaries of Coastal Districts

Unit: Metric Ton

(Old District	River Area (ha)	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93
Ncakhai	95732	24845	7807	11960	15244	16568	18966	23088	22535	23474	25542
Bansai	176105	59850	50418	70550	60498	48300	48101	63831	34554	29479	33342
Patuakhali	107443	8346	38639	10708	12021	15752	11981	10097	8695	8707	7182
Khulna*	203710	12255	14425	19186	11387	12874	8876	11835	12174	11206	11333
Total	582990	106298	109289	112402	99158	93494	87924	108851	77958	72866	77399
Mean Catch Kg/ha		181	187	193	170	160	151	187	134	125	133
Sundarbans	175600	7783	6825	7112	6035	8066	6416	6393	6651	6297	6939
Kg/ha		44	39	40	34	46	37	36	38	36	40

Note: * Khuina data includes Sundarbans production

Source: DOF Fish Catch Statistics of Bangladesh

4.3 Beel Fisheries

Beel fisheries of Khulna-Sundarbans are not as numerous as in some other parts of Bangladesh and were assessed by SPARRSO, during their 1983 surveys to total about 365 ha. In the meantime, as a consequence of various FCD or irrigation projects, some beels have been drained all together with the aim of creating additional rice growing land, and others converted from perennial to only seasonal water bodies. DOF figures show that beel fish production has declined by about 64% between 1983/84 and 1991/92. Fishermen stated that they are often denied access to areas which they once fished because the remaining small water bodies, after drainage are claimed as private property by neighboring farmers. In consequence, the fishermen have been forced to concentrate on catching riverine fish.

4.4 Flood Plain Subsistence Fisheries

Most of the fishing in this area during the flood season is carried out on a subsistence basis by the local population as a whole rather than by professional fishermen, and this customary right of free access to catch fish has been of particular importance to the poorest families. Fish production from this area by some 202 thousand subsistence fisheries households was estimated by DOF in 1983/84 to be 9464 mt, an average catch per household was 47 kg but in 1991/92, by 497 thousand households harvested an estimated quantity of 15969 mt, an average catch per household was only 32 kg. Increase in subsistence fishery production as shown only due to increase in fishing efforts but not necessarily due to increase in fish population.

5. CULTURE FISHERIES

The culture fisheries in Khulna area are at least potentially positive beneficiaries of FCD, comprise freshwater pond fish farming with associated hatchery services and wild spawn/fry collection, the boar fisheries which also depend on hatcheries to enhance their fish stocks and productivity, and brackish water shrimp and fresh water prawn farming.

5.1 Freshwater Fish Ponds

Freshwater pond fish farming yielded nearly 9300 mt. of fish during 1992/93 and has made steady progress during recent years. There are 4163 hectares of ponds in Satkhira, Khulna and Bagerhat districts and 85 percent of the total ponds have recently brought under semi-intensive fish farming yielding 2000 kg/ha. DOF demonstrations have shown that by stocking the right combination of fish species coupled with systematic feeding and pond water fertilization, or by integrating fish farming with poultry or duck production, yields and profitability can be increased still further to at least 4200 kg/ha.

5.2 Freshwater Fish Hatcheries

The fish farmers are well supported by a net work of carp hatcheries covering most of the region except for the brackish zone. In addition to the hatcheries, many pond owners are now specializing as nursery operators, taking hatchery produced or wild caught hatchlings and rearing them on to the fingerling stage for sale to nearby fish farmers or to specialist traders who transport the young fish to other parts of Bangladesh, where they are sold for growing on to market size.

5.3 Wild Spawn Collection

This specialized fishery was the traditional source of carp fry for stocking ponds, prior to the introduction of carp hatchery technology. The fishery is highly seasonal, occurring during May

to July each year, exists in the neighboring districts. Its importance to the fish farming industry however is much less now that hatchery production is so well established.

5.4 Brackishwater Shrimp Farming

Coastal aquaculture, which consists mainly of brackishwater shrimp farming is dependent on the collection of shrimp fry from the wild, for release into large ponds or bounded enclosures known as "bheries" or "gher", where they are grown to marketable size. Shrimp farming expanded very rapidly in recent years under the stimulus of keen export market demand and especially favorable local conditions, although not without some difficulty caused by social conflict, lack of enforceable regulatory system and some concern about the size and well-being of the wild stocks of shrimp on which everything depends, given the failure hitherto, of efforts to establish an effective hatchery in Bangladesh for the production of the "Tiger shrimp" *Penaeus monodon* post-larvae.

The collection of shrimp post-larvae from saline tidal areas, lagoons and khals, provides an important livelihood and source of income for many thousands of coastal zone residents, including women and children. It also supports a network of buyers and agents who undertake the task of delivery and distribution of the post-larvae to the various shrimp farms. In 1988 about 1.5 billion shrimp fry were collected, rising to more than 3 billion in 1992, but of these, it was estimated on average, that less than 20% survived to be harvested from the ponds, because of rough handling, lack of technical knowhow and inadequate facilities for transport and distribution. Significantly higher survival rates have been claimed in the IDA Polder 20 schemes, where stocking and subsequent feeding of the post-larvae was supervised by project extension workers.

Concern is being expressed that post-larvae catch together with the offshore trawled catch of adult shrimp of the same species, may be subjecting the stocks to an excessive degree of exploitation. It is noted that the composition of tiger shrimp *Penaeus monodon* in trawl catches has reduced, from 23% of the catch in 1981-82 to only 8% of this year's trawl catch (Figure 1) but the same is not true in case of other species (Figure 2) and that the collectors are having difficulty in catching the quantities of post-larvae which the shrimp farmers need. In correspondence, the price which farmers have to pay has increased during the past four years, to more than Tk. 1.5 per single post-larvae. The evidence is not conclusive, but at the same time there is pressure to increase shrimp pond yields by the use of more intensive culture systems and figures as high as 1700 kg/ac (4mt/ha) have been quoted in recent reports. This implies stocking at more than twenty times the present rate which may well be more than natural stocks can support and add urgency to the need for a reliable Penaeid shrimp hatcheries to be established as soon as possible.

The social conflicts associated with shrimp farming stem from a number of cases in which small landowners and share croppers have been forced by landlords and other more powerful interests to surrender the use of their lands, in exchange for cash compensation, for seasonal incorporation into large salt water "shrimp gher". Some times certain gher operators have failed to make these payments in full and some times shrimp harvesting has been unreasonably delayed beyond the time when the land can be prepared for the following rice crop. The position is made worse because Thana and District level committees were established by Government, vide Ministry of Fisheries and Livestock Notification No. MEL (MISC)2/86/17, published in the Bangladesh Gazette on 06.03.1986, to regulate shrimp farming and thereby avert such conflicts, but unfortunately they were not provided with the necessary legally enforceable means and have remained powerless to intervene. Action may be needed only in a minority of cases, but in general it is considered right that salt water shrimp farmers should be required to obtain a license and be permitted to operate only in specified areas. Licenses should not be transferable and breaches of licenses conditions should be punishable offenses. Government could still introduce

Figure 1: Percentage of Tiger Shrimp In Offshore Shrimp Catch

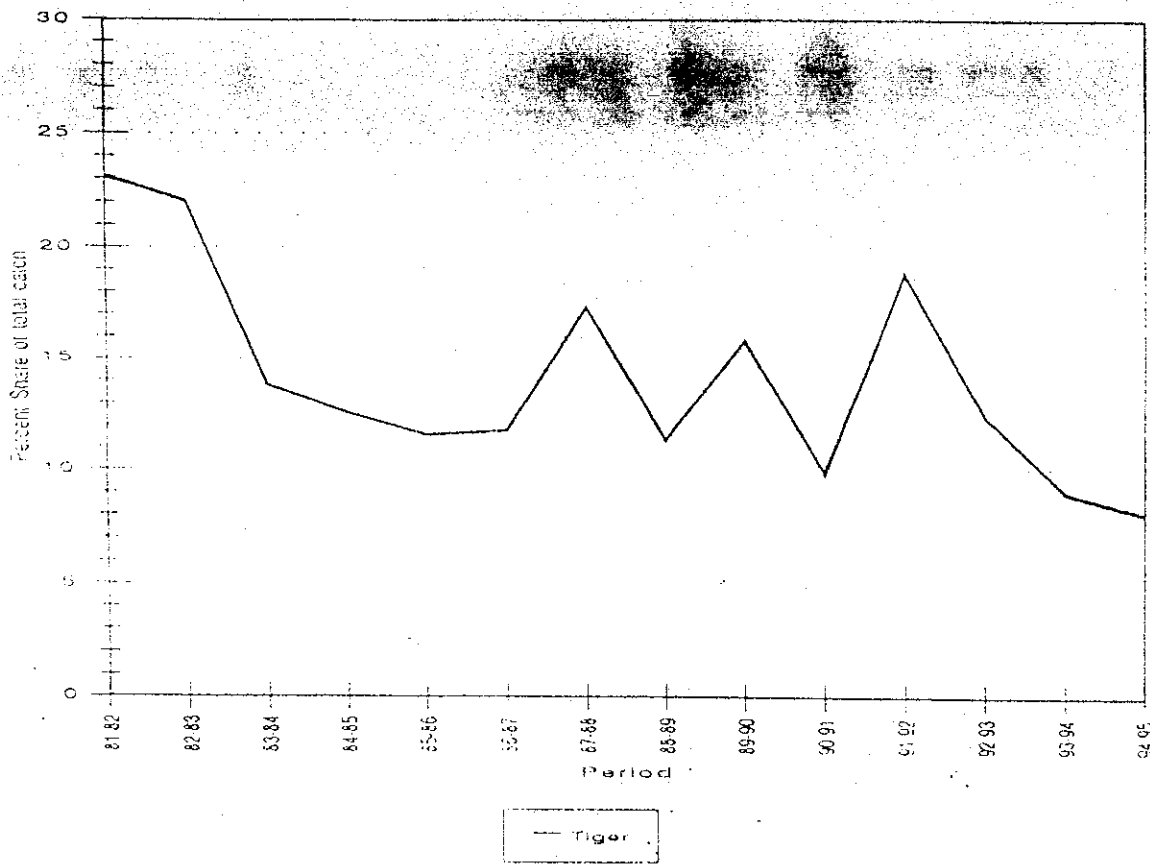
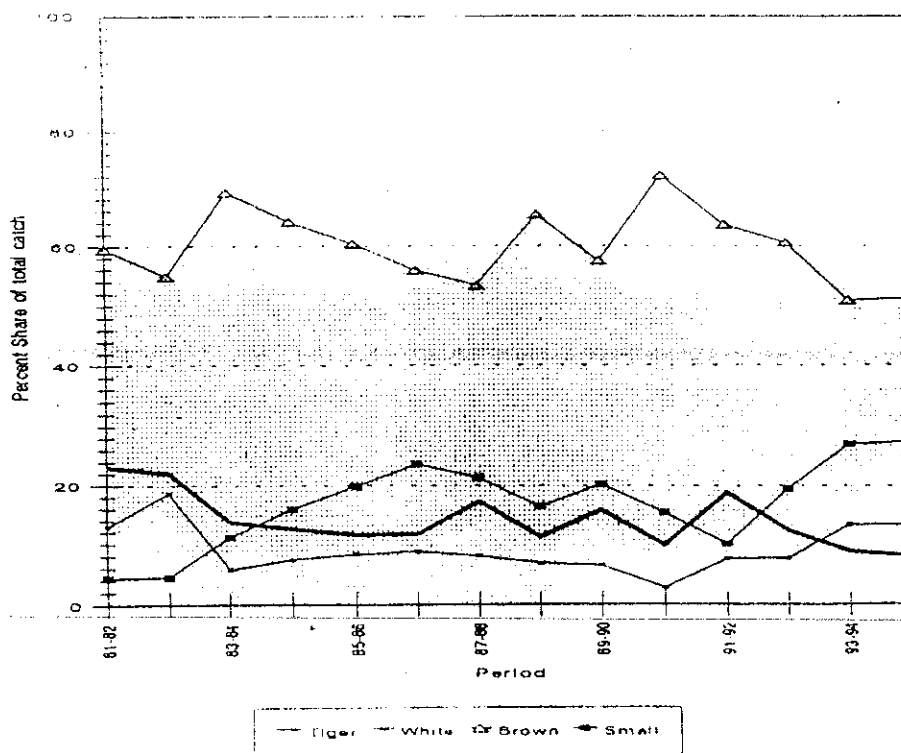


Figure 2: Groupwise Shrimp Catch Composition by Trawlers at E.E.Z: Bay of Bengal



such regulations and is strongly urged to do so. As is shown in Table 5 the area of Khulna-Sundarbans under brackish water shrimp culture has grown from 32280 ha in 1983/84 to nearly 100724 ha in 1993/94 and shrimp production from 2550 mt to over 18430 mt in the same period. It is reported that a further 7700 ha in Satkhira, Khulna and Bagerhat districts are suitable for development as shrimp farms. However, it is also noted that average shrimp farm productivity has stagnated since 1991/92, at around 209 kg/ha/year and is likely to decline unless the post-larval and feed supply problem can be solved quickly. It should be possible to increase production to at least 300 kg/ha, which is the reported average for India and Thailand. In fact, the IDA Shrimp Culture Project centered on Polders 20 and 20/1 which has demonstrated the feasibility of small scale shrimp/rice rotations within polders, has already achieved an average of 240 kg/ha, whilst one of the farms involved produced 409 kg shrimp per hectare. Thus, at full development and subject to establishment of the necessary hatcheries, it seems quite feasible to anticipate that brackish shrimp production from Khulna-Sundarbans area can be trebled to around 55000 mt/yr.

Table 5: Khulna-Sundarbans Area - Shrimp Farm and Shrimp Production

Pond Area (ha)	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92
Jessore	422	523	328	328	690	690	690	327	690
Khulna	31817	39453	62120	62120	68363	79728	79728	86209	79728
Patuakhali	42	52	26	28	84	326	326	230	326
Bansal	-	781	45	45	112	22	22	110	22
Total	32281	40809	62519	62519	80229	80766	80766	86876	80766
Shrimp Production (mt)									
Jessore	33	57	34	44	118	130	132	62	114
Khulna	2514	4878	12016	11311	13493	15049	15193	16758	16685
Patuakhali	3	5	3	4	11	92	82	43	88
Bansal	-	85	5	6	19	4	4	21	5
Total	2550	5025	12058	11415	13641	15245	15391	16884	18902
(Kg/ha)	79	123	193	183	197	189	190	190	209
Fish Production (mt)									
Jessore	31	37	11	17	35	60	60	28	71
Khulna	2354	1951	4432	5977	6064	6938	6905	7587	8210
Patuakhali	3	4	1	1	3	28	28	19	34
Bansal	-	55	2	2	6	2	2	9	2
Total	2388	2047	4446	5997	6108	7028	6995	7643	8317
(Kg/ha)	74	50	71	96	88	87	87	68	103

Source: DOF Fish Catch Statistics of Bangladesh.

The IDA Shrimp Culture Project developments in Polders 20 and 20/1 were a pilot trial to demonstrate the feasibility of small holder shrimp farming, provided that an appropriate water management infrastructure can be supplied. Polder 20 was laid out with a network of flushing and drainage channels and structures serving all the plots, so that each can be operated independently. Results of the work to date are set in Table 6 and 7 show that not only were the shrimp yields better than average, but there has been no decline in rice yields even after years of rotation. As a result, the new IDA Third Fisheries Project includes a shrimp component in

which the polder 20 experience has been extended to polders 5 and 23 initially and thereafter to polders 16, 18, 19, 31, 32 and 33.

Table 6: Production of Exportable Shrimp, 1991 from Polder: 20 and 20/1 (Paikgacha, Khulna) and Polder:5 (Shyamnagar, Satkhira)

Polder No	Area under Shrimp Culture (ha)	No. of Shrimp farm	Avg. Size of Shrimp Farm (ha)	No. of post-larvae Stocked/ha			Yield of Shrimp Kg/ha			Remarks
				Highest	Lowest	Average	Highest	Lowest	Average	
20 & 20/1	1178	88	13.38	25000	4815	13493	408.00	75.00	214.00	One crop
Ben A	257	29	8.86	32740	5000	22056	509.25	68.00	264.40	Two/more crops
Ben B	404	18	22.44	83750	12181	27187	650.50	135.70	275.90	
Ben C	265	28	10.96	51000	10800	20750	508.50	7288	213.07	

Source: IDA Shrimp Culture Project, Khulna.

Table 7: IDA Shrimp Culture Project Results: Polders 20 & 20/1 Paikgacha, Khulna

Items	Pre-Project Position	Position during Project Implementation					Remarks
		1987	1988	1989	1990	1991	
No. of Shrimp Farm	29	39	60	84	88		
Area of Shrimp (ha)	756	937	1219	1178	1178		
Highest yield/ha (kg)	-	222	270	375	409	One crop	
Avg. Yield/ha (kg)	68	92	137	175	217	-do-	
Avg. Yield of rice/ha (kg)	1961	1292	2048	1960	NA	T. Aman	
Avg. Yield of upshi/ha (kg)	-	-	5800	4920	NA	High yielding variety rice b.r.-10 & 11	

Source: IDA Shrimp Culture Project, Khulna.

5.5 Shrimp Hatcheries

To be successful, a *Penaeid* shrimp hatchery must have continuous access to ample supplies of good quality fresh water and sea-water. Unfortunately, there does not seem to be any site in Khulna - Sundarbans area which can satisfy both requirements. However, it is understood that there are sites along the coast south of Cox's Bazar towards Teknaf which appear to be more suitable and as a matter of urgency, they should be surveyed for site selection and early construction. It is understood that an ADB funded shrimp hatchery for the production of both *Macrobrachium* and *Penaeid* shrimp has been constructed at Cox's Bazar, but it has also suffered from water supply problems which have affected the production of post-larvae. An IDA funded *Penaeid* hatchery constructed at Cox's Bazar, but was badly damaged by the 1991 cyclone and made operational last year. The transportation of hatchery produced post-larvae to Khulna-Sundarbans area shrimp farms should not present any problems, because wild caught larvae are already being transported in both directions over the same route.

The requirements of producing post-larvae/juvenile of the giant freshwater prawn, *Macrobrachium rosenbergii*, whilst still involving ample supplies of freshwater and lesser quantities of saline water, seem less restrictive and the first hatchery in Khulna-Sundarbans area for this purpose had now been established at Kaliganj in Satkhira district. Hatching and larval rearing commenced only in February 1992, but had run into survival problems afterwards. The unit is intended for training and demonstration purpose as well as post-larval production. It is

anticipated that once the system can be demonstrated to work, private interests will take up freshwater shrimp hatcheries, as they already have with carp fry production and there should be no difficulty in finding suitable sites for *Macrobrachium* hatcheries.

5.6 Freshwater Shrimp Farming

It has never been as easy to collect *Macrobrachium* Juveniles from the wild in quantity, as it has been with *Penaeids*, and although they have been stocked initially in late eighties into ponds along with carp, it has been then on a generally smaller scale, but since 1992 monoculture of *Macrobrachium rosenbergii* adopted and expanded rapidly. The main center to date is in Bagerhat district where, during the past 5 years nearly 5165 freshwater shrimp farms have been established. These ponds/ghers are mostly individually owned and vary in size from less than, 0.1 to 10.0 ha, with an overall average of 0.6 ha, which contrast with the very much larger brackish water gher in Khulna, Satkhira and even Bagherhat district. Area and production of giant prawn, Golda chingri given at Table 8.

Table 8: Golda Chingri *Macrobrachium*: Farm, Area and Production

New District	No. Area		(ha)	No of post-larvae stocked/ha			Yield of prawn kg/ha		
	Farms	(ha)		Highest	Lowest	Average	Highest	Lowest	Avg.
Satkhira	58	64	1.40	50000	8000	10000	350	150	221
Khulna	1271	985	0.77	50000	10000	11440	450	170	228
Bagerhat	10442	3308	0.32	50000	12000	19800	600	190	265
Total/Average	11771	4357	0.37	50000	10000	13758	466	170	256

Source: Central Shrimp Cell, DOF, Khulna

The *Macrobrachium* hatchery development will open up the prospect for more wide spread production of freshwater prawns in ponds, regulated khals and even in paddy fields where they can be grown at the same time as the rice.

6 THE SUNDARBANS

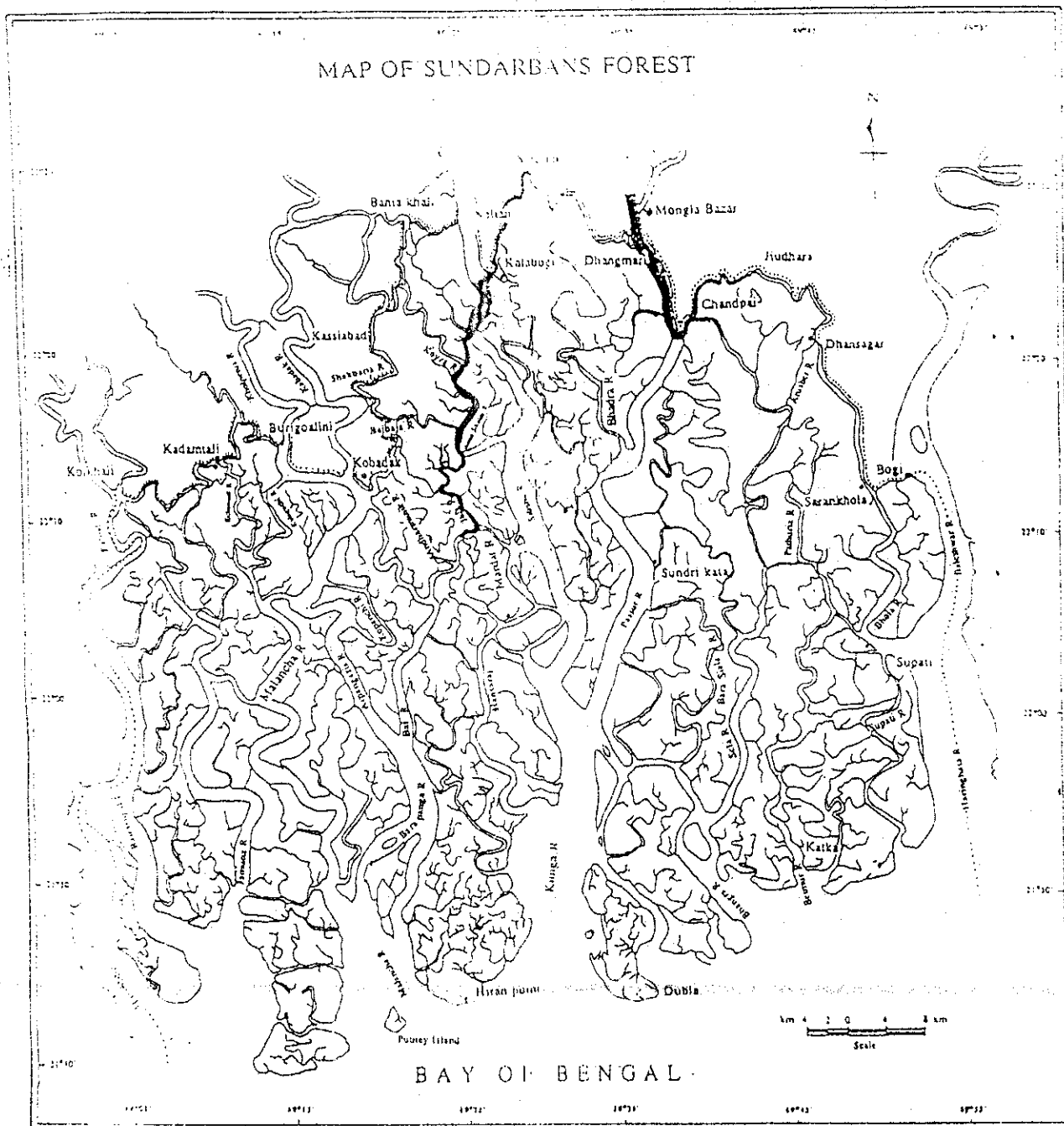
6.1 Background

The Sundarbans Reserved Forest (SRF) area extends from Raimangal river of Satkhira district to the west to Haringhata river of Bagherhat district in the east (Figure 3). The total area of SRF is 577285 hectares. The Pasur, Sibsha, Arpangasia, Barapangasia, Malancha and Jamuna are the principal rivers flow through the SRF. The total area of rivers, channels and creeks is 175600 hectares, abound with fisheries resources. The SRF has also been famous for its forest resources, wildlife, reptiles and birds. The entire resources of the SRF are under district control of the Forest Department. The management and conservation of forest resources, wildlife and birds, collection of revenues fixed on forest weather, inspection and execution of different programmes of activities including supervision of fishermen engaged in fishing inside and outside the SRF and collection of taxes on their harvests are accomplished through the officers and staff posted at 120 permanent and temporary offices in the forest.

6.2 The Sundarbans Reserved Forest Fishery

The coastal mangrove forest habitats considered to be most productive of all natural habitats of the world, especially for fisheries resources. The plants and vegetations of Sundarbans provide food and shelters for fish, crustaceans, mollusc and other aquatic lives.

Figure 3: Map of Sundarbans Forest



Sundarbans and the adjoining areas of brackish and marine waters are used as breeding, nursery and growing habitats by the varieties of fishes, crustaceans and mollusc. The resident and migratory fishes and prawn and post-larvae and juveniles of fishes and shrimp and prawns constitute the fishery but not only the juveniles as observed by Mr Pena (1994).

Fishing is more or less continuous year round process inside the SRF but outside the forest at sea, fishing season during October to January/middle of February when fishermen from Chittagong, Cox's Bazar, Bagerhat, Khulna, Satkhira, Pirojpur, Barisal and Jessore districts come for fishing in inshore and offshore waters of the Bay. The fishermen built temporary camps or huts in the chars of SRF and conduct fishing, marketing and processing activities using them as the bases. On the chars fishermen do not have any permanent establishments. This fishery is popularly known as the Dubla Char fishery, an integrate part of the inshore and offshore marine fisheries.

6.3 Current Fish Yield of the Sundarbans Fishery

The department of Fisheries do not collect any data on harvest of fisheries resources of the SRF. The annual publication, Fish Catch Statistics of Bangladesh of DOF includes production data of the Sundarbans as supplied by the Forest Department. The Sundarbans fish catch data include the quantity of fish harvested inside the SRF and outside in marine waters up to a depth of about 30 meters. The year-wise production data of the Sundarbans shown in Table 2 for the period from 1983/84 to 1992/93. The annual harvest of shrimp, shrimp fry and Hilsa and other fishes including boats and fishermen engaged in the fishery given in Table 9.

Table 9: Boats and Fishermen Engaged In the Fishery and Annual Harvest from 1993 to 1995

Year Month	Boat/Permit		No. of Fishermen		Shrimp/Prawn (mt)		Hilsa (mt)		Misc. Fishes (mt)		No. Bgda Fry (LAK)	
	93/94	94/95	93/94	94/95	93/94	94/95	93/94	94/95	93/94	94/95	93/94	94/95
July	2634	5415	8164	6952	6.20	3.61	18.63	15.17	57.63	57.46	2.30	8.37
August	9244	11817	19957	21830	14.91	11.56	70.67	35.64	119.44	92.31	5.23	16.73
September	13212	14440	118406	31317	20.72	22.73	64.68	63.03	195.59	171.42	9.79	11.94
October	14131	13758	32471	26655	28.18	26.99	72.51	91.03	225.62	203.63	7.08	4.72
November	13225	15010	28004	31332	32.75	35.08	34.70	19.95	235.01	242.98	7.32	8.70
December	16841	20198	30661	44288	40.74	38.51	12.11	46.04	219.37	199.25	1.58	31.18
January	19967	17574	30417	36922	48.78	46.06	1.02	16.28	150.63	153.02	17.81	27.52
February	25415	23630	31707	53822	34.54	30.63		5.17	133.25	125.52	8.21	30.75
March	24812	10630	18758	22296	31.90	22.87	0.51	1.37	103.30	127.37	31.25	9.04
April	17798	25886	25837	35148	23.81	22.03			116.37	135.73	20.99	233.75
May	20630	NA	28418	NA	18.18	NA		NA	116.41	NA	26.94	NA
June	39576	NA	57953	NA	21.50	NA	17.92	NA	169.33	NA	55.88	NA
Total	401167	188015	430878	333908	330.06	350.03	310.46	313.48	1813.96	1506.98	198.37	382.24

Source: Divisional Forest Office, Khulna

DFO's records do not provide the statistics of total number of boats and fishermen engaged annually in the fishery. Estimates of the number of fishermen operating in the SRF in 1993 range from 198308 (Chantarasri, 1994) based on Forest Office record, to 297000 (Shiva, 1994, cited by Khulna University, 1995).

Although the Sundarbans fishery is regarded as the richest fishery in the country, the annual catch statistics as supplied by the Forest Department fail to confirm it. The production

data supplied by them appear to be an under estimate. The results of Japanese Survey Vessels, "CHOSUI MARU" (1956) and "KAGAWA MARU" (1960) and Russian Research Vessel, "LESNOI" (1969) identified rich fishing grounds nearly 30 km south of Dublar Char on the Northern and Eastern sides of Swatch of No-ground. The species of fish and shrimp which are commonly available in the SRF were found in abundance on these grounds and cock-up, jew fishes, promfret and white shrimp, *Penaeus indicus* were the dominant species. Chantarasri (1994) estimated the total catch of the Sundarbans, based on Forest Department record, around 11786 mt, 3054 mt from the inside of SRF and 8733 mt from marine waters.

The Sundarbans fishery is however an integral part of the inland capture fishery but under the control and management of the Forest Department (FD). The Department of Fisheries responsible for collection of catch statistics of fisheries resources of the country, both inland and marine, are not involved in the SRF fishery. In the Fish Catch Statistics of Bangladesh published by the DOF also include the annual harvest statistics of SRF fishery as supplied by the Forest Department.

The Sundarbans fish harvest records as maintained by the Forest Department includes fishes and *crustaceans* harvested from within the SRF area and outside in marine waters. Of the total catch, inland capture fishery of SRF contribute only 26% and the rest from the inshore and offshore waters of the Bay. Catch per hectare inside the SRF is only 9 kg, very poor as compare to the catch of Patuakhali, the adjacent district. The annual harvest records of Forest Department do not testify the richness of fisheries resources Table 10.

Table 10: Trend of Annual Fish Harvest

Year	Total Catch (mt)					Catch/ha(kg)		
	Sundarbans			Patuakhali	Country	Sundarbans	Patuakhali	Country
	Total	Inside	Outside			Inside		
92/93	6539	1700	4839	7182	138746	9.68	67.00	135
91/92	6297	1637	4660	8707	12443	9.32	81.00	121
90/91	6651	1729	4922	8695	135355	9.85	81.00	131
89/90	6393	1662	4731	10097	17340	9.46	94.00	168
88/89	6416	1668	4748	11981	181140	9.50	112.00	176
Total	3296	8396	23900	48662	753494			
Average	6459	1679	4780	9332	150699	9.56	86.86	151

Source: Divisional Forest Office and Fish Catch Statistics, Bangladesh

The fish production statistics as maintained by the Divisional Forest Office, Khulna do not reflect the richness of fisheries resources of Sundarbans area and adjoining inshore and offshore fishery of the Bay of Bengal. Presuming the current yield of the Sundarbans fishery to be at least equal to that of Patuakhali district, the estimated annual harvest would be around 45250 mt. Inland capture fisheries harvest inside Sundarbans would be 11765 mt and outside Sundarbans in inshore and offshore waters of the Bay of Bengal be 33485 mt.

The estimated fish harvests of the Sundarbans as reported at different times are as follows:

- | | | |
|---|------------------------------------------------------------------------------------------|-----------|
| 1 | Mr Musliquat Ali (1988)
Director of Resource Survey System
Department of Fisheries | 38,000 mt |
| 2 | Mr S Chantarasri (1994)
Fisheries Biologist
BGD/84/056, Khulna | 11,786 mt |

6.4 The Hilsa Fishery

The Hilsa, *Hilsa ilisha* is the commercially most important species of fishes. It has local demand and export potential, harvested year round, but have two peak seasons. One falls during August to September and another during January to March. The final report Hilsa Investigation Scheme (1957-62) shows that in the past Hilsa harvested mainly from river and estuarine (94%) and only small quantity from the sea (6%). Every four/five years there is a peak in the abundance of Hilsa. It was observed in 1958-59. Table 11.

Table 11: Annual Production of Hilsa

<u>Year</u>	<u>Production in mt</u>
1956-57	137 583
1957-58	133 290
1958-59	147 065
1959-60	124 951
1960-61	953 55
1961-62	968 86
<u>Total</u>	<u>735 130</u>
<u>Average</u>	<u>122 688</u>

In fifties and sixties, Hilsa was in abundance in the rivers and estuaries of Khulna district and contributed on average 13.5 percent of the total catch. But the current yield of Hilsa is very poor. Hilsa production declined to 4909 mt in 1991-92, from 16528 mt during 1956-62, declined by 70%, and Hilsa production of rivers and estuaries of the country as a whole declined to 68356 mt (56%) in 1991-92 from the average production of 122688 mt during 1956-62, declined at an annual rate of 1.5 percent and annual harvest is now less by 54332 mt in inland waters (Figures 4 and 5).

Until mid-sixties Hilsa resources of the offshore water of the Bay Bengal remained almost unexploited. Thereafter, with the introduction of mechanized fishing boats in the offshore waters of Bay of Bengal Hilsa production has been increasing steadily.

The production of Hilsa in marine water has been increasing @ 2.6%. Presently, more than 3500 mechanized boats engaged in Hilsa fishery of Bay of Bengal. The trend of Hilsa fishery in inland and marine waters between 1983/84 and 1992/93 shown in Figure 5.

Figure 4: Production of Hilsa in Inland Waters 1956-57 to 1992-93

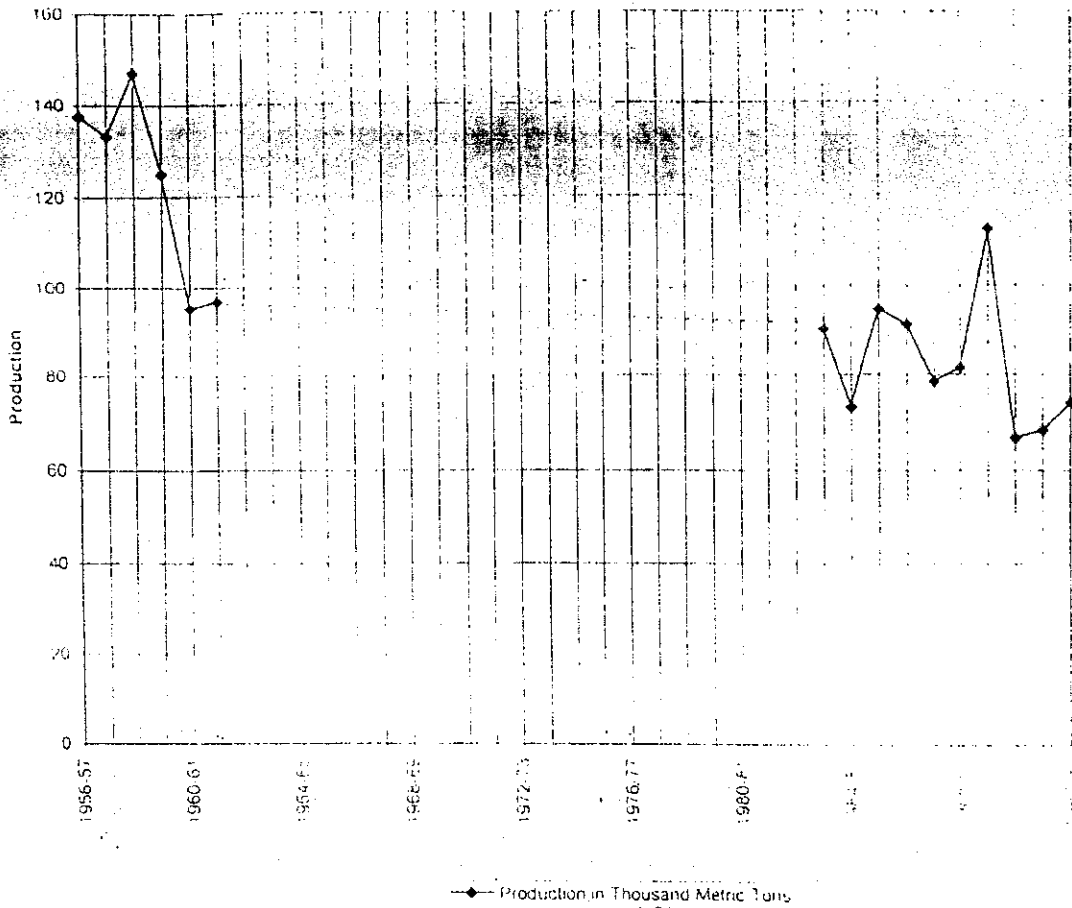
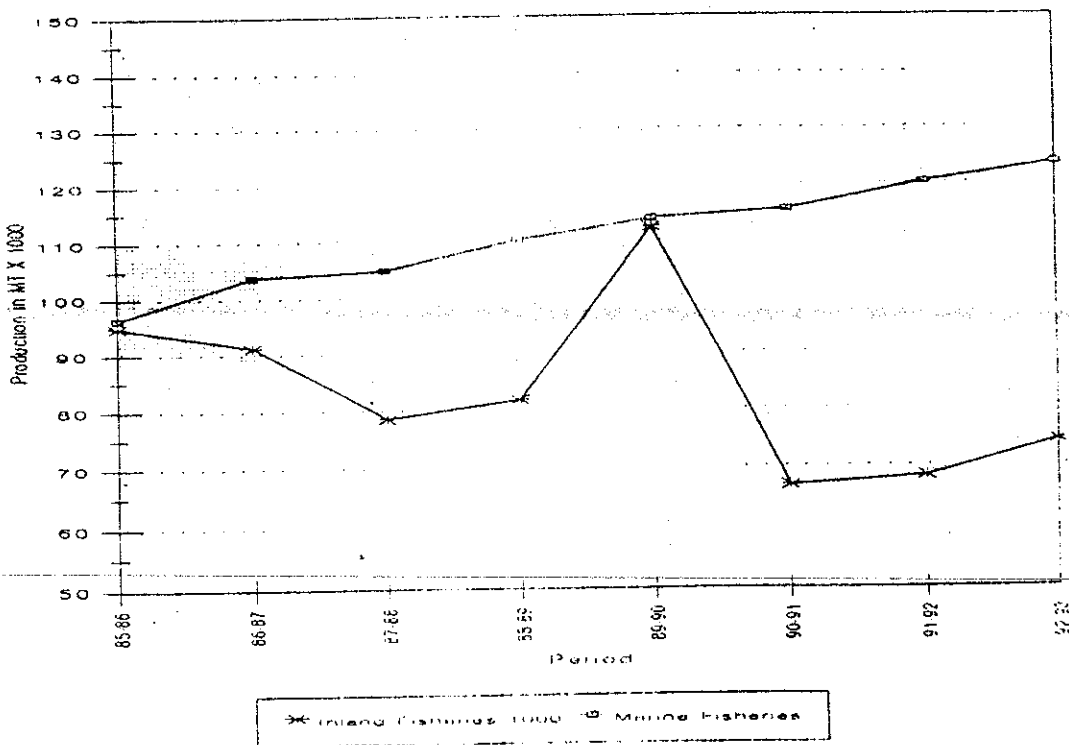


Figure 5: Production Trend of Hilsa Fishery in Inland and Marine Waters Period 1985-86 to 1992-93



7 RIVERINE FISHERY OF KHULNA

Table 12 shows the annual catch of different of species group of fishes in all the rivers of khulna district beyond the jurisdiction of the SRF. The catch of major carp and catfish declined sharply over the last decade, but in case of Hilsa annual catch ranged from 246 mt to 1663 mt and peak year of abundance was one in 1985/86 and another in 1991/92. The big shrimp, mostly Golda Chingri, *Macrobrachium rosenbergii* declined to 53 mt in 1991/92, from 1661 mt in 1985/86, declined by 97% over the period.

Table 12: Annual Catch in all Rivers of Khulna District by Species (1983/92)

	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92
Major carp	282	479	6	35	3	1	0	0	0
Other carp			1	4	0	2	0	0	0
Cat fish	255	433	78	83	38	41	158	18	42
Live fish	0	0	0	0	0	0	2	12	0
Hilsa	248	418	1819	315	484	53	225	1088	1663
Big shrimp			1661	244	414	126	112	378	53
Small shrimp	581	988	4922	2203	1708	1191	3229	2112	1669
Misc	3108	5282	3785	2432	2103	846	1718	1937	1480
Total	4472	7800	12074	3242	4808	2280	5442	5523	4600

Source: Fish Catch Statistics of Bangladesh, DOF

Table 13 shows the species group-wise catch of riverine fisheries in the country and the Sundarbans. The catch of big shrimp/prawn in rivers reduced to 460 mt in 1991/92 from 3140 mt in 1985/86, declined by 75% during the period of seven years but during the same period production declined to 307 mt from 480 mt, declined by 36% only. The catch of small shrimps and prawns during the period between 1985/86 and 1992/93 is 23% but in the Sundarbans catch declined by 69%. The catch of large crabs and small crabs and shrimp, mostly juveniles, increasing at a very high rate. The hilsa production declined by 28% in inland water outside the Sundarbans but within the SRF it is 25%. The catch of other fishes in the rivers declined by 54%, and in the catch of the Sundarbans it is only 9%. This is due to inclusion inshore/offshore catch with the catch of Sundarbans. The annual catch of rivers and estuaries in the country reduced to 138746 mt in 1992/93, from 199600 mt in 1985/86, declined by 30%, while the annual catch of Sundarbans reduced insignificantly to 6939 mt in 1992/93, from 7112 mt in 1985/86. This seems that substantial quantity of offshore catch has been recorded to be the catch of the Sundarbans.

Table 13: Species Group-wise Catch of Capture Fisheries in the Country and Sundarbans

Year	Big Shrimp/Prawn		Small Shrimp & Prawn		Crab		Crab, Shrimp & Residue		Hilsa	
	Country	Sundarbans	Country	Sundarbans	Country	Sundarbans	Country	Sundarbans	Country	Sundarbans
1992/93		307		182		492		109		4990
1991/92	460	310	19921	177		274		28	87808	5503
1990/91	765	333	19788	175		118			86184	8455
1989/90	377	387	13881	182		38		15	81107	5346
1988/89	2028	507	17494	145		12		12	77577	9748
1987/88	1141	540	17882	225		15			90348	8185
1986/87	1803	480	21795	321					94133	8819
1985/86	3140		25819	572						

Source: 1 Islam M A 1993. Some Relevant Information about Sundarbans
 2 Fish Catch Statistics of Bangladesh, DOF

Eleven types of gears employed in fishing within Sundarbans and inshore and offshore waters of the Bay of Bengal. The inshore and offshore fishery is popularly known as Dubla inland fishery and the gears used for harvesting fish and shrimps are commonly Behundi jal, Khawa jal, Purjal and Charata jal. In Sundarbans fish and shrimp harvested year round, but in Dubla Char Fishery, fishing and fish processing and marketing last three and a half months during winter season. The fishermen construct temporary hut and camps on 36 inlands (DOF) and conduct this fishing, processing and marketing activities using them as bases. The catch composition consists of Hilsa, Bombay duck, Pomfret, Jew Fish, Sharks and Rays, other marine fish and shrimp. The information on fishermen and fishing units are given in Table 14.

Table 14: Information on Fishing Units Engaged in Fishing at Different Places of Sundarbans Coast (1987).

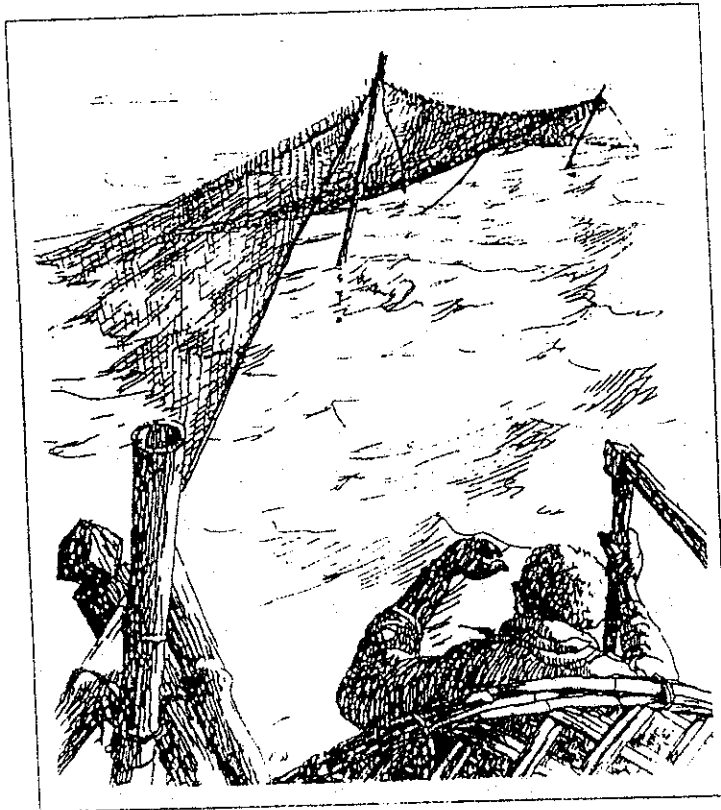
Name of Inland/Char	Number of				Number of different types of fishing unit											Total
	Boat	Fisherman	Mechanized boat	Boat	Behundi jal	Kuti jal	Alan jal	Charata jal	Khalpala jal	Khawa jal	Jashma jal	Pur jal	Charat jal	Senar jal		
Orcha Kaa	18	701	17	52	211	3	8	18	8	38	16	33	6	3	341	
Mura Kaa	27	1289	36	60	307	4	8	26	8	66	22	43	10	4	461	
Nona Ai	9	304	13	17	96	1	2	6	2	12	6	10	2	1	140	
Akrot	75	2755	16	489	956	7	15	47	13	99	34	78	18	6	1265	
Kapichar	1	37	-	11	22	-	1	3	2	6	5	10	1	-	56	
Kaba Khat	3	109	-	57	64	1	2	6	2	12	5	10	2	1	129	
Bara Ambaria	2	80	-	20	30	1	1	6	2	6	5	12	1	6	70	
Mama Khat	2	75	-	30	46	-	1	3	1	6	3	6	1	-	70	
Sofa Ambaria	1	17	-	11	18	-	1	3	1	6	3	6	1	-	36	
Kach Khat	10	768	-	237	440	3	7	21	4	42	11	24	4	3	569	
Nandebaria	7	327	-	66	136	2	6	15	4	30	11	23	5	2	256	
Kokimori	6	150	-	80	103	1	2	3	2	12	6	16	2	1	148	
Malar Char	23	1722	-	466	696	6	16	46	13	95	36	72	17	6	1000	
Kata	6	51	-	20	73	1	2	6	2	12	5	12	2	1	66	
Ve Kamal	10	172	-	47	-	28	-	-	-	-	-	-	-	7	35	
Chandbaria	5	90	-	24	30	6	-	-	-	-	-	-	-	-	56	
Bandar Khat	8	182	-	45	99	4	-	-	-	-	-	-	-	-	103	
Dara Kala	21	522	-	140	265	-	-	-	-	-	-	-	-	-	265	
Mara Khat	10	198	-	54	128	-	-	-	-	-	-	-	-	-	128	
Kharan	28	358	-	94	256	-	-	-	-	-	-	-	-	-	256	
Roa Tang	11	317	-	35	64	5	-	-	-	-	-	-	-	-	64	
Itan Char	7	182	-	45	66	9	-	-	-	-	-	-	-	-	54	
Pawa Suli	20	328	-	69	102	20	-	-	-	-	-	-	-	-	122	
Bhata Kayla	16	178	-	40	58	6	-	-	-	-	-	-	-	-	66	
Deep Char	16	113	-	37	70	-	-	-	-	-	-	-	-	-	70	
Malar Moha	17	156	-	56	66	-	-	-	-	-	-	-	-	-	66	
Pakra Tal	33	263	-	71	66	14	-	8	-	-	-	-	-	-	108	
Mandar Bais	19	141	-	40	60	-	-	-	-	-	-	-	-	-	60	
Reymongal Pura Khat	40	328	-	96	142	8	-	-	-	-	-	-	-	-	150	
Talpat Ramongal	2	28	-	7	8	2	-	-	-	-	-	-	-	-	10	
Kaman Daga	6	54	-	15	23	1	-	-	-	-	-	-	-	-	24	
Total	414	11826	78	2547	4740	134	89	250	61	426	187	353	70	41	6294	

Source: Draft report of the Committee for study of the problems and needs of fishermen engaged in coastal fishing in and off the Sundarbans area (1988), Ministry of Fisheries and Livestock.

Set Bagnet Fishery

The set bagnet (Behundi jal), a traditional fishing gear in the Bay of Bengal region, is being operated by small-scale (artisanal) fisherfolk in Bangladesh, Indonesia, Malaysia, Myanmar and Thailand. However, with some regional variations in designs and made the gear is more dominant in Bangladesh (Figure 6) than in any of the other countries. In Sundarbans fishery, of the ten types of gear employed for fishing, the set bagnets constitute 75 per cent.

Figure 6. The set bagnet of Bangladesh



The set bagnets used in artisanal fishery can be classified into:

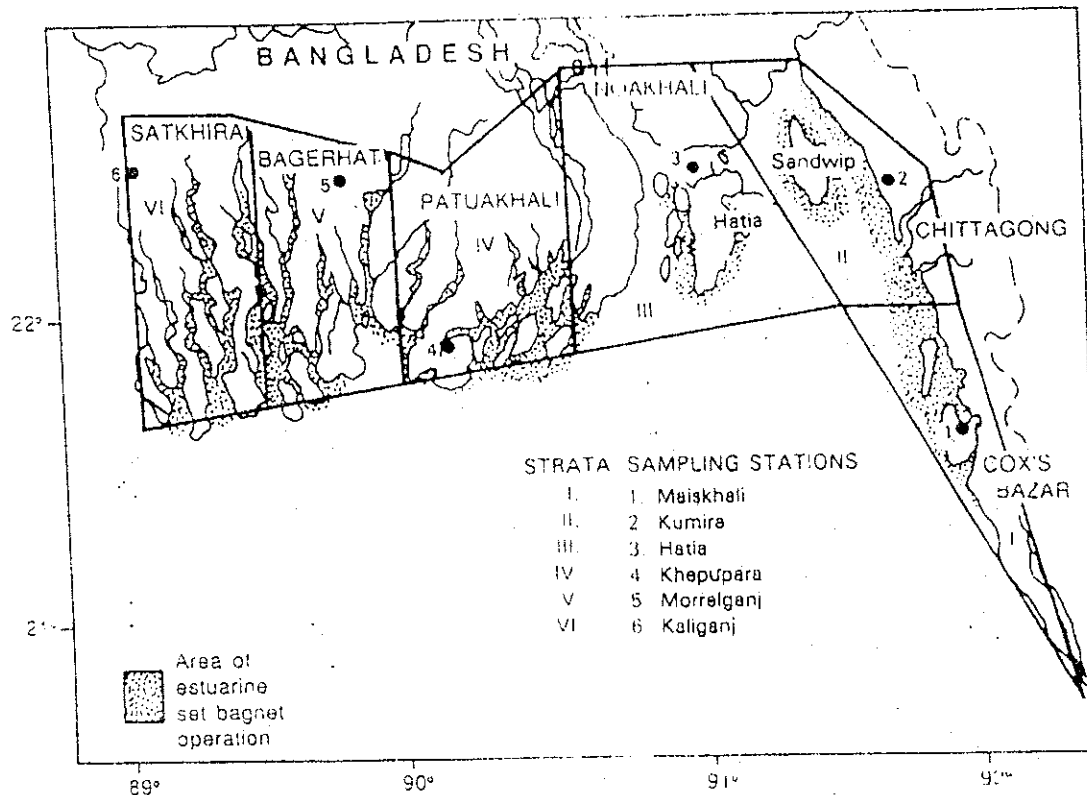
- i. Estuarine Set Bagnet (ESBN)
- ii. Marine Set Bagnet (MSBN)

8.1 Estuarine Set Bagnet Fishery

The ESBN fishery covers a vast coastal area. It embraces almost all the brackish water bodies, channels, tributaries and also the open sea waters where there is a heavy out flow of fresh water from the major rivers of Bangladesh. The set bagnet makes an efficient gear for capturing a wide range of finfish and shellfish species. But it at the same time captures a wide size-range of these animals, including juveniles.

The Marine Fisheries Survey, Management and Development Project studied the estuarine set bagnet fishery in 1989/90 with particular reference the seasonality in catch rates, species and size composition of catches as well as some biological characteristics and parameters of major peraeid shrimp and finfish. Six sampling stations were selected for detailed data collection which represent the six areas covering the 650 km coast line of Bangladesh, as well as the estuarine tributaries (Figure 7).

Figure 7. Areas of set bagnet (estuarine) operation in Bangladesh with sampling stations

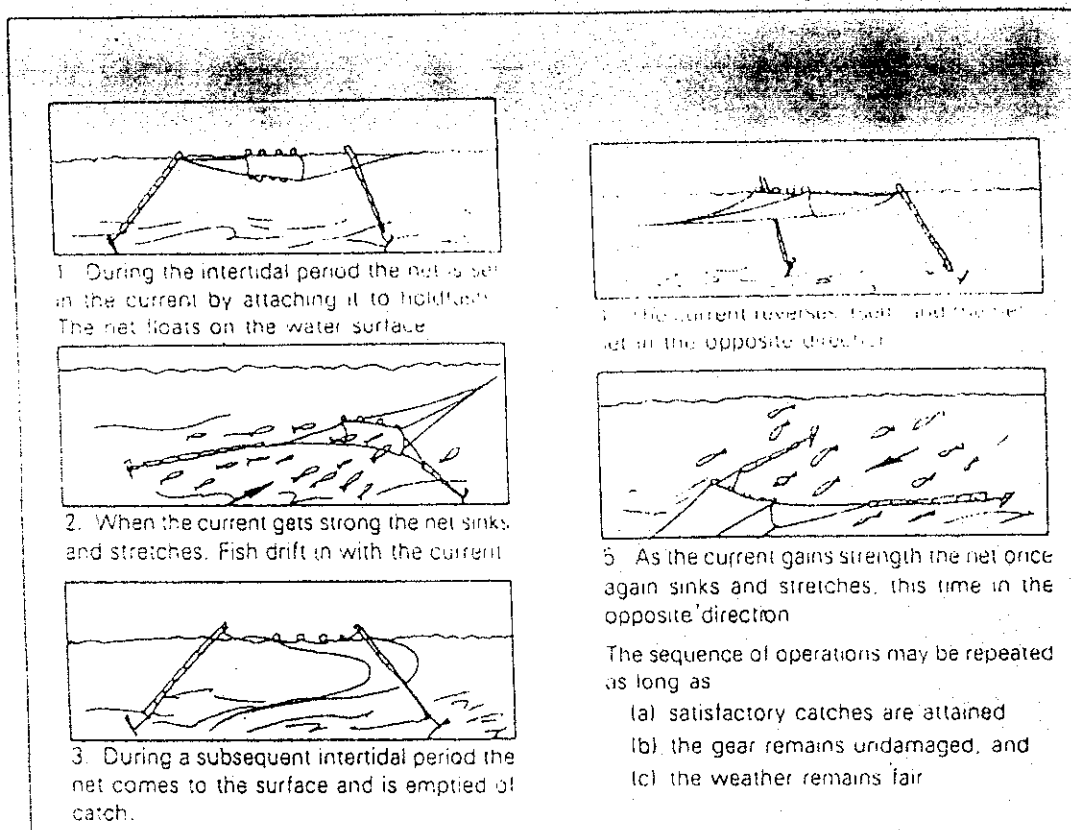


For sampling purposes, the nets used were classified into four sizes based on the measurement of month opening as follows:

Gear size category	Width of month (m)	Area of month (m ²)
G1a	<6	<15
G1b	6-10	15-50
G1c	10-15	50-90
G1d	>15	>90

The set bagnet catches those species of fish which drift with the current or do not swim fast enough to stem the current and, thus, maintain a fixed position in relation to seabed. During each slack period, the net rises to the surface and is emptied; it is then turned over to face the opposite direction and made ready for fishing again (Figure 8).

Figure 8. Operation of set bagnet (behundi jal)



The net is made up of four panels. The mesh size decreases from 140-20 mm at the month to 22-5 mm at the codend. The length of the net varies from 8.5 m to 41 m and the height of the month opening is 2-27 m. Particulars on size, material and costs of different nets found in different stations are given in Table 15.

Table 15: Characteristics of the estuarine set bagnet operated in different stations

Station	Gear size category (Code)	Mouth opening width (pole to pole) m	Mouth opening height (m)	Length of net (m)	Cod-end mesh size (mm)	Material	Avg. life (yrs)	Original cost (Tk)	Replacement cost (Tk)
I Maikhal	G1b	8.3-10.0	5.0-6.2	22.8-36.6	12	Nylon	6-7	5000-11000	15000-25000
	G1c	10.6-12.3	6.0-6.8	35.5-41.1	12-13	Tyrecord	6-7	3500-35000	20000-35000
II Kumira	G1a	3.6-6.0	2.6-3.5	13.0-20.0	10-15	PA & PE	8-12	7500-14000	10000-16000
	G1b	8.5	3.0-3.5	18.2-20.0	10-15	" "	10-15	10000-14000	14000-17000
III Hatia	G1a	5.1-5.9	3.0-6.1	12.3-18.0	12-22	Nylon	5-7	5000-15000	8000-20000
	G1b	6.2-10.0	3.6-5.5	15.3-22.9	11-16	" "	5-7	7000-15000	9000-25000
IV Khepupara	G1a	5.4-5.5	1.8-2.7	11.4-11.6	10-12	PA & PE	3-5	2250-3000	4000-6000
	G1b	6.9-9.1	3.2-3.7	23.3-32.0	8-12	Tyre cord	4-6	4000-12000	4500-15000
	G1c	11.4	4.6	34.3	10	" "	5-6	4500-8000	5500-85000
V Morreiganj	G1b	7.5-9.0	2.0-3.0	11.5-16.5	8-15	Nylon	4-12	4000-7000	8000-12000
	G1c	11.0-15.0	3.0-5.5	17.5-30.0	10-15	Tyre cord	7-10	9000-15000	18000-20000
	G1d	20.0	5.0	40.0	10-15	" "	10	20000-25000	25000-35000
VI Kailganj	G1a	5.4-5.8	2.7-5.4	12.6-27.0	10	Nylon	7-15	2000-8000	3500-8000
	G1b	6.3-7.2	2.7-5.4	13.5-27.0	8-14	" "	6-20	3000-10000	5000-15000

About 12,560 set bagnets were estimated to be operating in the estuarine areas of Bangladesh, out of which more than half were in Cox's Bazar and Chittagong. Details are given in Table 16. Of the gear size categories, Gla and G1b were the dominant ones (37 per cent each), followed by G1c (24 per cent). The G1c and G1d categories were operated mainly in the seasonal MSBN fishery, but some of these nets were also operated in the estuarine sector during the rest of the year.

Table 16: Distribution of set bagnets of different sizes in the six strata (percentages in parentheses)

No.	Stratum	Number of units of gear by size category				Total	Percentage distribution by area
		G1a	G1b	G1c	G1d		
I	Cox's Bazar	—	958 (30)	2274 (70)	—	3232 (100)	26
II	Chittagong	1994 (65)	1087 (35)	—	—	3081 (100)	25
III	Noakhali	1420 (70)	609 (30)	—	—	2029 (100)	16
IV	Patuakhali	613 (22)	1533 (56)	613 (22)	—	2759 (100)	22
V	Bagerhat	—	183 (44)	167 (41)	63 (15)	413 (100)	3
VI	Satkhira	592 (57)	455 (43)	—	—	1047 (100)	8
	Total	4619 (37)	4825 (38)	3054 (24)	63 (1)		100

8.1.1 Craft in the Estuarine Set Bagnet Fishery

The majority of the craft used in the ESNB fishery are nonmotorized. The fishing craft are grouped into four classes, based on their overall length: Class 1 = up to 5m, Class 2 = 5-8m, Class 3 = 8-12 m and Class 4 = above 12 m. Particulars of the different types and classes of craft and the minimum number that operated at different stations are given in Table 16.

Table 17: Characteristics and numbers of fishing craft used in estuarine SBN fishery at different stations

No.	Stations	Type	CODE	Length range (m)	Engine (hp)	Minimum number used in the fishery	Crew/Craft (no)	Gear/Craft (no)	Av. Life (yr.)	Original cost (Tk)	Replacement cost (Tk)
1.	Kheopara	SBN craft	4C2	5.1-8	—	1104	2	1-2	2-5	800-7000	1000-7500
			4C3	8.1-12	—	176	2-3	1-2	3-4	3000-7000	5000-8000
2.	Morrelganj	SBN craft	4C2	5.1-8	—	11	1	1-2	6-7	3000-7000	10000-13000
			4C3	8.1-12	—	143	1-3	1-2	4-20	2000-20000	4000-35000
			4C4	>12.1	—	53	2-3	1-2	5-20	6000-33000	8000-35000
3.	Kaliganj	SBN craft	4C3	8.1-12	—	363	2	1-2	7-30	1000-16000	4000-16000
			4C4	>12.1	—	161	2	1-2	15-40	5000-9000	10000-20000

The cost of the craft of the same class/type varied by station, probably due to differences in the price of timber which depends on type and quality. The average life of a craft also varied.

8.1.2 Species Composition

A total of about 185 species or groups of species of finfish and shellfish were identified in the ESNB catches. These included 15 penaeid shrimp, 3 nonpenaeid shrimp, 9 freshwater prawn, 3 crab, 3 molluscs, 90 pelagics and 62 demersal finfish. The annual average species composition by area and gear size class is given in Table 18 (facing page).

Table 18: Annual percentage composition of species (by weight) at Morrelganj & Kaliganj

S. No. species	Morrelganj			Kaliganj	
	Glb	Glc	Gld	Gla	Glb
A. SHRIMP					
1. Penaeidae (Shrimp)					
P. monodon (Tiger Shrimp)	0.0	0.0	0.0	0.2	0.3
P. indicus (White Shrimp)	0.0	-	-	-	-
M. monoceros (Brown/Speckled Shrimp)	2.2	0.2	0.0	1.2	0.9
M. brevisornis (Yellow Shrimp)	15.4	1.4	0.4	5.2	6.2
M. spinulatus (Spinulated Shrimp)	-	0.0	0.0	0.0	0.2
P. sculptilis (Rainbow Shrimp)	0.5	0.1	0.1	3.5	2.2
P. styliifera (Kiddi Shrimp)	0.5	0.0	0.0	2.6	2.3
Other penaeids	-	-	-	0.5	1.1
Subtotal	18.6	1.8	0.5	13.3	13.2
2. Palaemonidae (prawn)					
M. rosenbergii (Giant River Prawn)	1.3	0.1	0.1	0.2	0.1
P. styliferus (Roshana Prawn)	1.6	0.2	0.0	4.9	4.3
Other Palamonides	15.1	1.1	0.5	7.4	8.9
3. Acetes indicus (Sergestid Shrimp)	3.4	0.3	0.1	1.5	0.5
B. CRAB	2.0	91.8	94.8	23.7	31.4
C. FISH					
1. Ariidae (catfish)	0.1	0.0	-	0.3	0.2
2. Engraulidae (Anchovies)					
S. tri (Anchovies)	1.5	0.1	-	0.1	0.0
S. taty (Hairfin anchovy)	0.3	0.0	0.2	0.1	0.1
C. dussumieri (Grenadier Anchovy)	1.1	0.5	0.0	19.6	12.4
Thryssa spp. (Anchovy)	0.3	0.0	1.0	0.0	0.7
Subtotal	3.1	0.6	1.2	19.8	13.2

3.	Carangidae (Trevallies)	-	-	-	-	-
4.	Clupeidae (Shad/Herrings)					
	H. ilisha (Hilsa Shad)	0.2	0.0	0.0	-	-
	Other clupeids	6.0	0.5	0.3	0.2	0.2
5.	Gobiidae (Goby)	16.8	1.0	0.1	8.7	8.2
6.	H. nehereus (Bombay Duck)	0.0	0.0	-	2.3	2.4
7.	Mugilidae (Mullet)	4.1	0.4	0.1	0.2	0.3
8.	P. hasta (Javelin Grunter)	0.0	-	-	-	-
9.	Polynemidae (Threadfin)					
	P. paradiseus (Paradise Threadfin)	0.4	0.1	0.3	0.1	0.1
	H. tetradactylum (Four Finger Threadfin)	0.5	0.0	-	0.1	0.3
10.	Sillaginidae (Sillago)					
	S. domina (Gengetic Whiting)	0.3	0.0	0.1	-	0.0
	S. sihama (Silver Whiting)	-	-	0.0	-	0.0
	Subtotal	0.3	0.0	0.1	0.0	0.0
11.	Sciaenidae (Croaker)	8.3	1.0	0.7	3.9	3.6
12.	P. argenteus (Pomfret-silver)	-	-	-	-	-
13.	L. savala (Hairtail)	-	-	-	0.1	0.0
14.	Other finfish	17.8	1.0	1.3	9.0	8.0
15.	Other invertebrates	0.3	-	-	4.3	5.1
	Grand Total	100.0	100.0	100.0	100.0	100.0

The proportion of shrimp in the catches were high in Kaliganj, and in the G1b net in Morrelganj. The Yellow Shrimp (*M. brevicornis*) was the dominant species in both Morrelganj and Khaliganj.

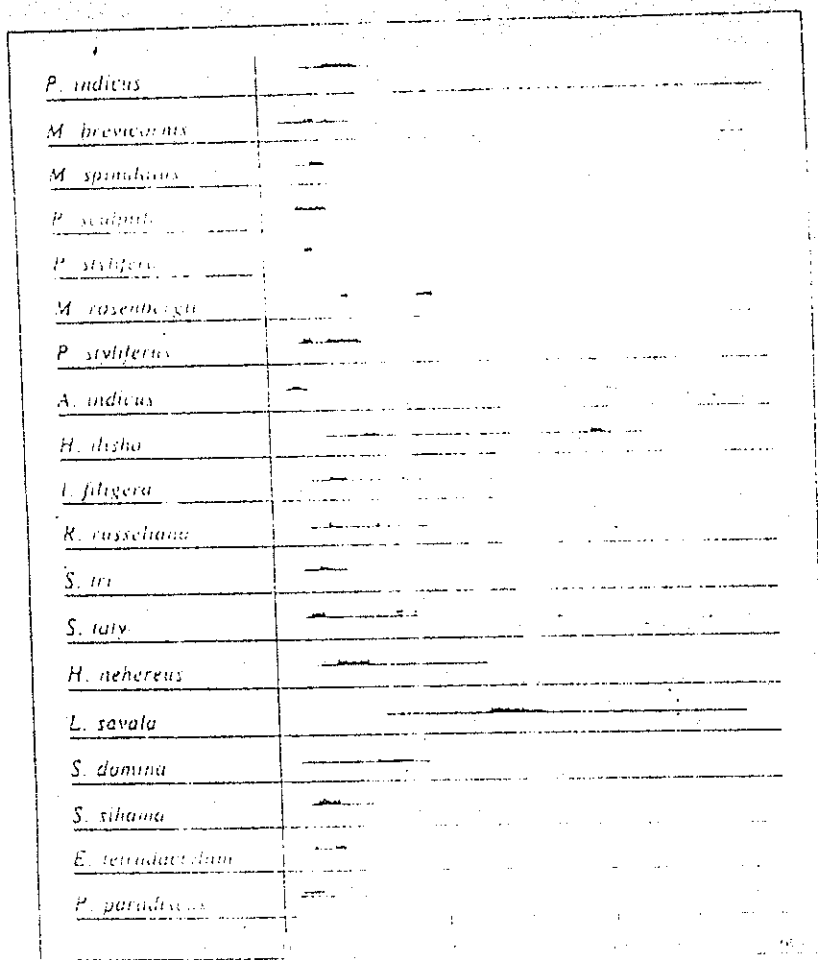
Abnormally high catches of swimming crabs in one month in Morrelganj (for G1c and G1d classes) and, to a lesser extent, in Kaliganj have given this group a very high value in the total percentage composition, particularly in Morrelganj.

Among the finfish, the Anchovy (Engraulidae) showed high contributions in Kaliganj (13-20 per cent). The dominant species was *C. dussumieri*.

The sizes of major shrimp and finfish caught in the ESN are shown in Figure 8.

Fig 9. Length range (cm) of major shrimp and finfish caught by estuarine SBN

Fig 9. Length range (cm) of major shrimp and finfish caught by estuarine SBN and frequencies of annual production in size classes of *P. monodon* and *M. monaceros*



The penaeid shrimp were mostly in the 2-15 cm range, except for the Tiger Shrimp (*P. monodon*) which were 5-20 cm. Annual length frequency for the whole area (pooled data) showed two peaks, one at 8 cm and the other at 11-15 cm, which indicated that they were mostly juveniles and immature. The predominant length of Brown Shrimp was 5-7 cm but there were several of smaller sizes, some even as small as 1 cm. They included a large proportion of juveniles and immature ones. Based on field observations during trawl surveys, Tiger Shrimp and Brown Shrimp are considered to mature when they are about 18 cm and 9 cm respectively.

The size range of the Freshwater Giant Prawn (*M. rosenbergii*) caught in the set bagnet in the estuarine waters was 6-26 cm. This included juveniles and adults. The predominant sizes were 8-9cm and 16-18cm. Unusually, eggbearing females were found at station in the western part of Bangladesh.

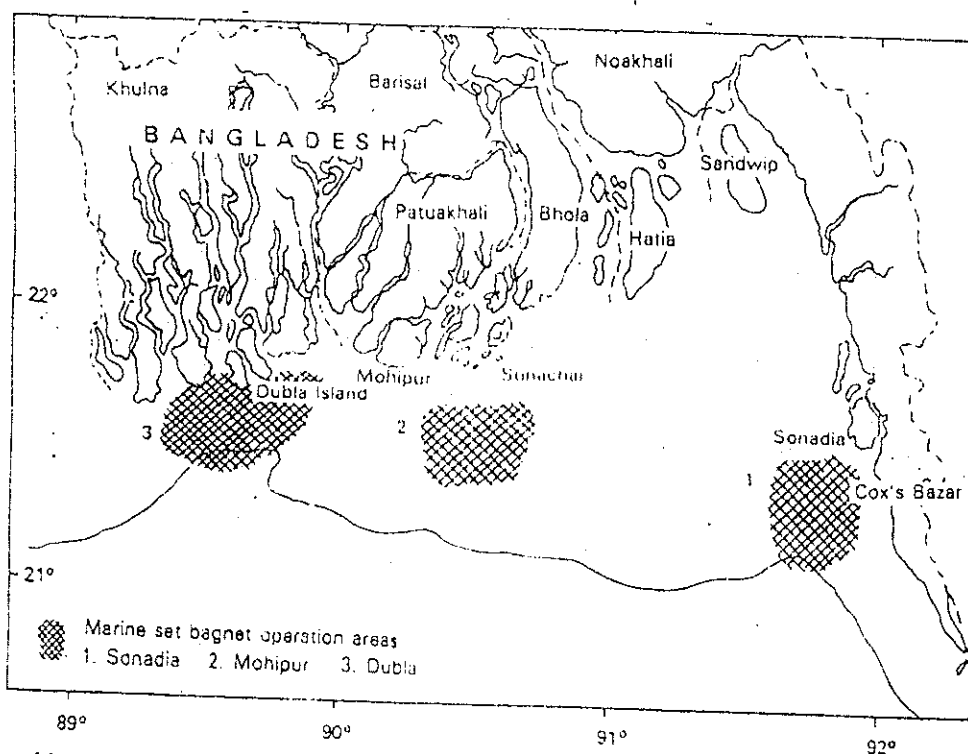
A comparison of the size ranges of most of the finfish caught, with the maximum sizes recorded for these species in the region, indicated that the ESN was mainly catching juveniles.

8.2 Marine Set Bagnet Fishery

According to existing fisheries statistics (1992-93), the annual marine fish production in Bangladesh is around 250,500 mt. The small-scale (artisanal) fisheries contribute 95 per cent of this production (238,300 mt) and 28 per cent of this (66,700 mt) is reported to be from set bagnet (SBN) of which marine set bagnets (MSBN) contribute about 27 per cent (18000 mt).

Marine Fisheries Survey, Management and Development Project, Department of Fisheries, Chittagong carried out studies in Mihipur and Dubla in January and March 1991 and in Sonadia in January 1991 to estimate the catch, effort, size composition and species composition of MSBN fishery (figure 10).

Figure 10. Areas of marine set bagnet operation in Bangladesh



Monthly species composition was estimated for Sonadia using the data collected during the earlier period, but for the other two areas it was established on the basis of the two surveys conducted in 1991.

Surveys were carried out, in Mohipur and Dubla in January and March 1991 in Sonadia in January 1991, to estimate the catch, effort, size composition and species composition.

8.2.1 Fishing Ground and Season

The MSBN is operated in a depth range of 10 - 30m in areas where the salinity is 20-30‰.

The fishing season is during the winter months, when there is no freshwater run-off. The fishery is suspended during the summer months, mainly because fishermen find it difficult to operate the gear under monsoon weather conditions.

MSBN fishing usually starts after the Southwest Monsoon and continues until the end of the Northeast Monsoon:

- In Sonadia, operations start around mid-September and continue up to February;
- In Mohipur, fishing starts in October and continues up to mid-March; and
- In Dubla, fishing is from October till the end of January.

8.2.2 Fishing Gear and Craft

The Gear

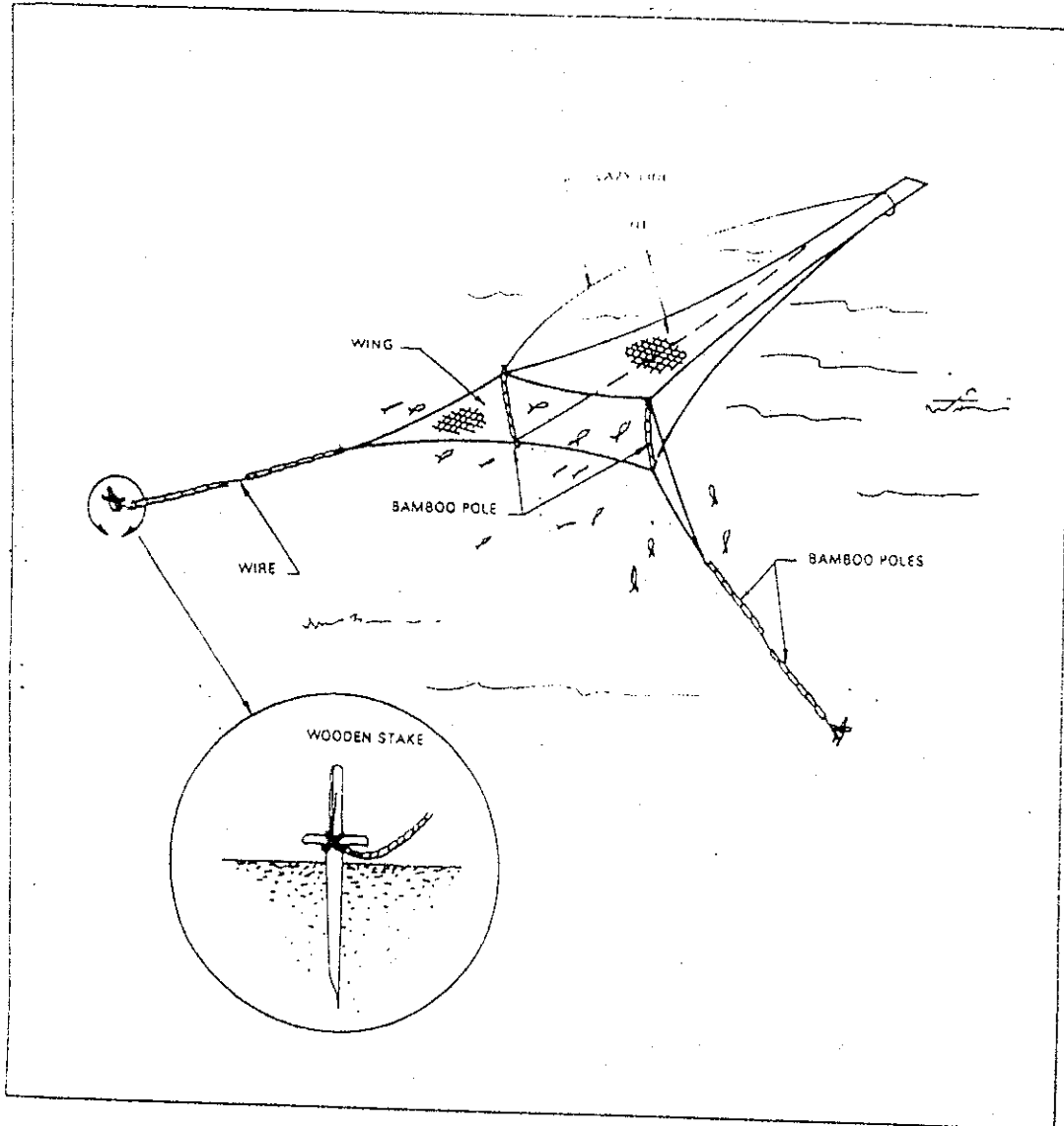
According to a pilot survey of the SBN fisheries of Bangladesh (Kashem and Iqbal, 1985), the number of MSBN in Sonadia was 549, in Mohipur 289 and in Dubla 2248, totalling 3086. According to the fisheries statistics of Bangladesh (DOF 1987/88), the total number of seasonal SBN, i.e. MSBN, was 5400. According to the pilot survey of this study in 1991, the total number of MSBN was estimated at 3852 (Table 19) - 65 per cent of them in Dubla, 24 per cent in Mohipur and only 11 per cent in Sonadia.

Table 19: Number and Particulars of Marine Set Bagnets Used in Different Areas

Fishing area	Gear class code	No. of gear	Width of opening (m)	Length of wings (m)	Length of net (m)	Depth of month opening (m)	Cod end mesh (mm)	Original cost (Tk)
Sonadia	Glc	415	11-15	10-16	18.5-35	5-8	12-25	25,000-35,000
	Gid	7	15.5-20	15.5-20	35-40	7-8	15-25	30,000-38,000
Mohipur	Glc	930	10.2-12.8	10.2-11.4	18.3-25	3.2-4.6	12	9,000-30,000
Dubla	Glc	2125	10-25	9-16	22-36	3.7-6.9	12-18	12,000-30,000
	Gid	375	15-23	15.5-23	34-36	6-6.9	15-18	30,000-35,000
TOTAL		3852						

The length of a MSBN varies from 18 to 40m. Its structure and shape and method of operation are similar to that of the estuarine set bagnet. A diagram of the set bagnet operated in the marine sector is shown in Figure 11 (facing page).

Figure 11: Traditional set bagnet



The Craft

Both motorized and nonmotorized craft are used in the MSBN fishery. The motorized craft are used both for fishing and as carrier boats. Details of different sizes and types of craft used in different areas are given in Table 20.

Table 20: Particulars of craft used in marine set bagnet fisheries in different areas

Area	Type of craft	Length (m)	Engine power (hp)	Crew/craft (no)	Gear/craft (no)	Avg. life (yrs.)	Original cost (Tk x 1000)
Sonadia	Motorized boat	> 12	15-22	08-12	5-8	8-10	300-500
	Motorized countrycraft	> 12	15-22	08-10	5-7	8-10	300-400
	SBN craft (nonmotorized)	8-12	-	06-08	3-4	5-6	050-060
Mohipur	Motorized boat	> 12	15-22	07-10	5-10	8-10	350-500
	Motorized countrycraft	> 12	15-22	05-08	5-8	8-10	300-400
	SBN craft (nonmotorized)	8-12	-	02-03	2-3	6-8	011-025
Dubla	Motorized boat	> 12	15-22	16-20	4-13	8-10	400-550
	Motorized countrycraft	> 12	15-22	10-15	4-8	8-10	400-500
	SBN craft (nonmotorized)	8-12	-	06-08	3-8	5-7	040-055

Motorized countrycraft and other motorized boats have engines of 15-22 hp in all three areas.

In Sonadia, 6-8 units of gear are operated by one motorized boat/countrycraft, while 3 or 4 units of gear are operated by one nonmotorized boat. In Mohipur, 5-10 units and in Dubla, 4-13 units are operated by a motorized boat/countrycraft. On the other hand, a nonmotorized countrycraft operates 2 or 3 gear in Mohipur and 3-8 in Dubla (Table 19).

The MSBN craft categories are similar in all three areas. However, their costs vary with area, mainly due to differences in availability and quality of the timber used and also due to the purchase of secondhand engines for the motorized craft.

8.2.3 Species Composition

There were 39 species/species groups identified in the MSBN catches, of which five were marine shrimp (penaeids), two freshwater prawn (palaemonids), one sergestid shrimp, one other mon-penaeid shrimp (solinoceran) and thirty finfish.

A comparison of the major species/groups in the three areas during January 1991 is given in Table 20 (facing page). The largest share of shrimp/prawn in the catches was recorded in Mohipur (17.8 per cent), followed by Dubla (11.1 per cent). The share of Rainbow Shrimp (*Parapenaeopsis sulptilis*) was approximately half in both areas. Yellows Shrimp (*M. brevicornis*) in Mohipur and Dubla, Kiddi Shrimp (*P. stylifera*) in Sonadia and a freshwater prawn (*Macrobrachium rudis*) in Dubla.

The finfish catches were dominated by the same three or four species in all areas, but their relative proportions varied between areas. In Sonadia, the Ribbonfish (*Lepturacanthus savala*) was dominant, followed by the Silver Pomfret (*Pampus argenteus*), Bombay Duck (*Harpodon nehereus*) and Anchovy (*Setipinna phasa*). Anchovy was the dominant group in Mohipur, followed by Bombay Duck and Ribbonfish. Dubla had Bombay Duck as the predominant species, followed by Ribbonfish and Anchovy.

Table 21. Major species/groups in the MSBN catches in the three areas during January 1991 (percentage by weight)

Species/Group	Sonadia	Mohipur	Dubla
a) Shrimp/Prawn			
Rainbow Shrimp	0.2	8.6	5.9
Sergestid Shrimp	-	4.3	-
Yellow Shrimp	-	2.9	2.1
Kiddi Shrimp	2.6	-	-
Freshwater prawn	-	0.7	-
M. rudis	-	1.1	3.1
Others	2.0	0.2	-
Subtotal	4.8	17.8	11.1
b) Finfish			
Anchovy	4.1	28.6	9.1
Bombay Duck	5.4	25.4	52.3
Ribbonfish	55.5	5.4	21.0
Silver Pomfret	7.2	-	-
Others	23.0	22.8	6.5
Subtotal	95.2	82.2	88.9

8.2.4 Catch Rate

The mean catch rate (kg/haul) estimated for different months in the different areas, the average number of hauls per day, the average number of MSBN gear operating per day and the number of active fishing days during each month are given in Table 22. There was no significant difference between the catch rates of MSBN categories G1c and G1d.

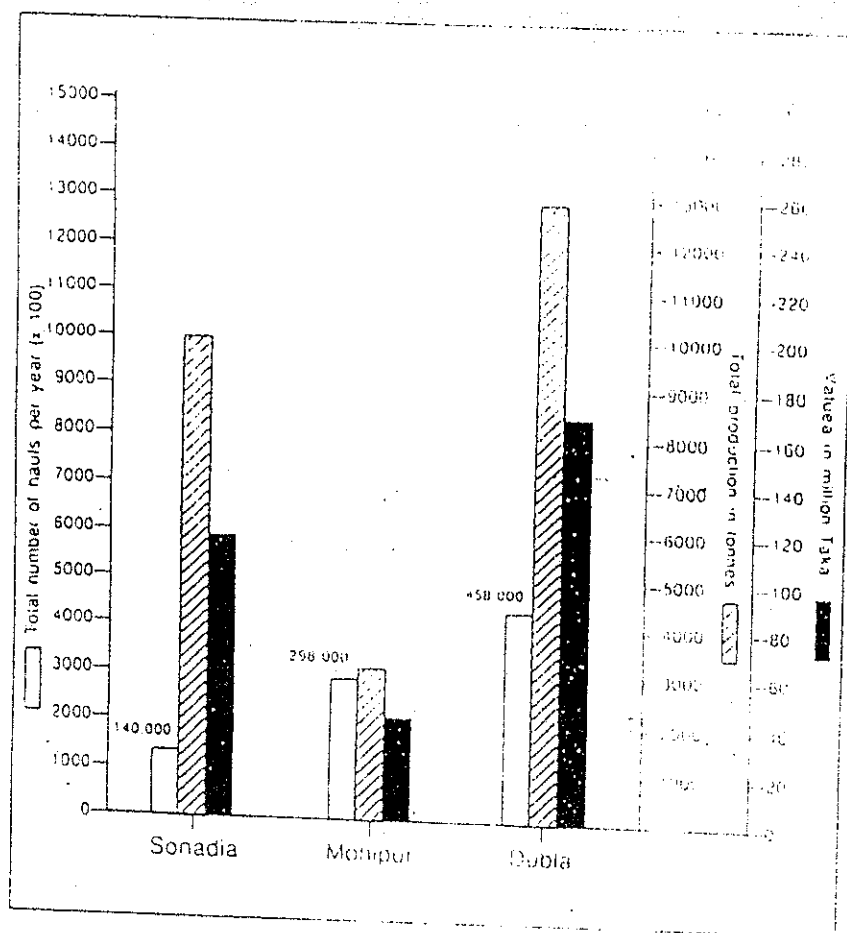
Table 22: Catch rate (kg/haul) and total production by marine set bagnets in different areas

Area	Period	Catch rate (kg/haul)	Hauls (no/day)	Gear in Operation (no/day)	Fishing effort (days/month)	Monthly production (t)	Fishing season (months/year)	Seasonal production (t)	Areawise production (t/year)	Total MSBN production (t/year)
Sonadia	Sept.	107.94	4	320	9	1,243				
	Oct.	67.07	4	355	18	1,714				
	Nov.	84.59	4	380	22	2,829				
	Dec.	64.90	4	370	22	2,113				
	Jan.	47.93	4	362	20	1,272				
	Feb.	48.37	4	325	9	565	5	9,736	9,736	
Mohipur	Mid Oct. to mid Jan. (peak)	11.90	4	777	22	814	3	2,442		
	Mid-Jan to mid March (lean)	7.80	4	650	18	365	2	730	3,172	
Dubla	Dec. (peak)	47.50	4	2125	22	8,883	1	8,883		
	Jan. to Feb (lean)	16.00	4	1875	18	2,160	2	4,320	13,203	
TOTAL									26,111	

8.2.5 Production

The estimated annual production was 9736 mt for Sonadia, 3172 mt for Mohipur and 13,203 mt for Dubla. Peak production was from October to December, October to January and in December for the three areas respectively. Total production for MSBN was estimated to be 26,111 t (Table 22) and production by area is shown in Figure 12.

Figure 12. Total number of hauls per year, the annual production and the gross value of the production of the marine set bagnet fishery (1991, Sonadia 1983-'86, '87, '91)



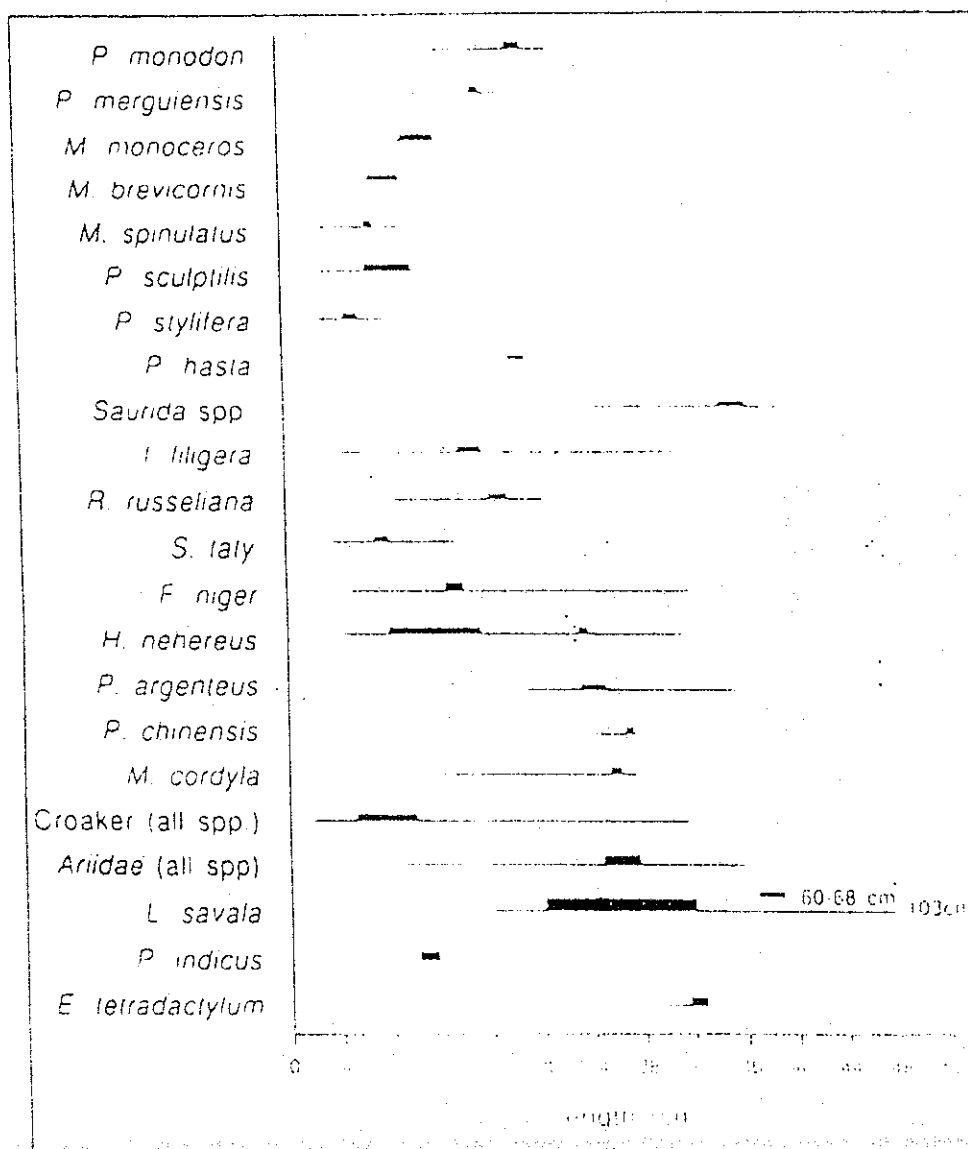
8.2.6 Size Ranges of Major Species

The size ranges of major penaeid shrimps and finfish caught in the MSBN fishery, based on information collected in 1983-1986, 1987 and 1991 are presented in Figure 26.

The penaeid shrimps were mostly 3-17 cm in length, except for the Tiger Shrimp (*P.monodon*) and Banana Shrimp (*P.merguensis*), which occurred at size ranges of 12-23 cm and 8-19 cm, with predominant sizes 19-20 cm and 15-16 cm respectively. Length range of Brown or Speckled Shrimp (*Metapenaeus monoceros*) was 6-13 cm, with predominant size 9-13 cm.

Size ranges of finfish were 2-43 cm, except Ribbonfish which occurred in the size range of 14-103 cm (predominant sizes being 20-32 cm and 60-68 cm). The size ranges of Bombay Duck, Silver Pomfret and Croaker were 4-32 cm, 9-35 cm and 2-33 cm respectively, with the predominant sizes 8-14 and 22 cm, 22-24 cm and 5-10 cm.

Figure 13. Total length range and predominant length range of major shrimp and finfish in marine set bagnet catches from Sonadia (1983-'86, '87, '91), Mohipur (1991) and Dubla (1991)



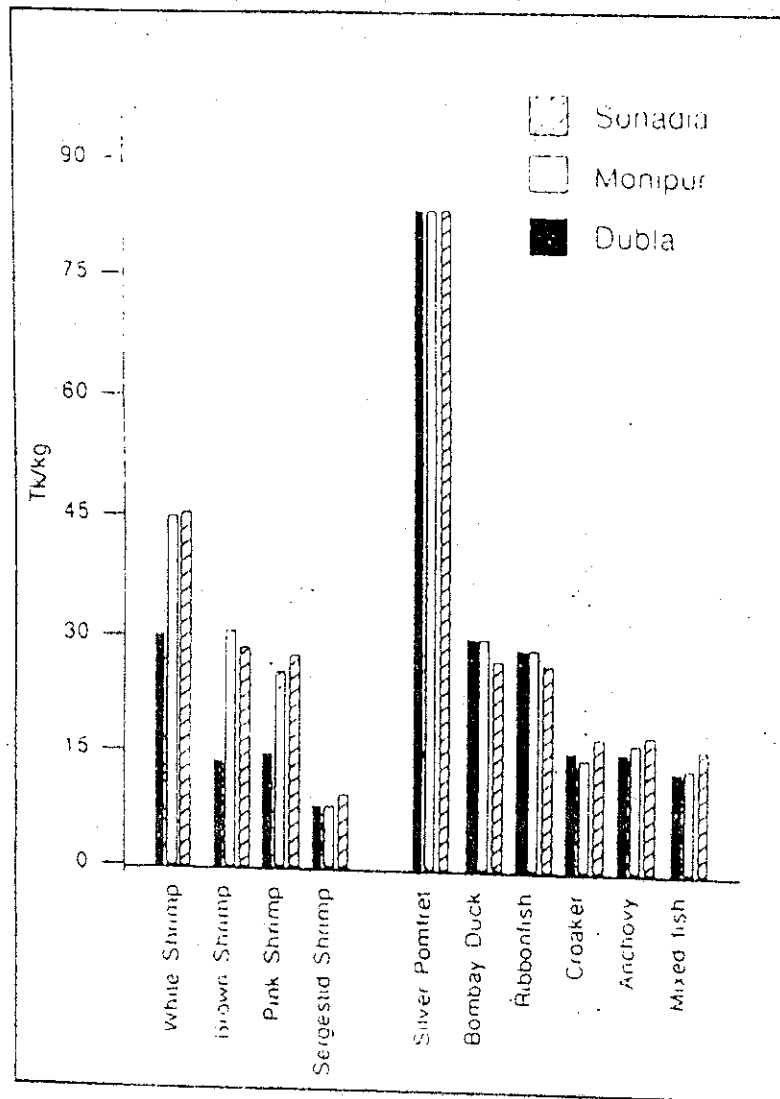
8.2.7 Economics of the Fishery

Prices of shrimp and fish

Price of Indian White Shrimp (*P. Indicus*) was higher in Sonadia than in the other two areas, while Brown Shrimp fetched higher prices in Mohipur. Price of dried fish is not much different in the three areas (Figure 14). Silver Pomfret fetched the highest price in all three areas.

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Figure 14. Price (Tk/kg) of wet shrimp and dry fish from the marine set bagnet fishery in different areas (1981)



Costs and earnings

An owner of a MSBN and supporting craft is locally known as a bahardar. He organizes the fishing units and may use his own craft and gear or, sometimes, hires craft and other equipment for the fishing season. At Sonadia, remuneration is based on a share system, but in Mohipur and Dubla both share and wage systems were observed. One, or a combination, of the two systems is applicable in all three areas. In the share system, the net income is divided into 74 shares and distributed as follows:

A. Bahardar's shares		
Boat (1 motorized)	2	shares
Set bagnets (15 units)	30	shares (2 shares per net)
Personal share as shore manager	1	
Subtotal	<u>33</u>	
B. Crew shares		
Majhi (1 no.)	1.5	shares
Majhi (2 nos. for rented boat)	3.0	
Engine driver (2 nos.)	2.5	(1.25 share per driver)
General crew (28 nos.)	28.0	(1 share each)
Shore labor (6 nos.)	6.0	(1 share each)
Subtotal	<u>41.0</u>	
Total	<u>74</u>	

The bahardar generally bears all expenses and these expenses are deducted from the gross revenue before the net revenue is shared. A typical operating unit comprises of two motorized craft (one generally rented) and one rented nonmotorized craft. These are used to operate 15 set bagnets. Table 23 (next page) and Figure 15 give details of the gross revenue, and costs. The operational cost includes hire of two craft, craft and gear repair, fuel, food, firewood, utensils, bamboo mats, drying racks, jute piling etc.

The costs, expenditure, profit and crew share for the entire fishing season for one net were as follows:

	Tk
Gross revenue	323,999
Total costs	<u>61,956</u>
Net revenue	<u>262,043</u>
Income to owner (33 shares)	116,856
Income from one net to all crew (41 shares)	145,186
Income per crew member for keeping 15 units of gear ($145,186 \times 15$)	53,117
	<u>41</u>

Figure 16. Costs and earnings analysis and net income of bahardar and crew per gear at Sonadia

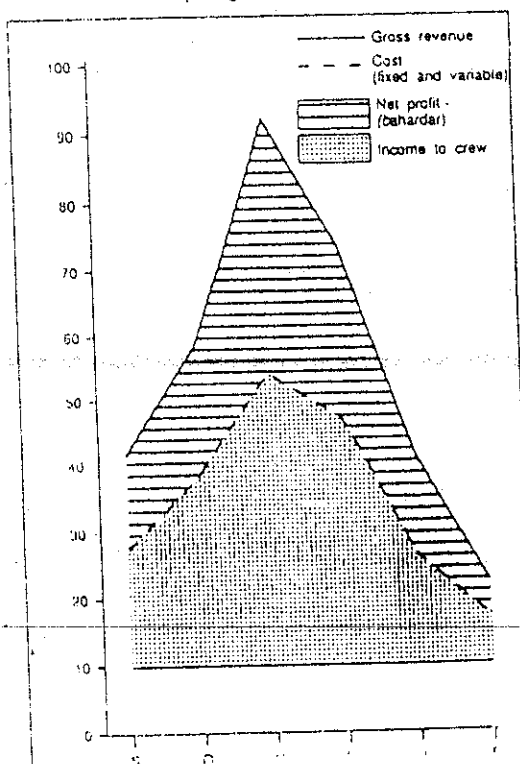


Table 23: Capital and operational cost of marine set bagnet unit at Sonadla (share system)

I. INVESTMENT COST

	Tk
1. One motorized fish carrier boat	400,000
15 set bagnets (Each Tk. 30,000)	450,000
Total	850,000

Depreciation	Yearly (6 month fishing)	Monthly (15 net)	Monthly per net
* Craft (10 years)	20,000*	3,333	222
Gear (5 years)	90,000	15,000	1,000
Operating cost	819,400	136,567	9,104
Total		154,900	10,326

* Only 50% of depreciation accounted for the fishery and the balance 50% attributed to other fisheries conducted during the remaining 6 months.

II. OPERATIONAL COST (including fish drying and shade-making materials)

	Taka
1. Piling	16,800
2. Bamboo	35,240
3. Jute	18,000
4. Miscellaneous (rope, nut, bolt, wire etc)	170,610
5. Utensils	8,750
6. Food items (including fire wood)	67,777
7. Diesel, Lub, oil	150,123
8. Mat	16,800
9. Boat and net repair	225,900
10. Boat hire charge (two boats)	110,000
	819,400

* The craft is used in other months as a carrier boat, on a rent basis

It was noted during the survey period that the shrimp catch, especially of exportable varieties was very low, and, hence, the price of shrimp was included under dried shrimp (Table 27). Normally, all the fish are sold after drying. When the fishing season ends, the drying racks, platforms and materials used in the fabrication of temporary shelter were auctioned by the bahardar, as these materials had been paid for by him.

As in the estimation of production from the catch per haul, for each area, the average value of a haul was raised for each area and for the season. The estimated total value of the annual production by marine set bagnets was Tk 117,578,657, Tk 35,686,378 and Tk 168,353,011 in Sonadia, Mohipur and Dubla respectively (Figure 12).

The study indicates that the marine set bagnet fishery contributes about 26,000 mt of fish and shrimp. This is higher than the estimate of 17,000 mt reported in the statistics of the Department of Fisheries. A total of 3852 units of gear are operated as approximately 250 operational units (each with 15 units of gear). Considering that a minimum of 40 people are engaged in each MSBN operational unit - for fishing, processing and marketing of the catch - approximately 10,000 people are estimated to be directly engaged in these activities in the MSBN fishery.

The economic analysis of a medium size set bagnet unit, consisted of one mechanized boat, five ordinary boats and ten nets, as given by the Committee for study of the problems and needs of fishermen engaged in coastal fishing in and off Sundarbans area shown below (1988):

(a) Initial Capital Investment (Life time 5 years)	Price (Taka)
1. Mechanized boat (22 HP)	180,000.00
2. Ordinary Boat 5 Nos. @ Tk. 25,000.00	125,000.00
3. Set Bag Net 10 Nos. @ 2 for each boat	150,000.00
	455,000.00
 (b) Operation Costs	
1. Fuel (For carrying catch)	70,000.00
2. Salaries of fishermen	100,000.00
3. Food for fishermen	100,000.00
4. Other expenses (Dram, wire, huts, etc)	50,000.00
5. Depreciation (Assume five years life time)	100,000.00
	420,000.00

Other expenses

1.	Interest on loan @ 30%	27,000.00
2.	Commission for Aratdar @ the 10 1/2% per metric ton	48,000.00
	Grand Total	<u>495,000.00</u> (Say 500,000.00)

(c) Quantity of fish harvested in a season and value

1.45 mt dry fish	600,000.00
2.2.3 mt shrimp	60,000.00
	<u>660,000.00</u>

(d) Net income

1.	Value of fish	660,000.00
2.	Total expenditure	500,000.00
	Net Income	<u>160,000.00</u>

It is noted that initial investment costs have been increased by 200 - 250 %, operation costs by 75 % and price of harvested fish by more than 200 %.

9. MARINE FISHERY

The marine fisheries catch comes from two production systems, industrial fisheries and artisanal fisheries. The total catch of marine fisheries in 1992/93 around 250,500 mt, 12,227 mt from industrial fisheries (Trawl fisheries) and 238,265 from artisanal fisheries. Presently, marine fisheries contributes 24.5% of the country's total production of 1,020,654 mt. The most effective gears used in the artisanal fishery are Gill Net and Set Bag Net and the two combined contributes around 80% of the total catch of artisanal fisheries. The trend of annual catch of Gill Net fishery and Set Bag Net fishery shown in Tables 24 and 25.

Table 24: Annual Catch of Mechanized and Non-Mechanized Gill Net Fishery

Unit: Metric Ton

Year	Mechanized		Non-mechanized		Total catch of mechanized and non-mechanized units
	No. of unit	Catch of fish	No. of unit	Catch of fish	
1991/92	2880	122935	3509	20078	143013
1990/91	2880	121966	3509	19983	141949
1989/90	2880	120234	3509	20969	141203
1988/89	2880	119184	3509	17285	136469
1987/88	2880	118276	3509	14614	132890
1986/87	2882	115997	3800	9898	125895
1985/86	2887	111000	3802	8500	119500

Source: DoF Fish Catch Statistics of Bangladesh.

Table 25: Annual Catch of Seasonal and all Season Set Beg Net Fishery

Year	Seasonal			All Season			Total (seasonal and all season)	
	No. of unit	Catch of fish		No. of unit	Catch of fish		Shrimp	Fish
		Shrimp	Fish		Shrimp	Fish		
1991/92	5400	4646	41814	7215	10609	12966	15255	54780
1990/91	5400	3220	42780	7216	8992	13489	12212	56269
1989/90	5400	3181	42289	7216	7990	12392	11171	54881
1988/89	5400	3150	41850	7216	6900	12004	10365	53854
1987/88	5460	3150	41850	7216	6472	11992	9622	53842
1986/87	5480	3031	41508	7165	600	11172	9031	52678
1985/86	5320	1000	42858	7295	500	16500	1500	59358

Source: DoF Fish Catch Statistics of Bangladesh

10 SHRIMP FRY COLLECTION

The tiger shrimp (Bagda) *Penaeus monodon* spawn in offshore waters of the Bay of Bengal, normally at a depth of water between 40-60 meters. But the larval and post-larval stages of this species live in the coastal mangrove areas, which constitute the nursery grounds, and subsequently, migrate to the sea as they grow to juvenile and pre-adult stages for further growth and development Figure 16. Contrary, giant freshwater prawn (Golda), *Macrobrachium rosenbergii* live in fresh water rivers and beels but migrate to the brackish water areas for breeding. The larval and post-larval stages of this species live in the coastal waters but migrate to the freshwater rivers and beels as they grow to juvenile and preadult stages for further growth and development. Taking the advantage of life cycle of both the species, post-larvae/fry are collected from Sundarbans and adjoining rivers and canals by three types of gear, such as fixed bagnet pushnet and dragnet Figure 17.

Collection of Bagda post-larvae for supplementary stocking of shrimp ghers begun in 1975-76 in the Satkhira district and collection of Golda fry begun in 1987-88 in Fakirhat thana of Bagerhat district and used for polyculture and subsequently for both poly and monoculture in ponds. Collection of Bagda post-larvae initiated in the late eighties in Sundarbans.

Bagda post-larvae are available in the brackish water rivers and estuaries year round, but abundantly between May and August. Golda post-larvae, however, available between April and December, but abundantly between July and September.

Reliable statistics do not exist on the number of post-larvae being trapped for culture at present. Kenneth Larson (1988) indicated that in the Satkhira District alone about 25,000 people were engaged in the collection of wild shrimp post-larvae. The annual collection there was estimated at 250-350 million, *Penaeus monodon* fry. Daily collection during peak season was 200 fry/day/gear (all types mixed) and average for the whole year was 70 fry/day/gear. The Forest Department records show more than 382 millions collected from the Sundarbans Table 25. The number of fry collected is 800% more than it was in 1987/88. This is a lucrative livelihood sources for young children and helpless women, particularly along the boundaries of Sundarbans Forest. The collection method is crude which kills eggs and larvae of other fish species.

Table 26: Year-wise production of Shrimp fry

Year	No. of Shrimp fry (in Mill)
1987/88	14.10
1988/89	30.42
1989/90	70.34
1990/91	72.69
1991/92	110.32
1992/93	127.98
1993/94	195.37
1994/95	382.24 (July-May)

Source: Divisional Forest Office, Khulna.

The Marine Fisheries Survey, Management and Development Project, Chittagong studied fry collection from November 1989 to October 1990. Sampling was conducted fortnightly, during New Moon and Full Moon, at high tide or at low tide depending upon the location and the commercial method of fry collection. The selected commercial shrimp fry collecting stations were Takenaf, Cox's Bazar, Khepupara, Moreigonj and Debhata as shown in the Figure 18.

Figure 6. Life Cycle of Tiger Shrimp
 Author: M. Ahsanullah

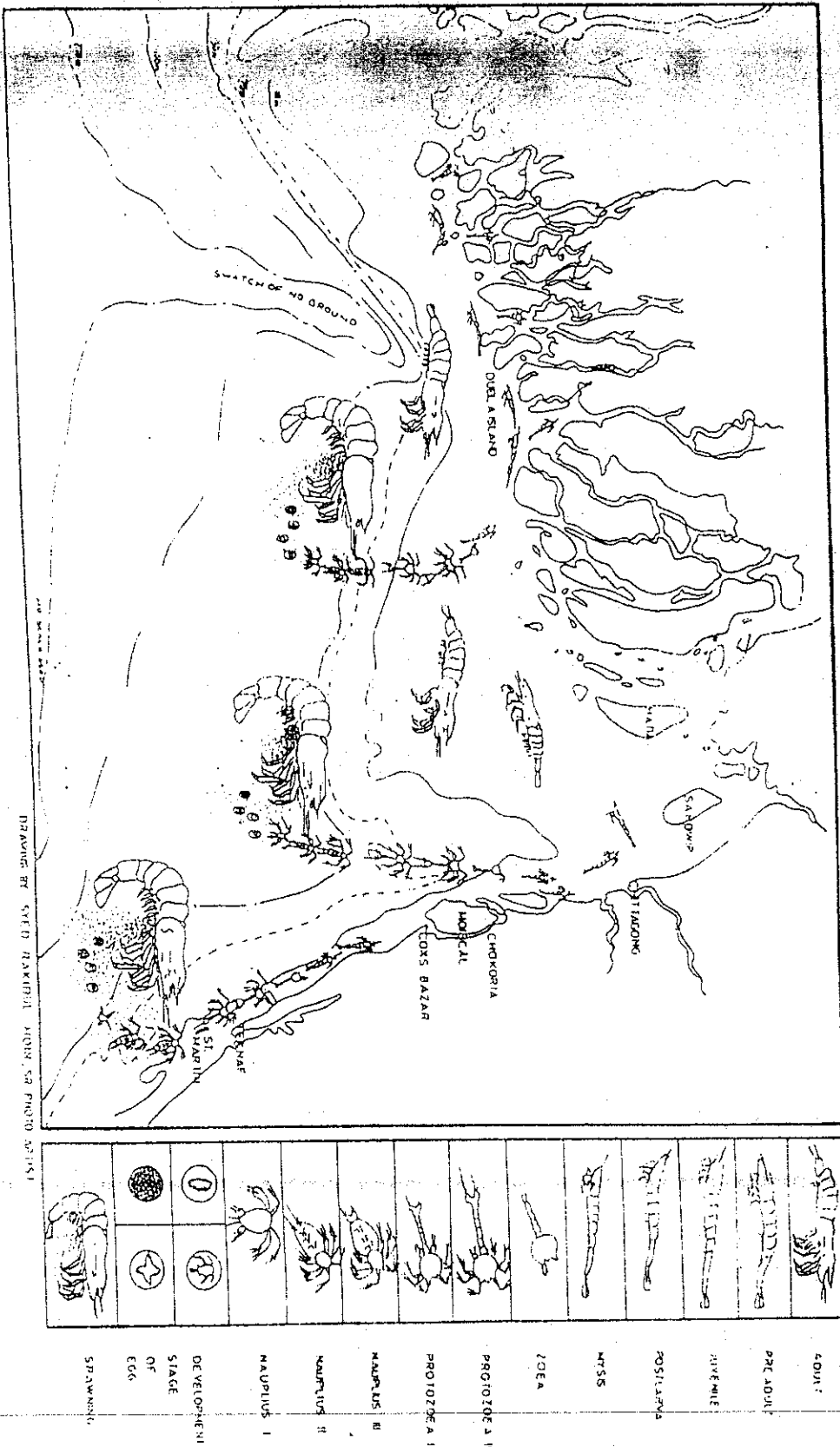


Figure 17. Fixed Bagnet, Pushnet and Dragnet Used In Shrimp Fry-collection

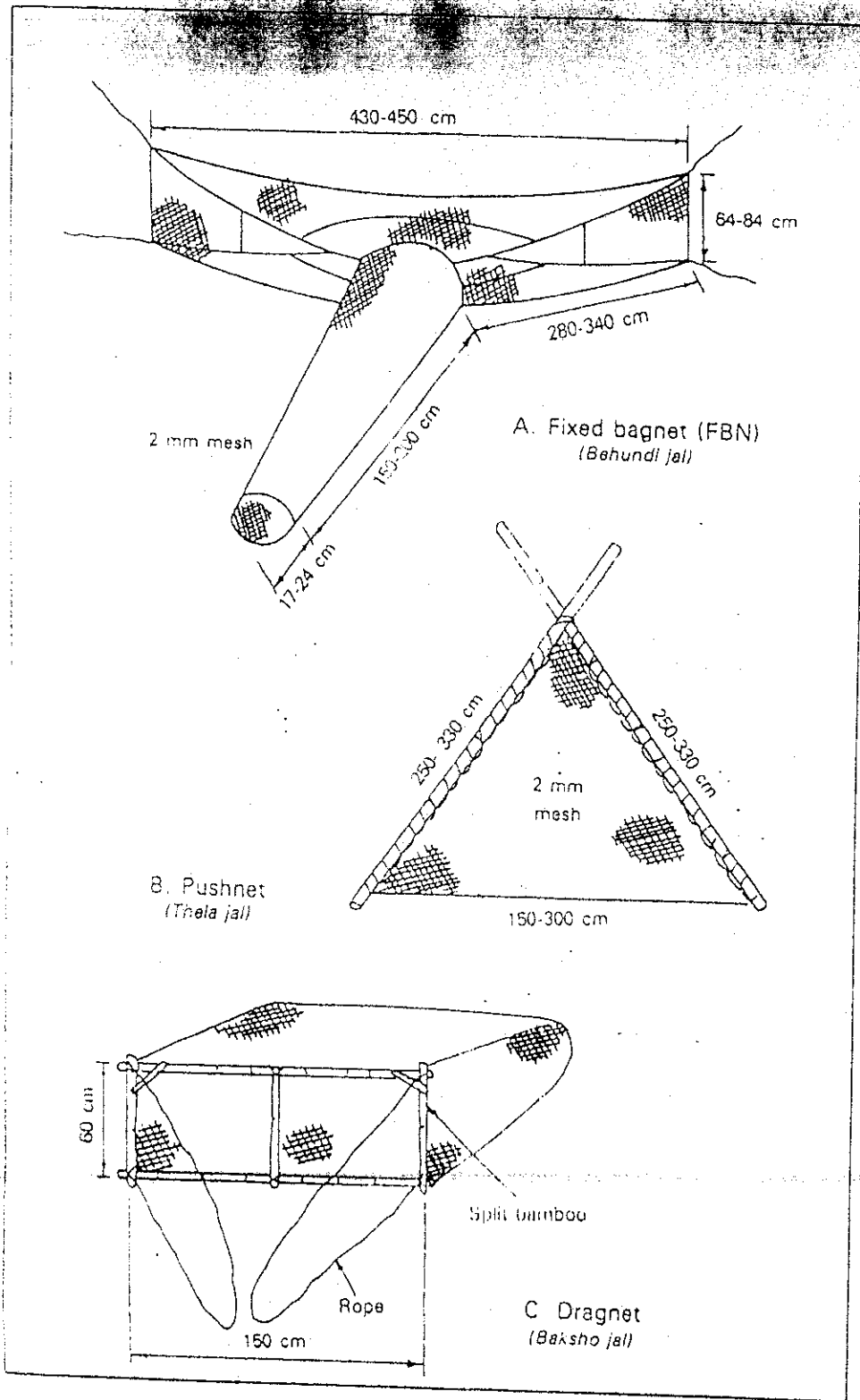
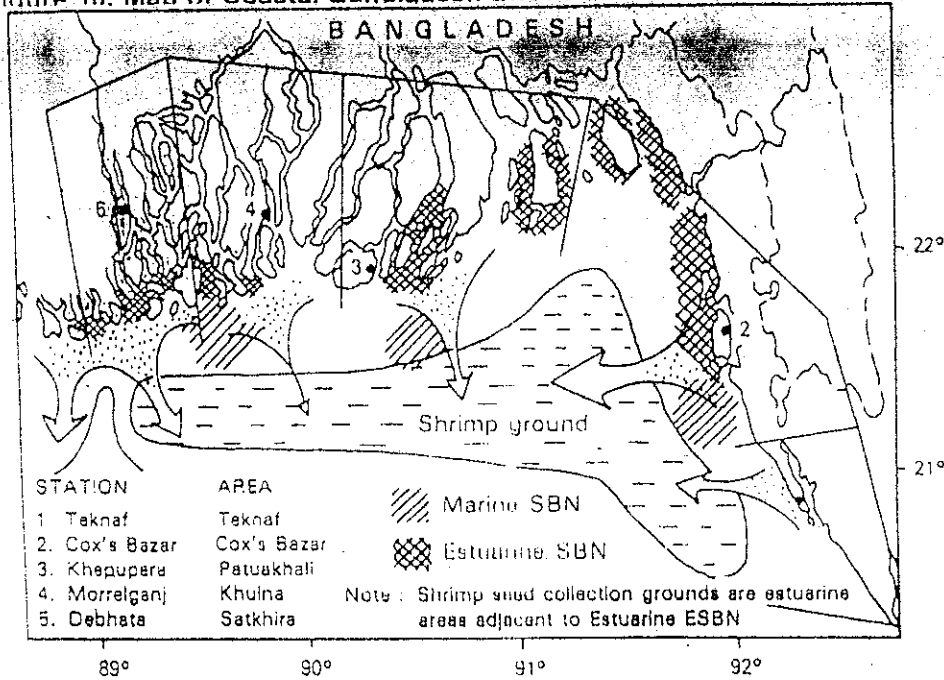


Figure 18. Map of Coastal Bangladesh Showing Shrimp Fry-collection Areas



This study shows that there were 60,000 collectors, and catch on average 35 fry/day/PN and 75 fry/day/FBN, and an estimated 2,035 million fry collected in 1989/90. Khulna-Sundarbans region contributes only 19 percent of the total quantity of *Penaeus monodon* post-larvae collected in Bangladesh. Significant losses from mortalities occur during transportation on bicycles and pots/canisters, and the numerous transfers and holding points before they reach the ponds. Average mortalities of 29 percent for *P. monodon* during transportation and of 70 percent in culture ponds would mean that only 483 million individual could be harvested from the 2,035 million fry collected in 1989/90. The production of shrimp post-larvae by different gears in different areas of the 1,362 km shoreline shown in Table 27.

Table 27: Total *P. monodon* Production by Shrimp Fry Gear in 1989-90 (in Millions)

Month	Teknaf		Cox's bazar		Patuakhali		Khulna		Satkhira		Total by gear		Grand total
	PN	FBN	PN	FBN	PN	FBN	PN	FBN	PN	FBN	PN	FBN	
November											7.4		7.4
December											13.9		13.9
January	2.8		13.2				14.2	3.5	7.3		97.9		138.6
February	7.8		89.8	106.3		16.4					97.3		220.3
March	15.1		559.8	29.5		117.5		8.2			114.1		842.2
April	2.0		58.8	111.9		5.8		1.0	8.7	15.0	70.5		204.2
May	3.8		112.8								22.1		138.7
June			74.2						43.2	2.9	117.4		120.3
July	11.2		52.4	24.5							63.6	25.3	88.9

Month	Teknaf	Cox's bazar		Patuakhali		Khulna		Satkhira		Total by gear		Grand total
	PN	PN	FBN	PN	FBN	DRAG	FBN	PN	FBN	PN	FBN	
August	17.5	30.9	-	3.8	-	-	-	-	21.2	52.2	21.2	73.4
September	102.6	-	22.5	-	-	-	-	-	-	102.6	22.5	125.1
October	0.4	58.2	-	-	-	-	-	2.1	-	60.7	0.0	60.7
Total (by gear in area)	163.0	1051.1	294.8	3.8	138.7	14.2	10.7	61.3	285.1	1283.4	740.3	2033.7
Grand total (by area)	163.0	1345.9		143.6		24.9		356.4		2033.7		2033.7
%	8	66		7		1		18		100		100

10.1 Catch Rate

The collectors used to collect 1,000-1,500 bagda post-larvae and 500-1,000 golda post-larvae per head per day in the past. But the number of post-larvae collected per head per day gradually declined over the past years and this year the number is very low, not more than 15-20 post-larvae per head per day.

10.2 Price of Post-Larvae

Initially the price of 1,000 post-larvae of both bagda and golda varied from Tk 120-150 and Tk 150-200 respectively. This year price varied from Tk 1,200-1,800 and from Tk 1,500-2,000 respectively.

A survey needs to be undertaken on an urgent basis to estimate the number of people engaged in fry collection and quantity of fry, both bagda and golda collected annually, as this have already affected tiger shrimp fishery of offshore waters of the Bay of Bengal (Fig.1) and threatened the continuation and expansion of shrimp culture in the Khulna region. Since 1994 there has been acute shortage of locally available shrimp fry and as such demand for shrimp fry are being met by importing post-larvae from Thailand, Indonesia and India.

10.3 Number of Shrimp Fry-collectors

The survey undertaken by Marine Fisheries project indicates that 120,000 - 200,000 persons are engaged in shrimp fry collection during March/April in the country but in Khulna - Sundarbans region the number of persons engaged may be 42,000-180,000. In Satkhira shrimp fry collected year-round expect for the months of February, September and October but in Khulna fry-collection period is January, March and April. Table 28 shows manpower engaged in shrimp fry-collection in the coastal belt of Bangladesh.

Table 28: Total manpower engaged in shrimp fry-collection in the coastal belt of Bangladesh (1989-90)

Month	Teknaf	Cox's bazar		Patuakhali		Khulna		Satkhira		Total	
	PN	PN	FBN	PN	FBN	DRAG	FBN	PN	FBN	PN	FBN
November	-	-	-	-	-	-	-	-	1631	0	1631
December	-	-	-	-	-	-	-	-	1398	0	1398
January	1292	8220	-	-	-	11850	5925	13980	46600	33342	52525

Month	Teknaf	Cox's bazar		Patuakhall		Khulna		Satkhira		Total	
	PN	PN	FBN	PN	FBN	DRAG	FBN	PN	FBN	PN	FBN
February	1900	21700	6220	-	207	-	-	-	-	23670	8297
March	2584	46650	1710	-	30054	-	1185	-	116500	49234	149449
April	1292	62200	12440	-	1385	-	948	23300	17708	86792	32481
May	1520	34210	-	-	-	-	-	-	11650	35730	11650
June	-	20214	-	-	-	-	-	41940	2798	82154	2798
July	2280	17108	8220	-	-	-	-	-	1165	19388	7385
August	4580	5286	-	2218	-	-	-	-	3728	12062	3728
September	9272	-	124	-	-	-	-	-	-	9272	1244
October	1292	4042	-	-	-	-	-	932	-	6268	-

10.4 Economics of Shrimp Fry-collection

Table 29 shows monthly average price per 100 *P. monodon* fry in the different areas. It varies from Tk 2 to 38, depending on the location and season. Monthly price fluctuations are mainly influenced by availability and stocking periods. The input costs for PN and for FBN are summarized in Table 30.

Owners and family members operate these gear and, therefore, there are no labor costs involved. Assuming two years' life for these materials, the annual cost of the PN is Tk. 202.50 and of the FBN Tk 455.00. Net income per gear varies between the different areas and for each gear type (see Table 31 facing page). In Teknaf and Cox's Bazar, the annual earning from the PN is Tk 7,689 and Tk 7,630 per gear respectively. For the same gear, it is only Tk 494 in Khulna, Tk 791 in Satkhira and Tk 43 in Patuakhall. The annual income per FBN in Cox's Bazar is Tk 6,200, but is much less elsewhere: Patuakhall Tk 3,721, Satkhira Tk 3,344 and Khulna Tk 2,056.

Table 29: Price (Taka/100) of *P. monodon* fry (1989-90)

Month	Teknaf	Cox's Bazar	Patuakhall	Khulna	Satkhira
November	-	-	-	-	11
December	-	-	-	-	8
January	17	15	-	29	15
February	15	17	30	-	-
March	15	12	35	38	35
April	12	14	12	30	30
May	12	12	-	-	36
June	-	10	-	-	10
July	9	10	-	-	10
August	10	7	7	-	12
September	6	3	-	-	-
October	10	2	-	-	9

Table 30: Input cost for PN and FBN gear

Input	Cost	
	PN (Tk)	FBN (Tk)
Net	210	600
Bamboo	20	60
Rope	10	75
Float	-	10
Enamel bowl	150	150
Sorting pot	5	5
Kerosene lamp	10	10
Total	405	910

Table 31: Monthly gross and net revenue per gear in shrimp fry collection in Tk (1989-90).

Month	Teknaf	Cox's bazar		Patuakhali		Khulna		Satkhira	
	PN	PN	FBN	PN	FBN	DRAG	FBN	PN	FBN
November	-	-	-	-	-	-	-	-	502
December	-	-	-	-	-	-	-	-	800
January	709	744	-	-	-	898	174	157	318
February	1279	1444	2885	-	2284	-	-	-	-
March	1755	1440	2070	-	1368	-	1991	-	343
April	394	260	1080	-	824	-	348	225	258
May	800	990	-	-	-	-	-	-	883
June	-	734	-	-	-	-	-	206	108
July	888	786	398	-	-	-	-	-	82
August	770	878	-	245	-	-	-	-	884
September	1438	-	544	-	-	-	-	-	-
October	80	678	-	-	-	-	-	405	-
Total (Gross revenue)	7891	7832	8655	248	4178	898	2511	993	3750
Total (Net revenue)	7889	7630	8200	43	3721	484	2058	791	3296

During the off-season, when there is no fry-collection activity, the people engage themselves in other activities, e.g. casual labor, rickshaw-pulling, earth-cutting, other fishing, wood-cutting, etc.

11. FISH LANDING AND MARKETING

11.1 Overall Fish Marketing Situation

Since there is a big gap between the supply and demand situation, fish marketing or in other words selling of fish domestically is very easy. All types of fish, high cost or low cost, are easily marketed due to the presence of a heterogeneous mixture of buyers. High cost fish like carps, catfish, live-fish from inland waters and Pomfrets, Indian-Salmon, Grunters, from marine waters etc. are either sold to rich class of people or are processed for exports. The mixed fishes are usually sold to the vast majority of the people of the low income group of the society who do not have enough purchasing capacity for the better species. Shrimps harvested from capture and culture fisheries are mostly processed and exported. Only small and poor quality shrimp are locally consumed. Due to high domestic and international demand the price of fish for the exportable species have increased manifold in recent years.

The fish markets and the marketing of fish is generally conducted by fish traders either individually or by group or by Fish Traders Association or by the Fishermen's Cooperative Societies. Almost all fish markets, operated by such people, association or cooperatives, are very ill-managed, unhygienic and unscientific. There is no proper handling, washing, cleaning, icing or re-icing of the fish besides there is no landing facilities. They care very little for post-harvest management of the resource, but are more interested in earning more revenues at the cost of the fishermen and the final users or the consumers. Most fish markets in the cities, district towns and in the villages managed by fish traders have no modern infrastructural facilities, not even overhead sheds. In the villages fish are directly landed in the soil by bamboo baskets and are sold there by auction which are then transported to cities/towns for sale.

Bangladesh Fisheries Development Corporation (BFDC) is the only organisation which has constructed modern Fish Harbours and Fish Landing Centres in the coastal areas like Chittagong, Cox's Bazar, Barisal, Khepupara, Patharghata and Khulna. These Landing Centres provide all sorts of modern and hygienic facilities for the fishermen and fish traders with facilities like berthing, landing, auctioning, ice plants, cold-storage, freezer storage, freezing plants and fish vans etc. In these centres alone post harvest resource management is properly taken care of.

11.2 Marketing System of Fish Trade

Four levels of markets or marketing systems are observed in the distribution channel of fish trade, such as primary, secondary, higher secondary and final consuming markets.

Primary Market: It is a marketing place at the catching point of the fish. Fish collectors/assemblers commonly known as "Mahajans or Aratdar-cum-Mahajans" procure fish from the catchers mostly by the help of local brokers called "Dalals" who get a profit margin or commission from the Mahajan. Part of the catch are also locally sold in the rural markets by the catchers/farmer or by retailers.

Secondary Market: The collectors bring the fish from the primary markets to the landing ghats usually to the nearest Thana Market or at a place well connected by rivers, roads or rail. Fish collectors or Mahajans sell the fish here to the distributors known as beparies with the help of "Aratdars or Commission Agents".

Higher Secondary Market: The distributors or Beparies transport the fish to the nearest city/town markets by road, rail or by boats which are the main distribution markets. Here the Beparies sell the fish to another set of distributors known as "Paikers" with the help of Aratdars or Commission Agents, who operate their business in the Higher Secondary Market and get commission on sales value.

Final Consuming Market: On purchasing the fish from the Higher Secondary Markets the "Paikars" (distributors) sell the fish to retailers. There are two channels of retailing - the urban retailers sell the fish in the urban markets at fixed stalls or by vending on head of tricycle (rickshaw) vans, and the other retailers take the fish to sub-urban places or to the villages around the city or town.

In the course of marketing at all stages, collectors or distributors carry out the functions of handling, cleaning, sorting, icing, preservation and transportation under his care and costs as far as possible. Expenses on such accounts are deducted from the bills of sellers.

Trade Flows: Trade flows or movement of fish for domestic consumption originates from Cox's Bazar, Chittagong, Barisal, Khulna, Bagherhat, Parerhat and also Chandpur for the marine and estuarine fish. After meeting the local consumption, the surplus fish are sent to the major markets of Dhaka, Sylhet, Rajshahi and other markets.

11.3 Ice and Processing Plants

There have been much improvement in the ice supply situation during the last few years. Many ice-plants have been established in Cox's Bazar, Chittagong, Khulna, Barisal, Khepupara, Patharghata and other small fish landing sites of the coastal belt. The number of ice-plants with daily production capacity in the major fish landing centres are as follows (1993 figures):

Name of Centre	Number	Capacity/day
Chittagong	68	1055 mt
Cox's Bazar	30	842 mt
Barisal	39	1654 mt
Patuakhali	-	-
Khulna	60	660 mt
Bagerhat	21	180 mt
Mongla	05	34 mt
Parerhat	04	55 mt

The number of ice plants and the quantity of ice produced in Khulna-Sundarbans area, however, are much less than the present needs.

With the steady and rapid progress of shrimp and prawn farming in Khulna region, the number of processing plants increased manifold in recent years, but the processing plants can not run in full capacity beyond the harvesting season of culture shrimp. Khulna has developed a big shrimp processing industry. Out of 97 processing plants (1992-93) in the country, 81 located in Khulna region and capacity utilization for shrimp freezing accounted for 19% only. Some processing plants reported to have diversified towards fin-fish processing and freezing for export and domestic marketing. A list of the processing plants of Khulna region is given in Appendix IV.

11.4 Marketing

Besides the harvested fish and shrimp of Khulna-Sundarbans area, a substantial quantity of fish and shrimp harvested from capture fishery of coastal districts and offshore waters of Bay of Bengal by gill nets, estuarine and marine set begnets and trammel nets are landed at Khulna for marketing within the country and for export after processing. The quantity of fish and shrimp currently harvested in Khulna-Sundarbans are:

A Capture fisheries:

	Unit: Metric Tons
Rivers and estuaries :	4,394
Sundarbans :	50,000 (estimated)
Beels :	77
Flood lands :	18,160
Capture total :	72,631

B Culture fisheries:

Ponds :	9,318
Baors :	88
Shrimp farms :	27,769
Culture total :	37,175
Capture & Culture total:	109,806

Khulna-Sundarbans area contributes 11.5% of the country's inland capture fisheries production and 16.4% of the culture fisheries production, and around 88% of shrimp farms' yield, the entire quantity of which is exported.

A total of 48,235 mt of shrimp belonging to eight common exportable species valued at Tk 10,081 millions (Table 32) purchased in 1994 (Azam and Mamoon 1995) through Farias/Aratdars and also directly from ghear owners and supplied to the processing plants by six companies based at Khulna. All the six companies pay the almost same price for individual species to the aratdars and created a sort of monopoly. They control local market price of shrimp. The quantity of shrimp purchased by the six companies represents 93% of the total quantity of shrimp processed and exported from Khulna.

The quantity of shrimp harvested from capture fisheries of Khulna region is around 3,524 mt (DOF). Whereas the six companies purchased from aratdars 31,520 mt of shrimp harvested from capture fisheries. It seems that the additional quantity of 28,000 mt come mainly from estuarine and offshore set beagnets and trammel nets fisheries operating beyond Khulna-Sundarbans region.

Table 32: Quantity and Value of Shrimp/Prawns Purchased In 1994 by Six Companies

Local Name	Capture Fishery						Total (all companies)	% of the total	Total Value	Price/mt
	A	B	C	D	E	F				
Bagda	3466 (3199)	2773 (2557)	2550 (2303)	2078 (1916)	1391 (1280)	2502 (2258)	14758 (13523)	30.6	5332	0.4239
Golda	1369 (747)	1151 (616)	1089 (542)	847 (474)	525 (281)	1111 (532)	6092 (3192)	12.6	2205	0.3619
Chaka	373	2970	2707	223	157	2733	9193	19.0	1354.4	0.1489

Local Name	Capture Fishery						Total (all species)	% of the total	Total Value	Price/mt
	A	B	C	D	E	F				
Damma	533	473	383	320	217	372	2302	4.8	258.1	0.1125
Chali	1065	879	800	844	441	834	4685	9.7	316.7	0.088
Cal tiger	1600	1268	1193	959	831	1188	9849	14.2	432.2	0.062
Goibunia	271	263	233	189	118	238	1280	2.7	57.8	0.045
Morka	267	2200	192	159	104	196	3118	6.5	123.7	0.040
Total (all species)	8944 (3946)	11877 (3173)	9147 (2846)	6397 (2390)	3588 (1681)	9182 (2790)	48235 (16715)	100	10081	0.228
Total Value	2055	2158	1912	1241	817	1901	10081			

() Quality of shrimp/prawns from culture fishery.

The total quantity of fish and shrimp currently available for marketing within the country and for export is estimated as follows:

i	Quantity of fish produced in Khulna region	109,806
ii	Offshore catch of mechanized boats landed at Khulna	4,000
iii	Estuarine and offshore shrimp catch of set beignets trammel nets, etc.	28,000

Total **141,806**
(14% of country's total fish production)

11.5 Fish Landing Centre

In Khulna-Sundarbans area there has been one Fish Landing and Marketing Centre at Khulna, established by the Bangladesh Fisheries Development Corporation (BFDC) in seventies where marine fish caught by the mechanized boats at sea are mostly landed and sold on auction through common marketing channel. This centre also supplies ice needed by fishing boats and fish carrier vessels. Besides, fish carrier vessels and mechanized boats also unload and sell their catches at two other private fish markets at Khulna where proper landing and ancillary facilities do not exist. In 1994/95, about 4,000 mt of marine fish, mostly hilsa landed at BFDC Fish Landing Centre (2,337mt) and local fish markets at Khulna. In addition to the Fish Landing and Marketing Centre at Khulna, the BFDC established one Cold storage and Ice Plant at Mongla in early eighties.

11.6 Marketing of Fish at Dublarchar

There has been no fish landing centres in any one of the temporary villages at chars in the Sundarbans coast. Every bahadar constructs temporary residential huts having enough space to be used as fish drying yard. Fish landed near fish drying yard on the bank of khal/coast. But during low tides the boats can not reach the bank of the khal, the catches then unloaded from the fishing/carrier boats on head to the drying yard from a distance. Almost entire quantity of fish harvested, except quality fish and exportable shrimps, are dried as shown in (photographs Appendix II). Occasionally, when bad weather prevails for a longer time than sundrying is hampered which results in the deterioration/decomposition of landed catch and the fishermen incur heavy losses. This also causes bad environment and the fishermen often fall victims of diarrhoeal diseases/cholera.

Shrimp Traders

The varieties of fresh fish and shrimp which have demand both in local and foreign markets are sold through existing marketing channel. The shrimp traders live in boats in the char areas and buy shrimp from bahardars. They carry ice and insulated boxes, collect shrimp from bahardars, keep shrimp on ice in boxes/baskets after deheading and then send to Khulna and Mongla through trade channel for processing, packing and export by the processing plant owners. They use same boxes/baskets repeatedly without cleaning them properly which results in deterioration of shrimps to be processed for export. Further, whole shrimps on ice remains in good condition for a longer duration than deheaded ones, but the traders prefer deheaded shrimp as it saves space and ice.

In many cases, the shrimp traders provides bahardars/fishermen with mechanized boats on the condition that the entire catch of exportable shrimp has to be sold to them at a prefixed price. Operational costs of such boats, are borne by the bahardars/fishermen. There are 30-35 shrimp traders in Dublarchar, each trader collects on average 500-700 maunds (14-18 mt) of shrimp in a season. The price paid by the traders in 1988 season to bahardars for shrimp given below:

1. Chaka chingri - Tk 1,600-1,800 per maund (Tk 42,800-48,200 per mt)
2. Chali chingri - Tk 700-800 per maund (Tk 18,700-21,400 per mt)
3. Tiger chingri - Tk 500-600 per maund (Tk 13,400-16,000 per mt)
4. Motka chingri - Tk 400-500 per maund (Tk 10,700-13,400 per mt)

The farias collect shrimp from the bahardars, after deheading deliver the product to the trader's boats and receive commission for this work at a fixed rate.

Bulk of the harvested catch of set bagnet, consists of fish, small shrimps, crabs and molluscs, is sundried, sorted and then put into sacks/gunny bags and the dried products are sent to Chittagong by launch/motorized boats for sale. But poor quality products, mostly juvenile fish, shrimps, crabs and molluscs (about 1500 mt) are used as raw materials by the fish meal factories at Khulna for production of fish meals, needed for preparation of shrimp feed.

Shark Traders

There are some specialized traders who buy sharks from the bahardars and after drying send the products to aratdars at Chittagong. Dried sharks sell @ Tk 400-500 per maund (Tk 10,700-13,400 per mt). Transportation cost per maund of dried shark from Dublarchar to Chittagong in 1988 was Tk 120 per maund. There were ten shark trader groups at Dublar cher and each group consisted of seven members. Each group makes around 3.5 mt of dried products in a season.

Crab Traders

Mud crab or blue crab (*scylla serrata*) is the most economic crab in the Sundarbans. The production recorded by F.S. of Sundarbans in 1992-93 was 312, but the estimated total catch of this species in the Sundarbans in 1993 (Chantarasri, 1994) was 375 mt. The crab marketing system has expanded over the last 3-4 years, with foreign markets opening up. Before that crabs were marketed only locally in negligible quantities. Now, crab marketing for domestic consumption has rapidly developed. Two types of markets exist for crabs in the country: (a) Local markets in the vicinity of fishing villages and (b) Consumer markets (bazar, hat, etc) away from the fishing areas. A good portion of the catch from the Sundarbans is sold in Khulna direct sale by fishermen in the local market or in consumer markets is the common mode of marketing.

Sometimes a member of a fisherman's family participates. Previously, there were no middlemen in this trade. But now two purchasing centres, one each at Swarankhola and Burigualine in the Khulna region, have been established. Crabs are sold at these centres by retailers, for supply to the consumer markets. The retailers sell crabs in fish market keeping them in bamboo baskets. Each pair of medium sized crab sells at about Tk 8-12. The larger, meat heavy crabs are selected for export.

At present mud crabs are a good export item, either in the form of meat frozen in a block or in cooked condition or live. Mud crabs are exported in live condition from Bangladesh through Dhaka airport. Although female crabs fetch a better price than males, the fishermen usually get an average price from exporters. The exporters in Dhaka are required to ship the crabs from Dhaka. If there happens any mortality during the transportation to Dhaka from local market, the value-loss is deducted from the catcher's payment. Mortality generally varies from 10-20 per cent. In summer it is more due to high ambient temperatures. The export value of live crab is 2-3 US\$/kg. Hong Kong, Malaysia and Singapore are the principal buyers of live crabs from Bangladesh. Male crabs weighing less than 200g and female crabs less than 150g are rejected. The rejected crabs are sold locally at about 15-20 Taka/kg. Bamboo baskets are used to air freight, the crabs from Dhaka international airport. The international market for crabs is 75 Taka/kg. But in Bangladesh crabs are locally sold at 80-120 Taka/kg. Maximum portion of exportable crabs originate from Ghers of this country.

11.7 Farias

The Farias work as middlemen between bahadars and Shrimp traders. Every trader buys shrimp from bahadars at a pre-fixed price. Farias collect shrimps from bahadars, deheaded them and keep in the stores of traders. Farias receive commission for this work at a fixed rate depending on the types of shrimp at the following rate:

1. Chaka chingri Tk 5358/mt
2. Tiger chingri Tk 2680/mt
3. Chali chingri Tk 5358/mt
4. Chatka chingri Tk 2680/mt.

This rate prevailed in 1988 and the present rate is 50% higher than it was in 1988.

11.8 Financial Arrangement

A few bahadars can invest capital for fishing unit operating at seas or offshore waters of Dubla Island. Majority of the bahadars borrow money from the Mahajans at a high interest rate. The rate of interest for the money borrowed from Aratdars/Mahajans is 30-40% for a period of 3-4 months, 120% in a year. There are few bahadars who borrow money from Banks providing co-laterals. But majority of the bahadars unable to take loans fulfilling the bank's conditions. On the other hand traders or moneyed men, who operate fish collection activities in Sundarbans, provide loan to bahadars without co-lateral but on certain unwritten conditions which they fulfil. Because, fish harvesting activities under the full control of the Mahajans/Aratdar and rich people. The Aratdars/Mahajans borrow often money from the bank and then give loan to the bahadars at a very high rate.

RECOMMENDATIONS/DEVELOPMENT STRATEGIES

After careful consideration of the status of Khulna-Sundarbans fishery, the problems of fishermen engaged in fishing inside the SRF and outside at marine waters, fish harvesting, landing and marketing of fisheries products, the following recommendations/development strategies proposed:

1. Catch assessment survey of the Sundarbans fishery should be undertaken on regular basis by the Fisheries Resource Survey System (FRSS) of Department of Fisheries (DOF).
2. Introduce semi-intensive shrimp culture technology in all shrimp culture ponds/ghers for increased production.
3. Strengthen shrimp culture extension service to take necessary steps for the establishment of shrimp and prawn hatcheries at private level.
4. Impose restriction on wild shrimp/prawn fry collection and rehabilitate fry-collectors.
5. Impose restriction on harvesting tiger shrimp by shrimp trawlers in offshore spawning grounds of tiger shrimp for a period of one month (mid-December to mid-January).
6. Develop and introduce scientific methods of shrimp fry handling, packing and transportation.
7. Establish shrimp nurseries in private levels near the fry-collection centres.
8. Study carrying capacity of coastal riverine systems and population dynamics and stock assessment of commercially important fisheries.
9. Study life history, biology and bionomics of commercially important fish, shellfish and molluscs.
10. Study the impact of shrimp farming on mangrove and estuarine environment.
11. Study coastal ecology, biodiversity and man-made changes in the coastal/Sundarbans environment.
12. Develop mariculture of fishes, crabs and oysters.
13. Undertake development projects for management, development and conservation of fisheries resources of the Sundarbans.
14. Restriction should be impose to limit the use of set bagnet fishing inside and outside the SRF area.
15. Establish fish landing centres with modern facilities for preservation, distribution and freezing at Dubla and nearby places.
16. Establish more ice plants in Sundarbans and adjoining area.

17. Establish floating cold storage (chilling room) at important fish landing sites of the Sundarbans.
18. Ensure reasonable price for the catch by formation of fisheries cooperative society, involvement of Bangladesh Fisheries Development Corporation (BFDC) and NGOs.
19. Eliminate middleman/influential and rich people/aratdars/mahajans from involvement in fish harvesting and marketing activities as far as possible and provide loans in the fishermen at easy terms without mortgage associating banks and NGOs.
20. Introduce supervisory credit system through loan guarantee fund scheme.
21. Establish required number of light houses (at least two) in the Sundarbans coast to provide navigational facilities for the fishermen of Dublarchar engaged in marine fishing.
22. Introduce quick transportation facilities between Sundarbans coast and nearby towns/habitatious.
23. Arrangement be made for timely weather forecasting system for the safety of life and property of fishermen engaged in Dublarchar fishery.
24. Protect fishermen from plirates strengthening forest guards and police force.
25. Processing industries should utilize catch of set bagnets for production of value added products such as surimi, fish paste, cooked fish ball, fish finger etc for export and local consumption as well.
26. Establish sea food restaurants in district towns and even at Dublarchar to popularize eating quality sea products such as lobster, mud crabs, cuttle fish, squid, octopus, sole, Indian halibut and lady fish by the tourist and local people.
27. Introduce refrigerated van for transportation of harvested shrimp from ghers/markets to the processing plants.
28. Constitute a committee involving all concerned organizations to look after overall management, development and conservation of fisheries resources of Khulna-Sundarban areas and welfare of the fishermen.

REFERENCES

- Hora, S L. 1953. Symposium on Hilsa and its Fisheries. A Review Journal of the Asiatic Society, Science. Vol XX, No. 1, 1954.
- Ahmad, Nazir. 1953. Hilsa Fishery of East Bengal Journal of the Asiatic Society, Science. Vol XX, No. 1, 1954.
- Hora, S L. 1953, Biology of Hilsa. Journal of the Asiatic Society, Science. Vol. XX, No. 1, 1954.
- Agriculture Pakistan, 1962. Vol XIII, Fish Number 2, Government of Pakistan
- Central Fisheries Department, 1963. Final Progress Report of the Hilsa Investigation Scheme, East Pakistan, Chittagong (1956-62).
- Marine Fisheries Department, 1967. Final Progress Report of Shrimp Exploration Scheme, East Pakistan, Chittagong (1962-67).
- Ahsanullah M 1964. Population Dynamics of Hilsa. "Agriculture Pakistan" Vol. XV, No. 3.
- Ahsanullah M 1967. A Note on Length, Weight and Length - Weight Relationship of Hilsa, "Agriculture Pakistan," Vol XVIII, No. 1.
- M M Hussain, 1970. Marine and Estuarine Fishes of the North-East Part of Bay of Bengal
- M M Hussain, 1971. The Commercial Fishes of the Bay of Bengal. UNDP Project Pak22, Project Publication No. 1
- Bangladesh Fisheries Development Corporation, 1972. Report on Marine Fishing Village Identification Survey in Bangladesh. UNDP Project Publication No. 2.
- Ahsanullah M 1977. The life of an Oyster and the Prospect of Development of Oyster Industry in Bangladesh. Marine Biological Laboratory, Cox's Bazar, Department of Fisheries, Proceedings of the National Marine Fisheries Seminar, March 19-21, 1977.
- Ahsanullah M 1978. Marine Fisheries Resources in the Waters of the Bay of Bengal. Marine Biological Laboratory, Cox's Bazar, Department of Fisheries
- Ahsanullah M 1980. Shrimp Resources of the Bay of Bengal and the Current Status of Their Exploitation. Marine Fisheries Research, Management and Development Project, Chittagong, Department of Fisheries.
- Kabir, M A 1983. A Checklist of the Prawn Fauna of Bangladesh with some new records. Research Report No. 7 (Prawn Investigation) Freshwater Research Station, Chandpur
- Sharif, M 1983. Chingri Chash Sonall Digante Kalo Thaba. Weekly Bichitra. 11 yr. No. 40
- Khan H 1983. Resources of the Sundarbans. Weekly Bichitra. 11 yr. No. 47

- FAO/UN, 1984. Integrated Development of the Sundarbans, Bangladesh. Fisheries Integrated Development in the Sundarbans
- National Seminar, 1985. Fisheries Development in Bangladesh, Fisheries and Livestock Division, Ministry of Agriculture, Dhaka
- Master Plan Organisation. 1985a. Open Water Capture Fishery Resources. Technical Report No. 16. Ministry of Irrigation, Water Development and Flood Control, Dhaka
- Master Plan Organisation. 1985b. Fisheries and Flood Control Drainage and Irrigation Development, Technical Report No. 17. Ministry of Irrigation, Water Development and Flood Control, Dhaka
- Master Plan Organisation. 1985d. Closed Water Culture Fishery Resources, Technical Report No. 19, Ministry of Irrigation, Water Development and Flood Control, Dhaka
- Master Plan Organisation. 1985e. Economic Analysis of Fisheries Modes of Development. Technical Report No. 28, Ministry of Irrigation, Water Development and Flood Control, Dhaka
- Ahsanullah M 1983. Tiger Shrimp Fishery of the Bay of Bengal, Department of Fisheries, Government of Bangladesh.
- Ahsanullah M 1987. Current Status of Shrimping Industry of the Bay of Bengal. Department of Fisheries, Government of Bangladesh.
- Ahsanullah M 1987. Conservation of Tiger Shrimp, *Penaeus mondon* of the Bay of Bengal, Department of Fisheries, Government of Bangladesh.
- UN/ESCAP, 1987. Final Report: Vol II. Coastal Environmental Management Plan for Bangladesh.
- Ahsanullah M 1988. Stock Assessment of Demersal/Pelagic Fishes of Bangladesh, Department of Fisheries, Government of Bangladesh.
- Ministry of Fisheries and Livestock, 1988. Draft Report of the Committee for Study of the Problems and Needs of Fishermen Engaged in Coastal Fishing in and off Sundarbans Area
- Ministry of Fisheries and Livestock's Permanent Committee, 1989. Report of the Sub-Committee 2 on the Status of Shrimp Culture in Khulna Region.
- Ministry of Fisheries and Livestock, 1989 Policy Recommendations for Fisheries Development in Bangladesh, Government of Bangladesh, Dhaka
- Ministry of Fisheries and Livestock, 1990. Fourth Five-Year Plan (1990-95) for Fisheries Development, Dhaka
- Chowdhury Z A et al, 1991. The Beach Seine Fishery of Teknaf. Marine Fisheries Survey, Management and Development Project, Department of Fisheries, Chittagong.

- Huq, Q M, et al, 1991. The Bottom Longline Fishery for Croaker (Sciaenidae). Marine Fisheries Survey, Management and Development Project, Department of Fisheries, Chittagong
- Quayum, M S A, et al, 1991. The Marine Set Bagnet Fishery. Marine Fisheries Survey, Management and Development Project, Department of Fisheries, Chittagong
- Islam, M S, et al, 1991. Estuarine Set Bagnet Fishery. Marine Fisheries Survey, Management and Development Project, Department of Fisheries, Chittagong
- Islam, M A, 1993. Some Relevant Information about Sundarbans, Government of the People's Republic of Bangladesh, Sundarbans Forest Division, Khulna
- Shiva, M P, 1994. (Draft) Report on Mangrove Non-Wood Forest Products. Integrated Resource Development of the Sundarbans Reserved Forests BGD/84/056
FAO/UNDP Project BGD/84/056
- Chantarasri, S, 1994. (4 TH Draft) Report on Fisheries Resources Management for the Sundarbans Reserved Forest. Integrated Resources Development of the Sundarbans Reserved Forest. FAO/UNDP Project BGD/84/056.
- Pena, M, S. 1994. Activity Report on Fishery Harvesting and Marketing. Integrated Resources Development of the Sundarbans Reserved Forest. FAO/UNDP Project BGD/84/056
- Vinh, C T and Long, N 1994. Marine Fish Harvesting in Vietnam. INFOFISH International 1/94
- Department of Fisheries, 1994. Compiled Information Available at Central Shrimp Cell, Dhaka
- Khulna University, 1995. (Draft) Further Analysis of the Fisheries Data collected by S. Chantarasri, Fisheries Biologist. Integrated Resource Development of the Sundarbans Reserved Forest. FAO/UNDP Project BGD/84/056.
- Banik, H, 1995. Forest Resources in Sundarbans and Their Management.
- Third Fisheries Project, 1995. (Draft) Management Information Systems in the Fisheries Sector of Bangladesh. Prepared by MRAG Ltd and Fisheries Development Ltd for ODA.
- CMFRI, Bulletin 28, 1978. Coastal Aquaculture: Marine Prawn Culture Part I. Larval Department of Indian Penaeid Prawns. Cochin 682018, India
- Funegaard, P, 1986. Shrimp Seed - Any to Sell? Come to Satkhira, Bangladesh. Bay of Bengal News, Issue No. 22, June 1986.
- UBINIG, 1988. Prawn Seed Collectors. A New Economic Reality. A Study on the Prawn Seed Collectors in Cox's Bazar and Satkhira. Bay of Bengal Programme, Madras.

FAO Regional Studies No. 4. 1967. Fish Processing in the Indo-Pacific Area. Indo-Pacific Fisheries Council. FAO Regional Office for Asia and the Far East, Bangkok, Thailand

Brown E W and Larson A 1970. Recommended Practices for Vessel Sanitation and Fish Handling. United States Department of Interior, Fish and Wildlife, Parks, and Marine Resources, Washington DC

Project Identification Report, 1982 Wholesale Fish Market in Chittagong, Bangladesh

Etoh, S 1985. Aspect of Full Utilization of Marine Resources in Bangladesh. Discussed Text for "National Seminar on Fisheries Development, 1985"

Rapport Bangladesh Limited, 1988. Report on Survey and Marketing of Fish and Shellfish in Bangladesh. FAO/UN, DP/BGD/79)015-3F1

Elsy R 1986. Executive Summary of "Marketing and Development Options for Shrimp Bycatch Products in Bangladesh" FAO, Project BGD/80/025.

Coulter, J P and Disney, J G 1987. The Handling, Processing and Marketing of Fish in Bangladesh ODNRI Bulletin No. 1 viii+49 pp

Bay of Bengal News. Issue No. 32, 1988 Focus on Post-Harvest Technology. BOBP for Fisheries Development

Ministry of Commerce. 1989. Export Policy: 1989-91, Government of the People's Republic of Bangladesh, Dhaka

Carlos A Lima dos Santos, et al. 1994. EEC Quality and Health Requirements and Seafood Exports from Developing Countries. INFOFISH International 1/94

Subasinghe, S 1994. 'Greening' the Seafood Processing Industry. INFOFISH International 1/94

Hall, G M and Silva, S de, 1994 Shrimp Waste Ensilation. INFOFISH International 2/94

Bangladesh Bank 1993-94. Annual Export Receipts, Statistics Department, Bangladesh Bank.

Rahman, A K A, et al, Economically Important Marine Fishes and Shell Fishes of Bangladesh, Department of Fisheries, 1995.

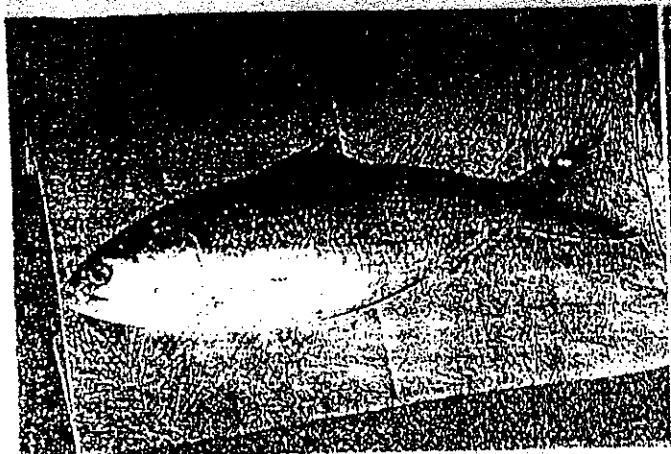
**APPENDIX 1
LIST OF PEOPLE MET**

- 1 Dr A Latif, Chief Scientific Officer, Brackishwater Research Station, Fisheries Research Institute, Palkgacha, Khulna.
- 2 Mr R I Chowdhury, Deputy Director, Khulna Division, Department of Fisheries, Khulna.
- 3 Mr S A Quayum, Curator, Marine Fisheries Survey Management and Development Project, Chittagong (now posted at Khulna) Department of Fisheries, Khulna.
- 4 Mr Nurul Islam, Fisheries Survey Officer, Fisheries Resource Survey System, Department of Fisheries, Khulna.
- 5 Mr S M Nazrul Islam, Deputy Project Director, Shrimp Culture Project (IDA), Department of Fisheries, Khulna.
- 6 Mr Prafulla Kumar Sikdar, Assistant Director, Shrimp Culture Project (IDA), Department of Fisheries, Khulna.
- 7 Mr M Abubakar Sikdar, Assistant Director, Third Fisheries Project, Department of Fisheries, Khulna.
- 8 Dr M Abdul Hashem, Private Shrimp Farmer, Khulna.
- 9 Mr A K M Fazlur Rahman, Manager, BFDC Fish Landing and Marketing Centre, Bangladesh Fisheries Development Corporation, Khulna.
- 10 Mr Mizanur Rahman, Inspector, Marine Fisheries Development, Chittagong (now posted at BFDC Fish Landing and Marketing Centre, Khulna).
- 11 Mr Mazbaul Islam, Manager (Retd), BFDC Fish Landing and Marketing Centre, Khulna.
- 12 Mr Muztafa Jahangir, Fish Processing Technologist-in-Charge, BFDC Fish Processing Plant, Mongla.
- 13 Mr Kazi Abdul Jabbar, Union Council Member, Union-10 No. Bashfali, Rampal Thana, Bagherhat District.
- 14 Mr Swapan Kumar Dev, District Fisheries Officer, Department of Fisheries, Bagherhat.
- 15 Mr M Helaluddin, Deputy Director, Fish Inspection and Quality Control Office, Department of Fisheries, Khulna.
- 16 Mr Abdur Rashed, Inspector, Fish Inspection and Quality Control Office, Department of Fisheries, Khulna.
- 17 Mr Shahjahan Ali, Inspector, Fish Quality Control Office, Department of Fisheries, Khulna.
- 18 Mr Atul Kumar Paul, Fisheries Technologist, Quality Control Office, Department of Fisheries, Khulna.

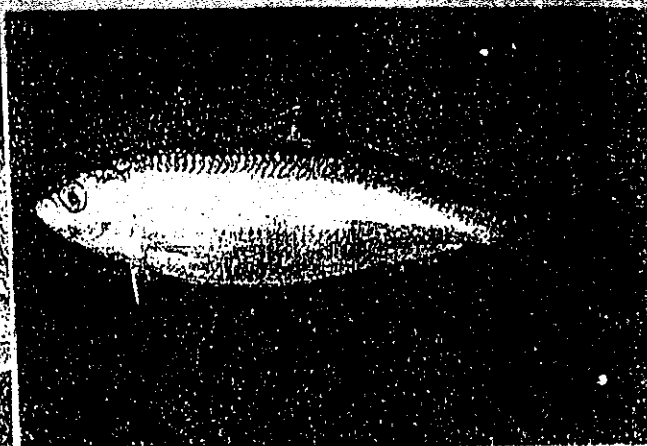
- 19 Mr Abdur Roub, Conservator of Forest, and National Project Director, IRMSF, Forest Department, Khulna.
- 20 Mr Shamsul Huda, Deputy Conservator of Forest, Sundarban Circle, Forest Department, Khulna.
- 21 Mr M Harun-or-Rashid, Deputy Director (Marine Fisheries), Department of Fisheries, Chittagong.
- 22 Mr M Gaishuddin Khan, Project Director, Marine Fisheries Survey Management and Development Project, Department of Fisheries, Chittagong.
- 23 Mr M Mustafa, Scientific Officer, Marine Fisheries Survey Management and Development Project, Department of Fisheries, Chittagong.
- 24 Mr Akter Ali, Deputy Director, Fish Inspection and Quality Control Office, Department of Fisheries, Chittagong.
- 25 Mr Kadar Ahmad, Inspector, Fish Inspection and Quality Control Office, Department of Fisheries, Chittagong.
- 26 Mr Zakaria Mamoon, Project Manager, Project for Fish Landing, Preservation and Distribution Facilities at Monoharkhali, BFDC, Chittagong.
- 27 Mr Rafiqul Islam Chowdhury, Senior Marketing Officer, Fish Harbour, BFDC, Chittagong.
- 28 Mr Abdul Momen, Manager-In-Charge, Chittagong Net Factory, BFDC, Chittagong.
- 29 Mr M Majibur Rahman, Marketing Officer, Project for Fish Landing, Preservation and Distribution Facilities at Monoharkhali, BFDC, Chittagong.
- 30 Mr M Isaq, Mechanized Fishing Boat Owner, Monoharkhali, Chittagong.
- 31 Mr Ali Akbar Bhuiyan, Conservator of Forest, Forest Department, Dhaka.
- 32 Mr A K M Fazlul Haq, Conservator of Forest (Retd) Forest Department, Dhaka.
- 33 Al-Haj M M Hossain, Chairman, Bangladesh Fisheries Development Corporation, Dhaka.
- 34 Khandaker M Hasan, Manager, Planning Division, Bangladesh Fisheries Development Corporation, Dhaka.
- 35 Mr Liaquat Ali, Director and Project Director, Third Fisheries Project (WB), Department of Fisheries, Dhaka.
- 36 Mr Mahamudul Haque, Assistant Director (Marine), Department of Fisheries, Dhaka.
- 37 Mr Swapan Kumar Paul, Scientific Officer, Central Shrimp Cell, Department of Fisheries, Dhaka.
- 38 Mr Manatosh Roy, Statistician, Department of Fisheries, Dhaka.

APPENDIX II

Common Commercial Fish and Shell Fish of Sundarbans Estuaries and Marine Waters



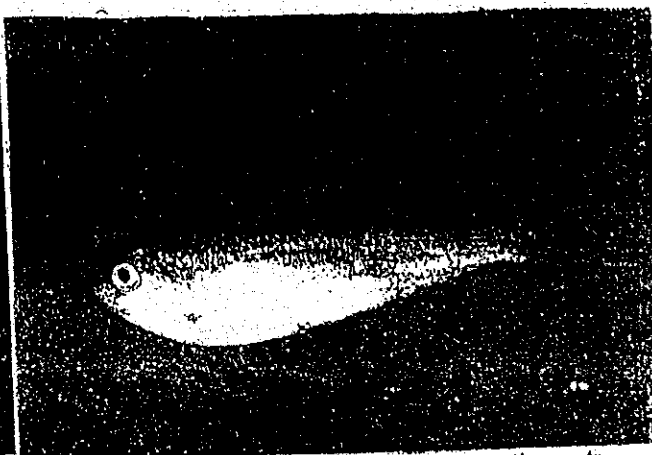
Species : *Hilsa ilisha*
 English name : Hilsa Shad
 Local name : Ilish/Hilsa



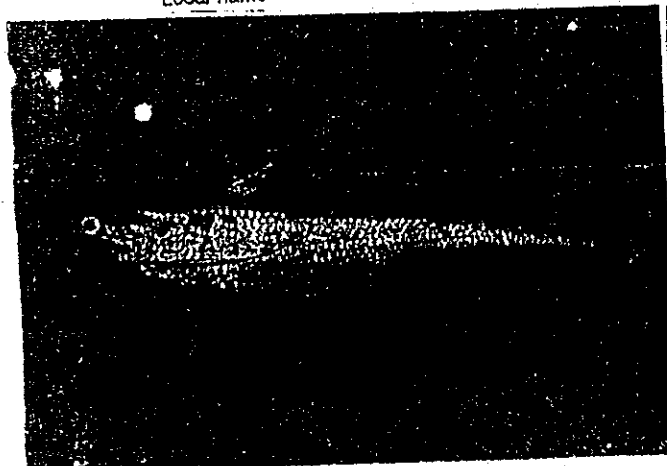
Species : *Chirocentrus dorab*
 English name : Wolf herring
 Local name : Karati-Cheila



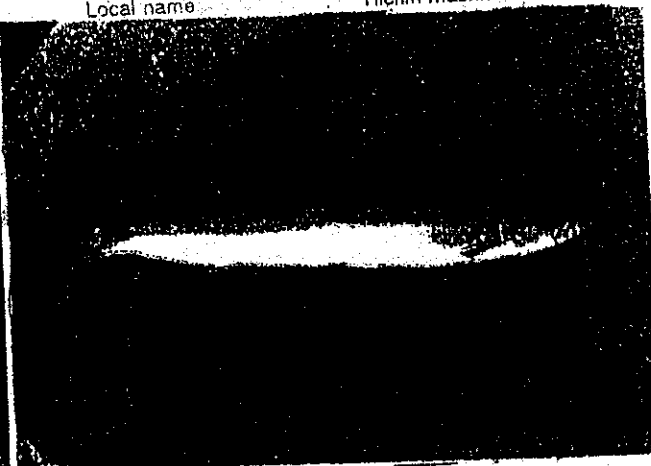
Species : *Ilisha filigera*
 English name : Big Eye Ilish
 Local name : Choukya



Species : *Escualosa thoracata*
 English name : White Sardine
 Local name : Hichiri machh

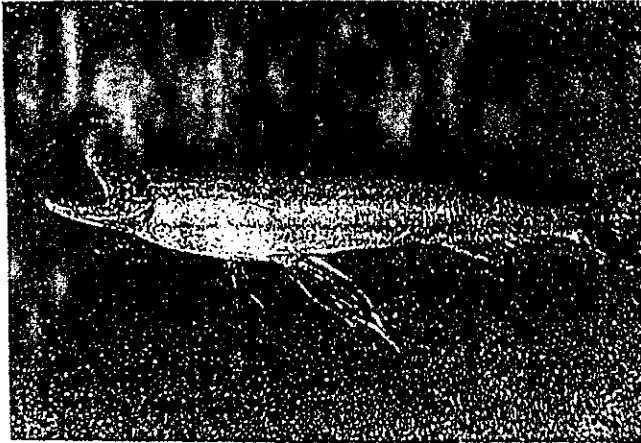


Species : *Coilia dussumieri*
 English name : Pointed tail anchovy
 Local name : Otua



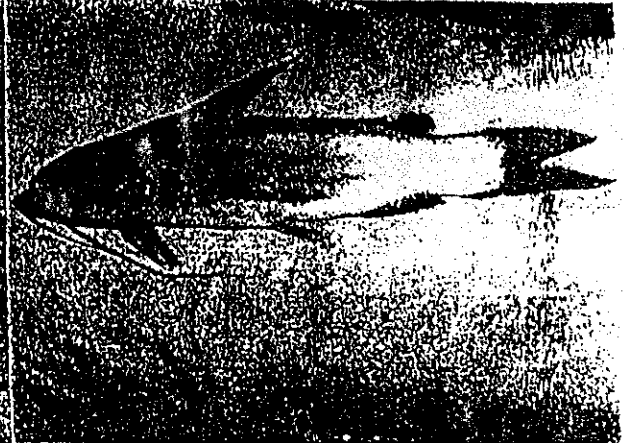
Species : *Sardinella fimbriata*
 English name : Fringe-scale sardine
 Local name : Takhia

APPENDIX II (Cont'd)



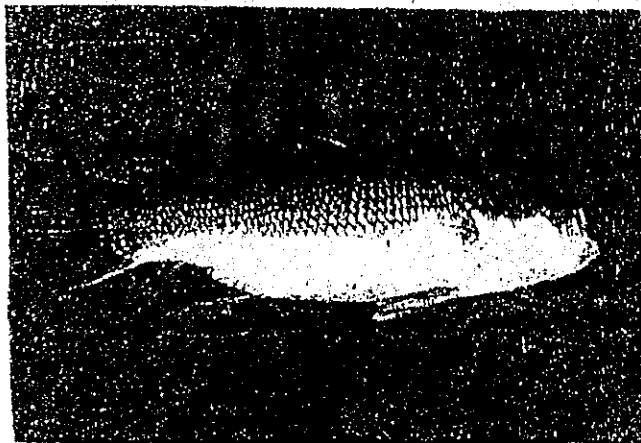
Species
English name
Local name

Harpadon nehereus
Bombay duck
Loitya machhi



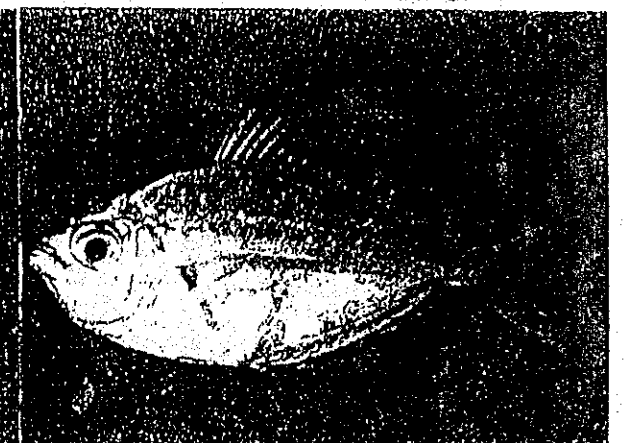
Species
English name
Local name

Mystus gulio
Bagrid, shad
Nuna tenra'sakha



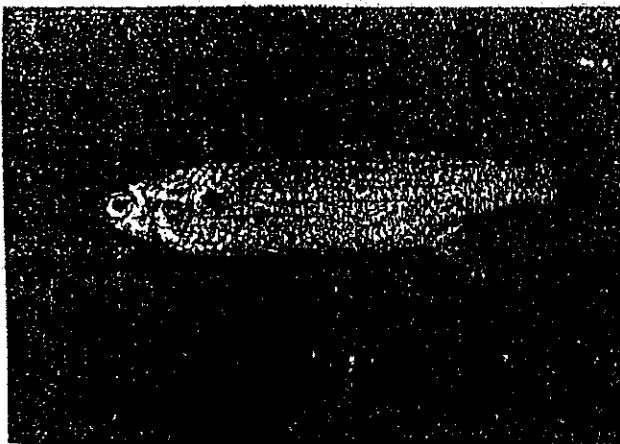
Species
English name
Local name

Lates calcarifer
Giant suaperche/cock-oi
Bhatki/Koromuddi



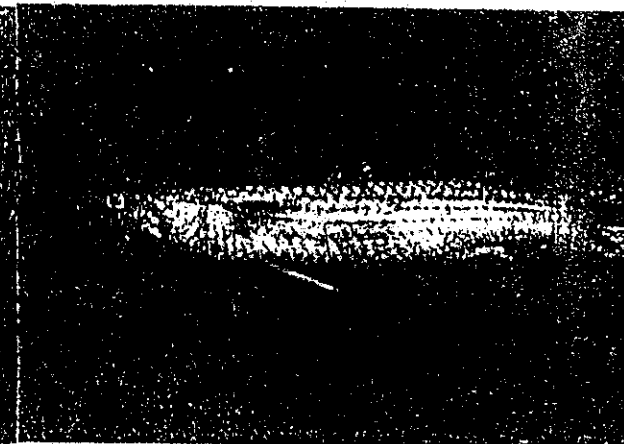
Species
English name
Local name

Lefognathus brevirostris
Shortnose parrotfish
Naka Chama



Species
English name
Local name

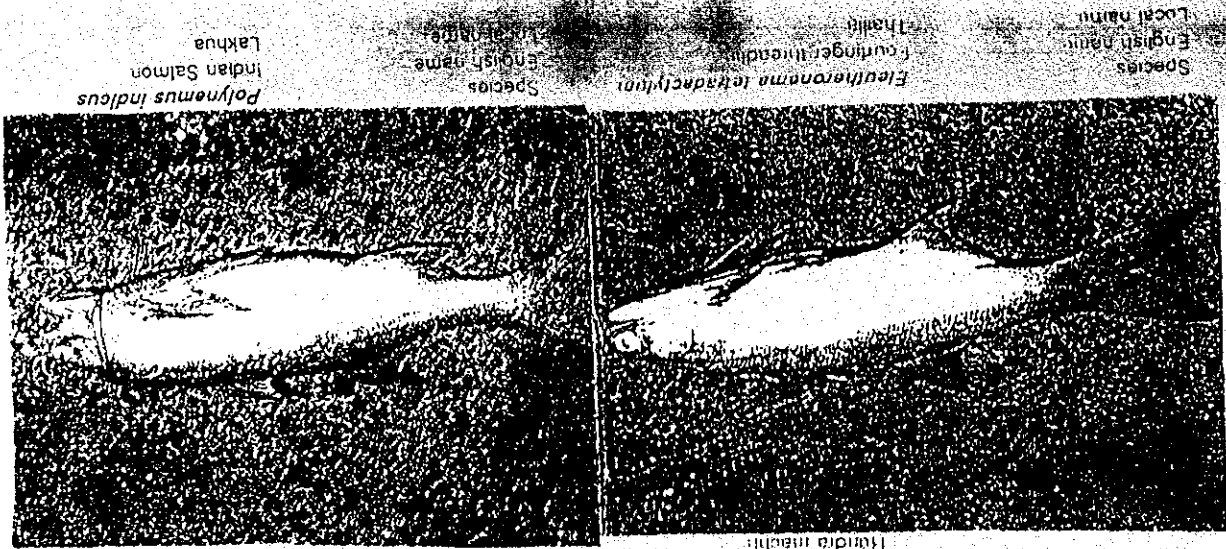
Liza tade
Fauz moy mital
Jok chadi



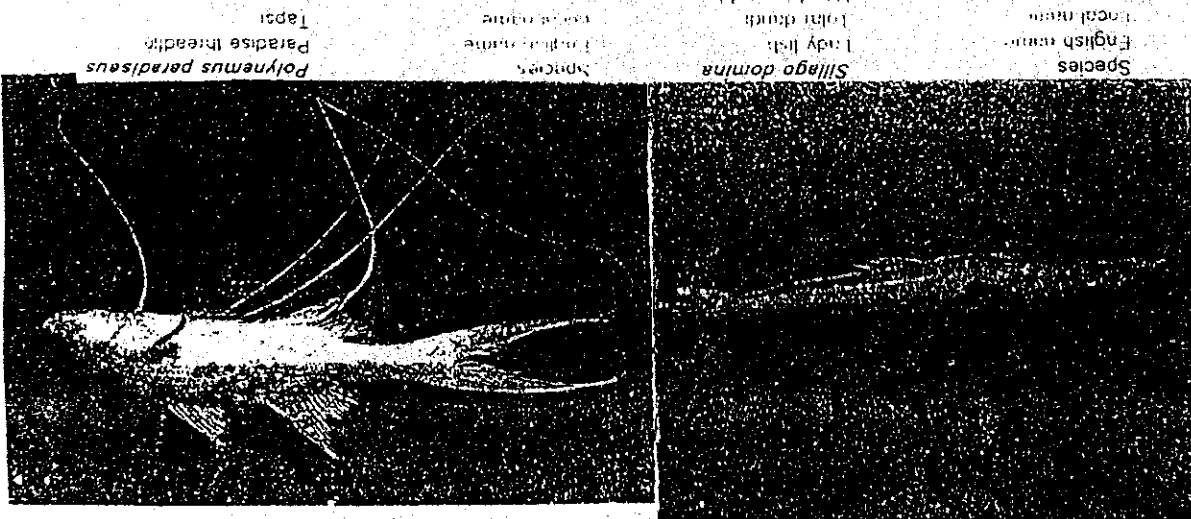
Species
English name
Local name

Liza subviridis
Green back grey snail
Khorul/Panda/Bhagana/...

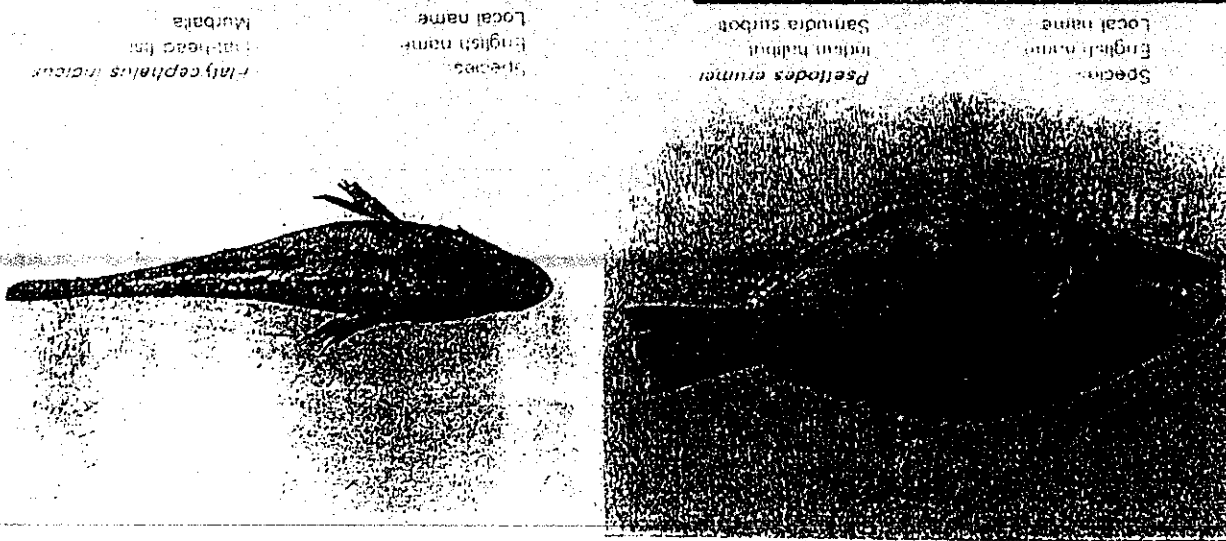
APPENDIX II (Cont'd)



Species	<i>Polynemus indicus</i>	Species	<i>Eleutheronema tetradactylum</i>
English name	Indian Salmon	English name	Fourfinger threadfin
Local name	Lakhua	Local name	Thallu

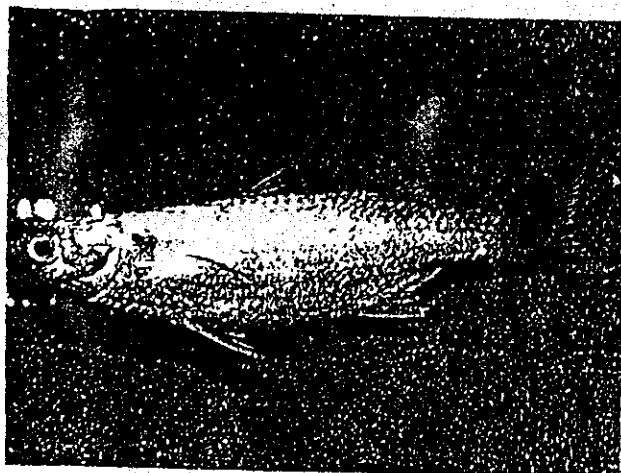


Species	<i>Polynemus paradiseus</i>	Species	<i>Sillago domina</i>
English name	Paradise threadfin	English name	Lady fish
Local name	Tappi	Local name	Lotu douch

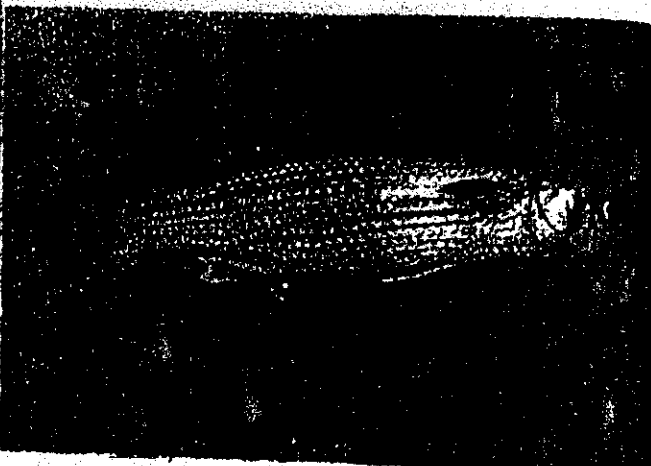


Species	<i>Pristigaster indicus</i>	Species	<i>Psellodes erumei</i>
English name	Spot-head fish	English name	Indian halibut
Local name	Murbala	Local name	Sanudia surbot

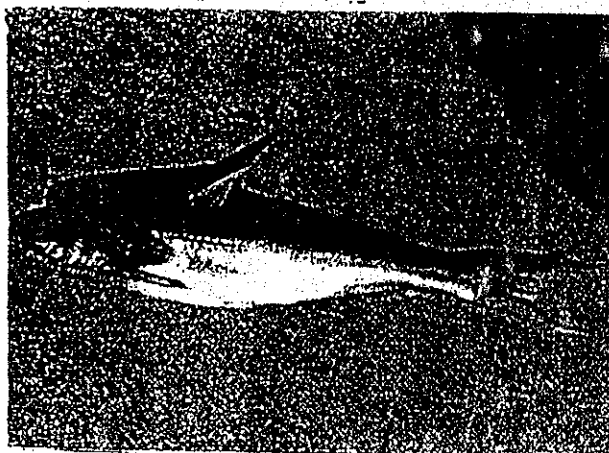
APPENDIX II (Cont'd)



Species : *Valamugil speigleri*
 English name : Speigler's grey mullet
 Local name : Fhena Khaiya /Patha bata



Species : *Mugil cephalus*
 English name : Flathead grey mullet
 Local name : Khorul bata



Species : *Pangasius pangasus*
 English name : Fatty Catfish
 Local name : Pangas



Species : *Pomadasya hasta*
 English name : Lined Silver grunter
 Local name : Sadha datina

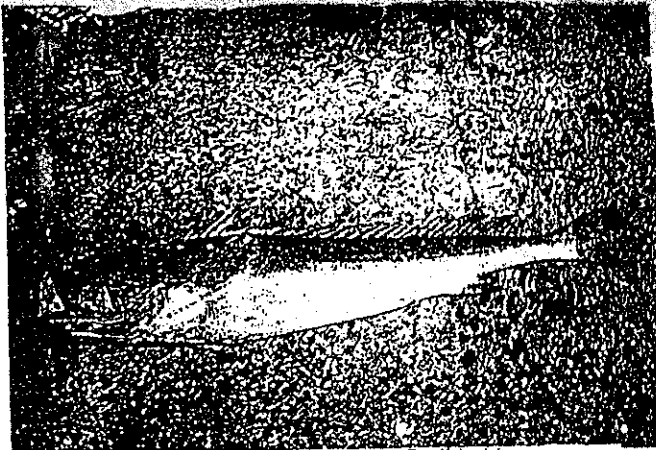


Species : *Pomadasya maculatus*
 English name : Blotched grunter
 Local name : Gutti-datina



Species : *Priacanthus tayenus*
 English name : Purple-spotted big-eye
 Local name : Pari machh

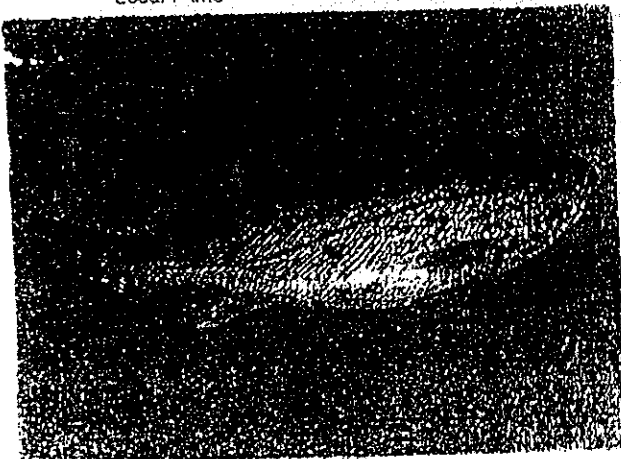
APPENDIX II (Cont'd)



Species *Otolithoides pama*
 English name Pama Croaker
 Local name Lambu



Species *Otolithes maculatus*
 English name Blotched tiger toothed Croaker



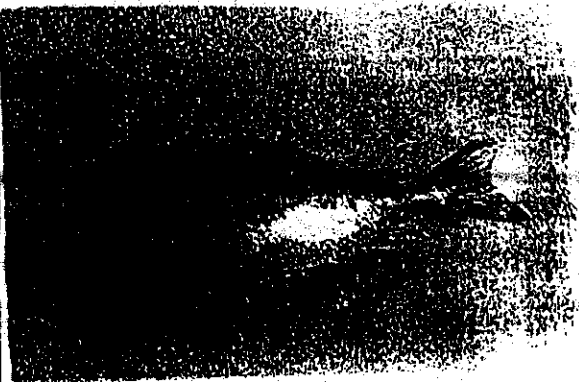
Species *Otolithes cuvieri*
 English name Lesser tiger-toothed Croaker
 Local name Poa



Species *Protonibea diacanthus*
 English name Spotted Croaker
 Local name Kala datina/Kala Poa

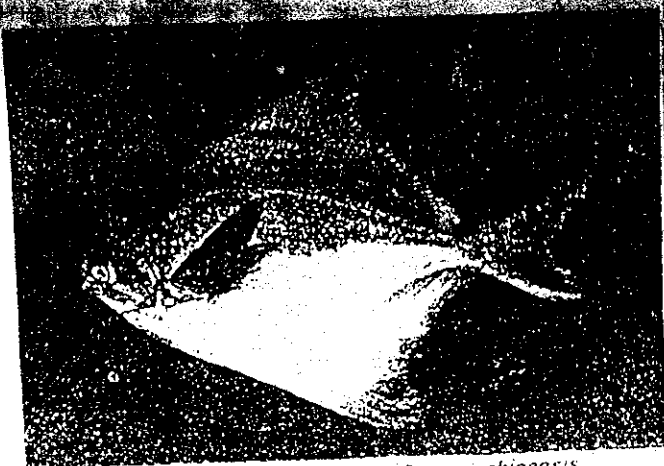


Species *Johnius argentatus*
 English name Silver Pennah Croaker
 Local name Lalpoa



Species *Siganus javus*
 English name Streaked mackerel

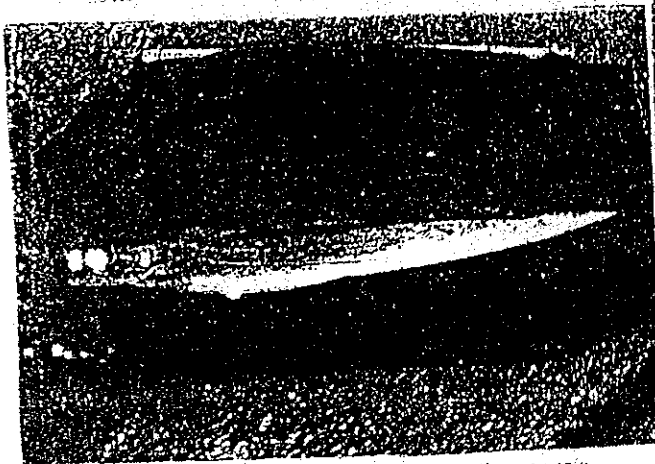
APPENDIX II (Cont'd)



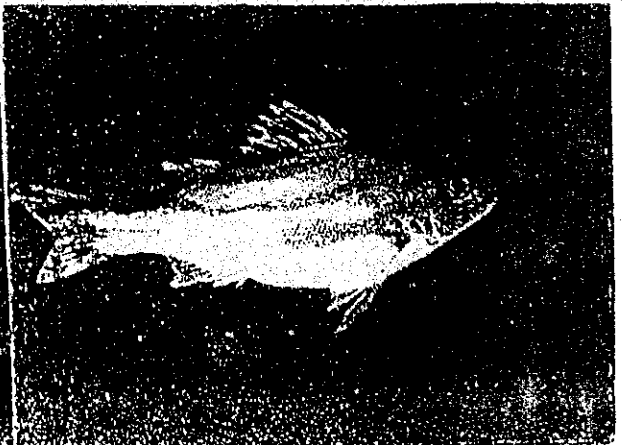
Species: *Pampus chinensis*
 English name: Chinese pomfret
 Local name: Rop Chanda



Species: *Pampus argenteus*
 English name: silver pomfret
 Local name: Rop Chanda



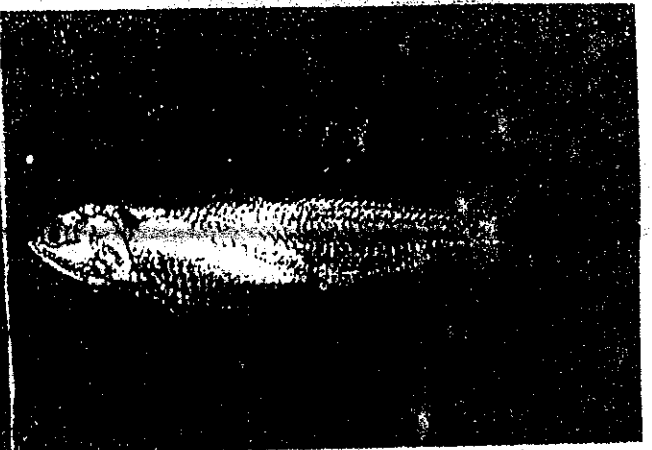
Species: *Lepturacanthus savala*
 English name: Hairtail/Ribbonfish
 Local name: Chhun Machh



Species: *Therapon jarbun*
 English name: Therapon perch
 Local name: ibargun

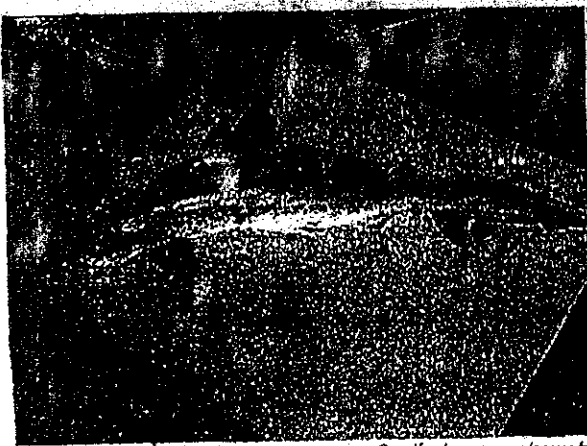


Species: *Settopia lala*



Species: *Thyssa mystax*
 English name: Mustax
 Local name: Chasa

APPENDIX II (Cont'd)



Species : *Scoliodon sorrakowah*
 English name : Spadenose shark / Dogfish
 Local name : Thutte Hangar



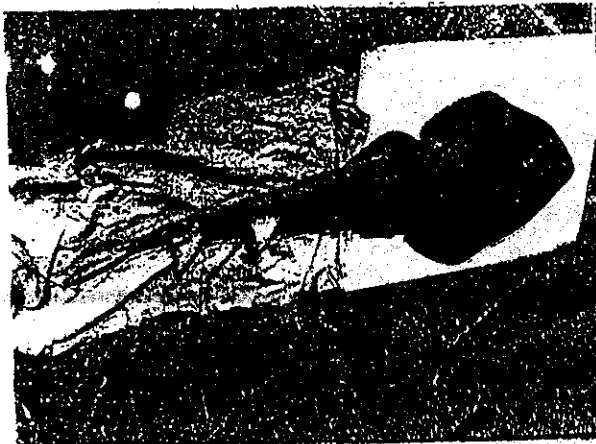
Species : *Sphyma blochii*
 English name : Hammer-headed shark
 Local name : Haturi Hangar



Species : *Rhinobatos granulatus*
 English name : Skate
 Local name : Pitambar



Species : *Scoliodon walbeohmi*
 English name : Milk shark
 Local name : Kamot/Hangar



Species : *Rhychobatus djiddensis*
 English name : Skate
 Local name : Pitambar

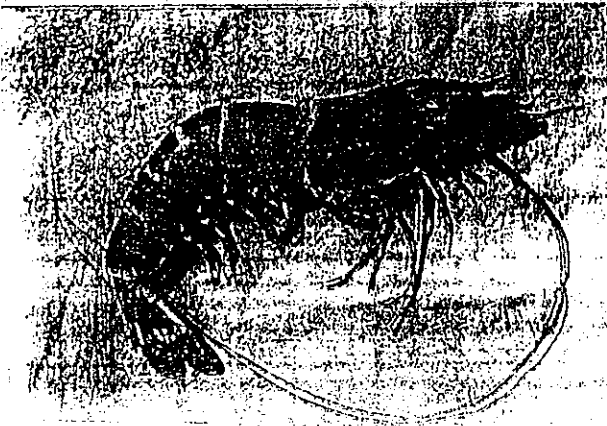


Species : *Himantura uarnak*
 English name : Sting ray
 Local name : Haush/Sankush

APPENDIX II (Cont'd)



APPENDIX II (Cont'd)



Species
English name
Local name

Penaeus monodon
Giant tiger shrimp
Bagda chingri



Species
English name
Local name

Penaeus japonicus
Kuruma shrimp
Dorakata chingri



Species

Metapenaeus monaceros

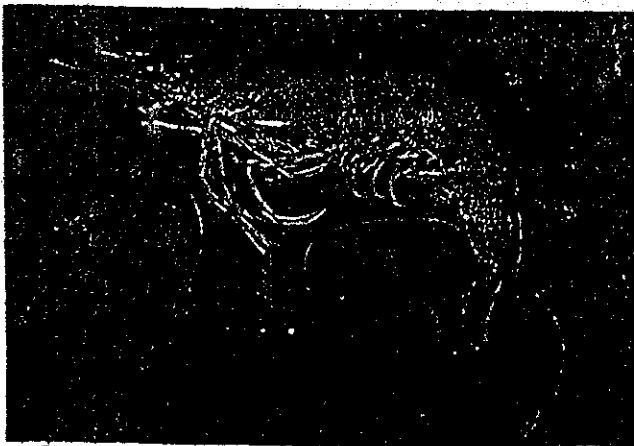


Species

Penaeus indicus

English name
Local name

Indian White shrimp
Sanga Chingri

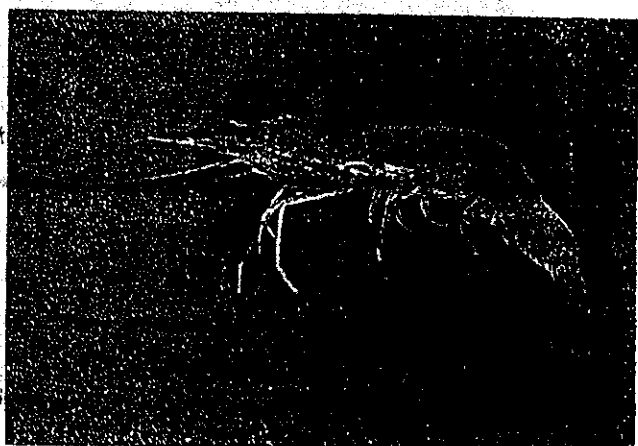


Species

Metapenaeus monoceros

English name
Local name

Speckled shrimp
Horina Chingri/Loilla chingri



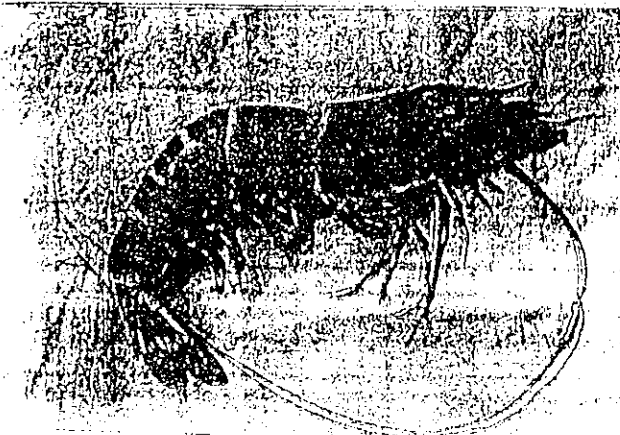
Species

Metapenaeus brevicornis

English name
Local name

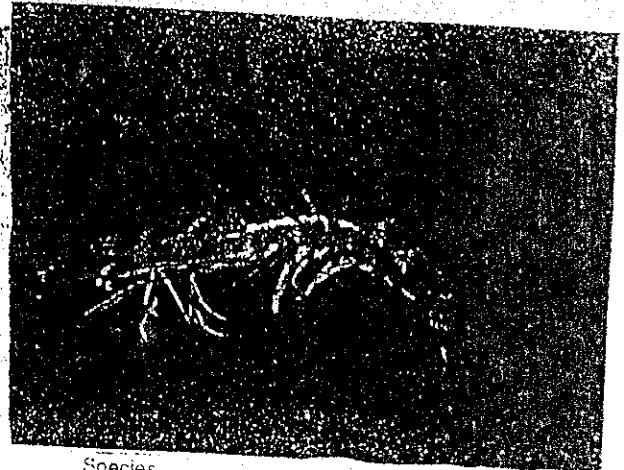
Yellow shrimp
Hunney chingri/Loilla Chingri

APPENDIX II (Cont'd)



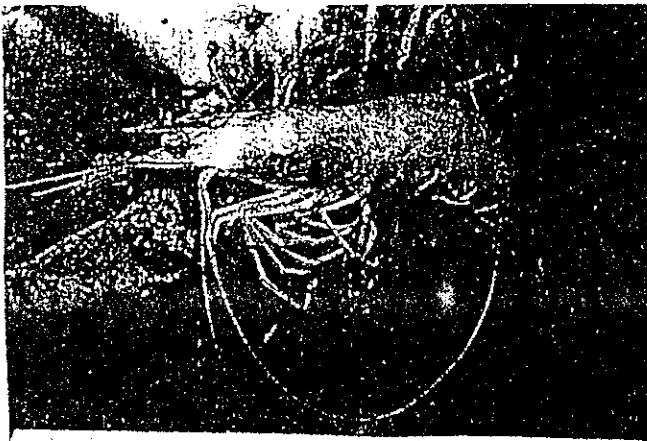
Species
English name
Local name

Penaeus monodon
Giant tiger shrimp
Bagda chingri



Species
English name
Local name

Penaeus japonicus
Kuruma shrimp
Dorakata chingri



Species

Metapenaeus monoceros

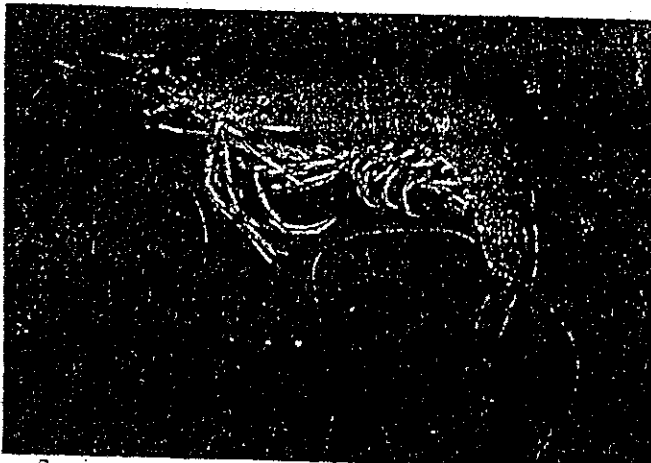
English name
Local name



Species

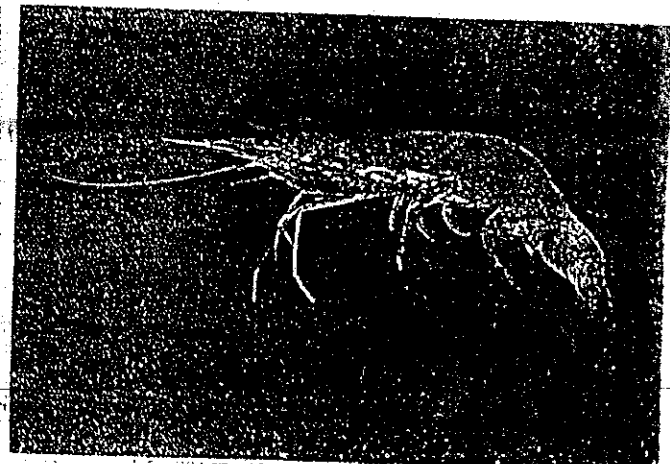
Penaeus indicus

English name
Local name



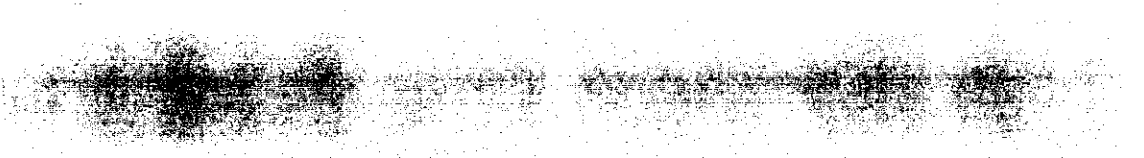
Species
English name
Local name

Metapenaeus monoceros
Speckled shrimp
Horina Chingri/Lolla chingri

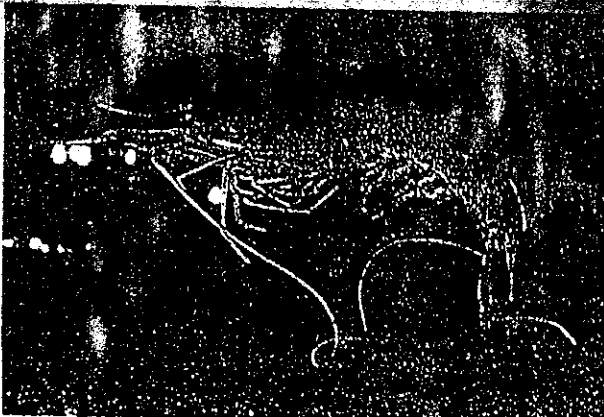


Species
English name
Local name

Metapenaeus brevicornis
Yellow shrimp
Munay chingri/Chingri



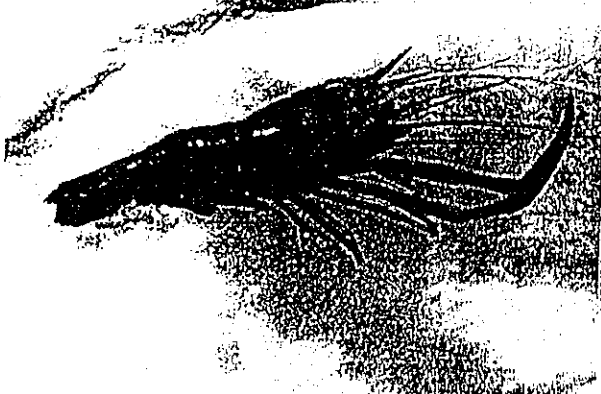
APPENDIX II (Cont'd)



Species : *Parapenaeopsis sculptilis*
 English name : Rainbow shrimp
 Local name : Ruda chingri



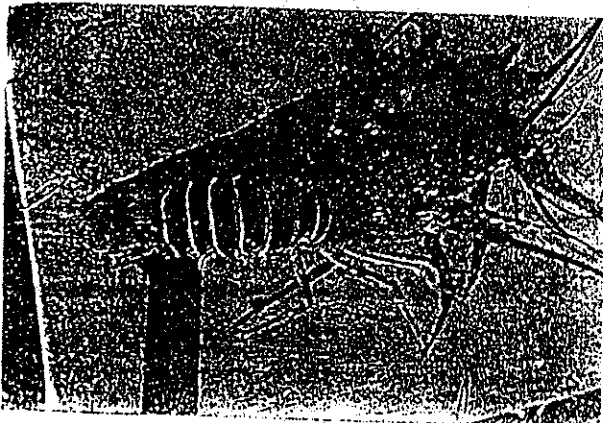
Species : *Parapenaeopsis stylifera*
 English name : kiddi shrimp
 Local name : Ruda Chingri



Species : *Macrobrachium rosenbergii*
 English name : Giant river prawn
 Local name : Golda Chingri



Species : *Nematopalaemon tenuipes*
 English name : spider Prawn
 Local name : Jura Ichha

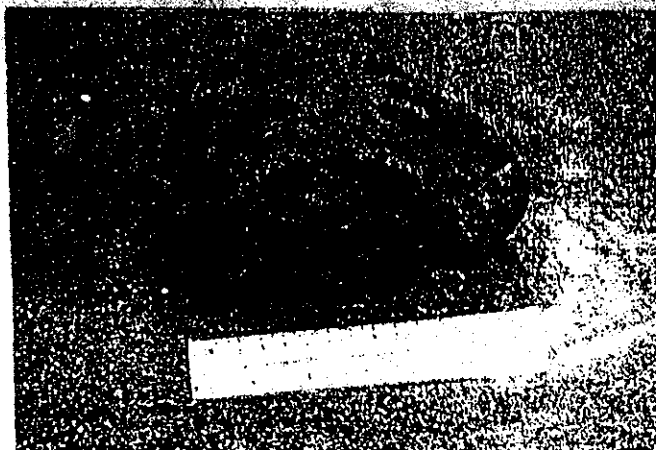


Species : *Penaeus subvittatus*
 English name : ...
 Local name : ...

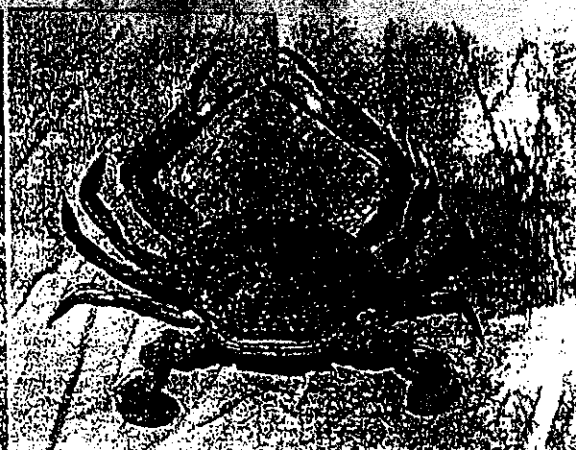


Species : *Thonus orientalis*
 English name : Flathead locus
 Local name : Belsanasa Lobs...

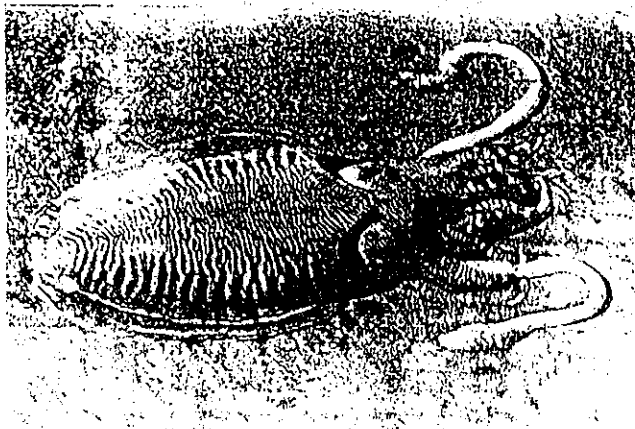
APPENDIX II (Cont'd)



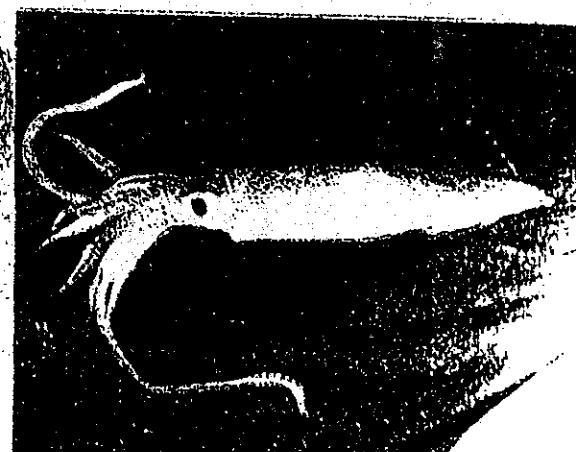
Species : *Scylla serrata*
 English name : Mud crab
 Local name : Sila/Gool Kakra



Species : *Neptunus pelagicus*
 English name : Blue swimmer crab
 Local name : Zaji Kakra



Species : *Sepia sp*
 English name : Cuttlefish
 Local name : Nuna chaa



Species : *Loligo sp*
 English name : Squid
 Local name : Nulla



Species : *Octopus vulgaris*
 English name : Common Octopus
 Local name : Octopus



Species : *Cynoglossus bilineatus*
 English name : Fourlined tongue sole
 Local name : Kukurjib

APPENDIX II
Shrimp Fry-collection Marketing and Transportation



Above - Mobile gears for startup and collection. The pushover gear is very heavy. Below - Shrimp seed transported the hard way. In some areas, women are paid as much as men for shrimp seed.



APPENDIX II (Cont'd)

Below: Transport of shrimp seed by boat



Below: Transport of seed by bicycle. Such bicycles are referred to in Satkhira as "helicopters"



APPENDIX II (Cont'd)

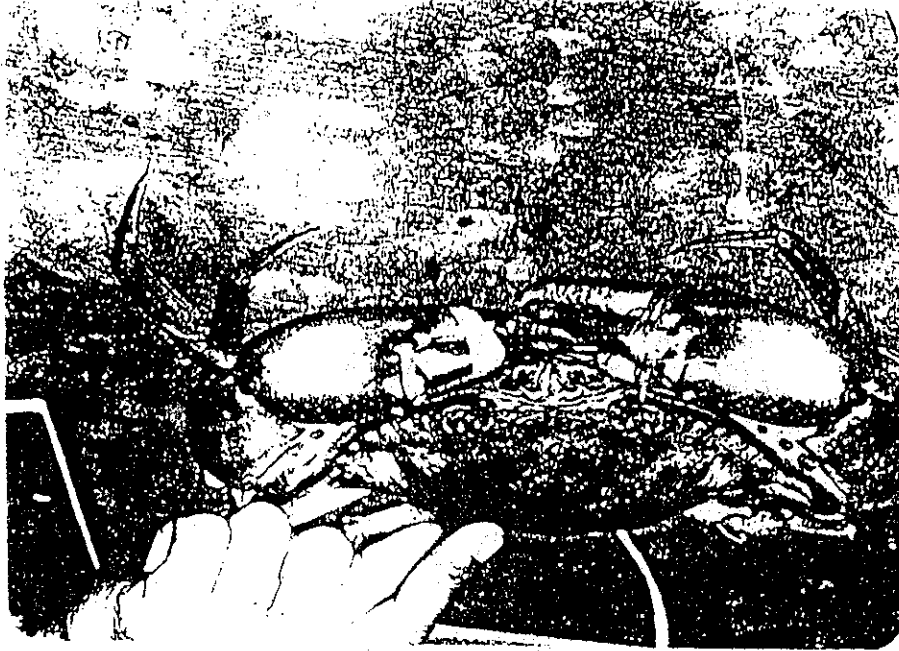


Below. Buying and selling of shāmp seed



APPENDIX II (Cont'd)

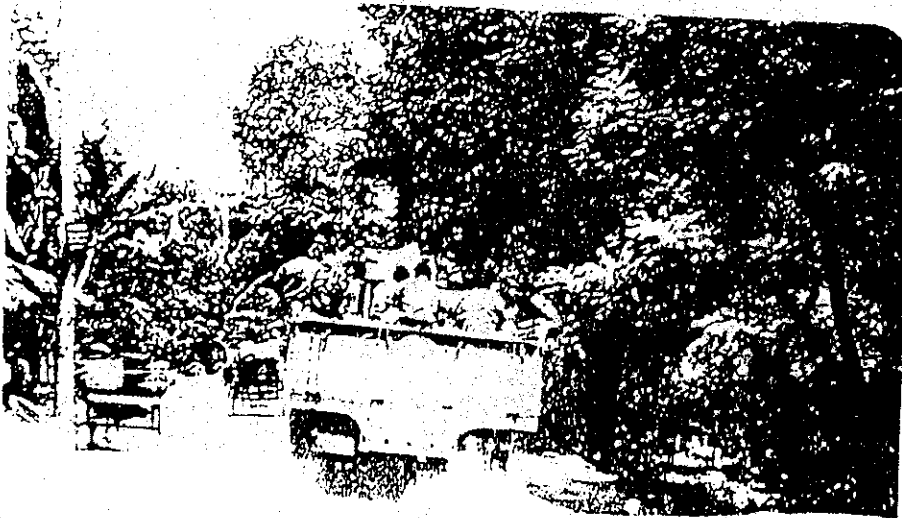
Crabs in Baskets for Transportation



Shrimp in Baskets for Transportation by Trucks



Shrimp in basket



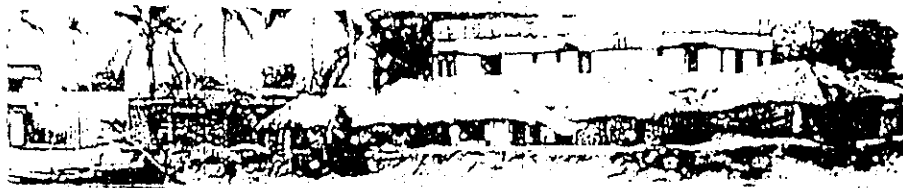
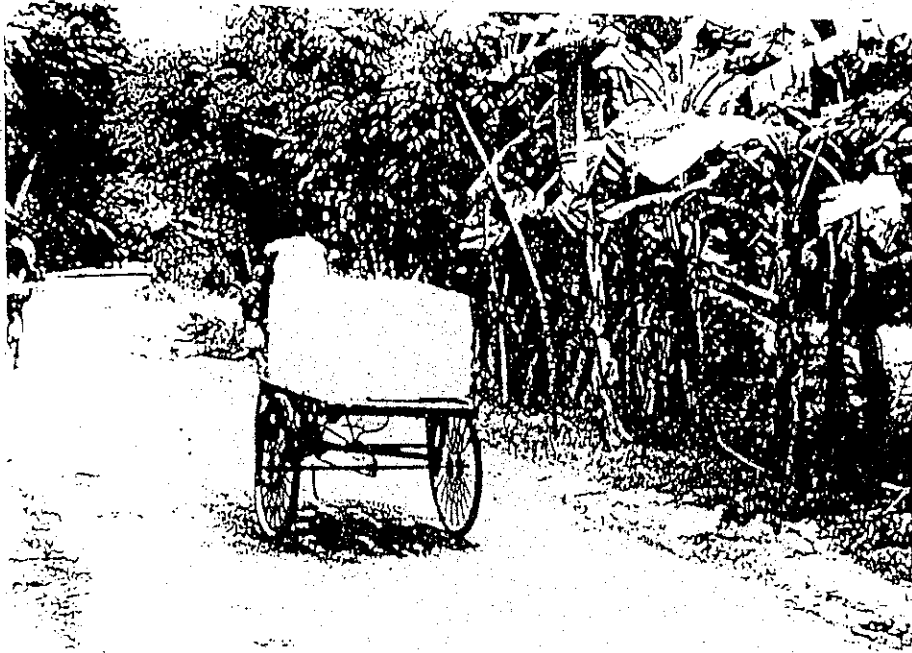
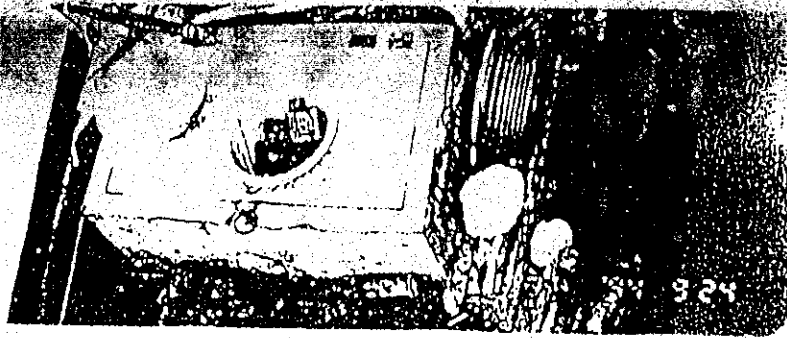
Transportation



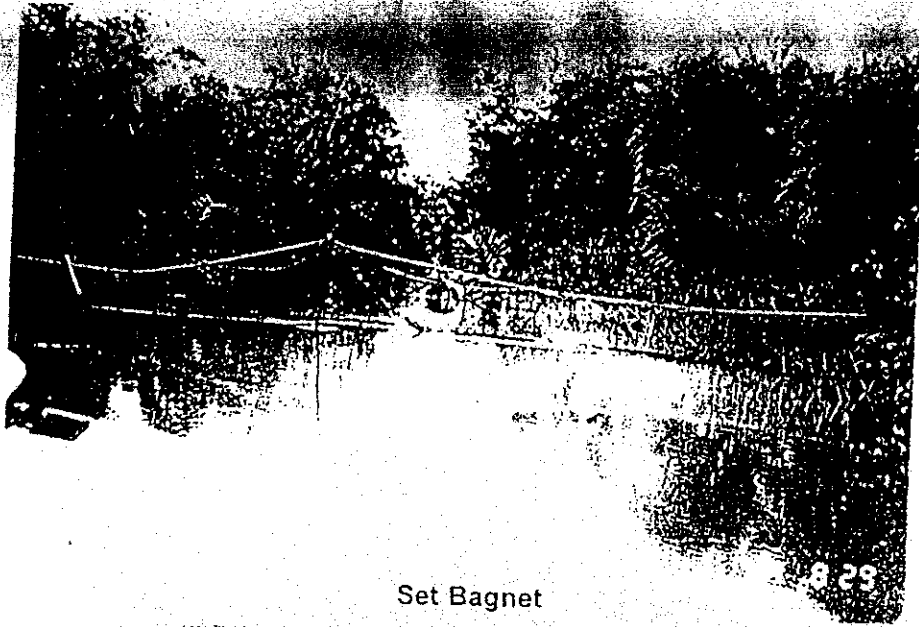
APPENDIX II (Cont'd)



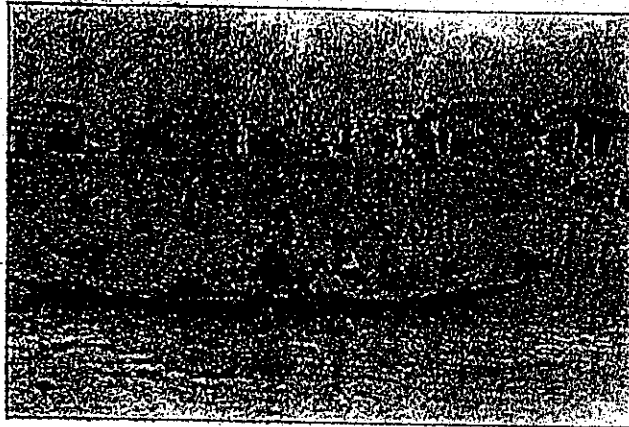
APPENDIX II (Cont'd)



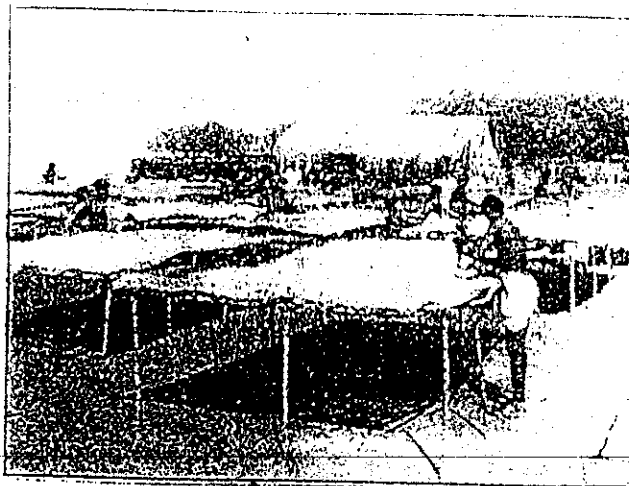
APPENDIX II (Cont'd)



Set Bagnet



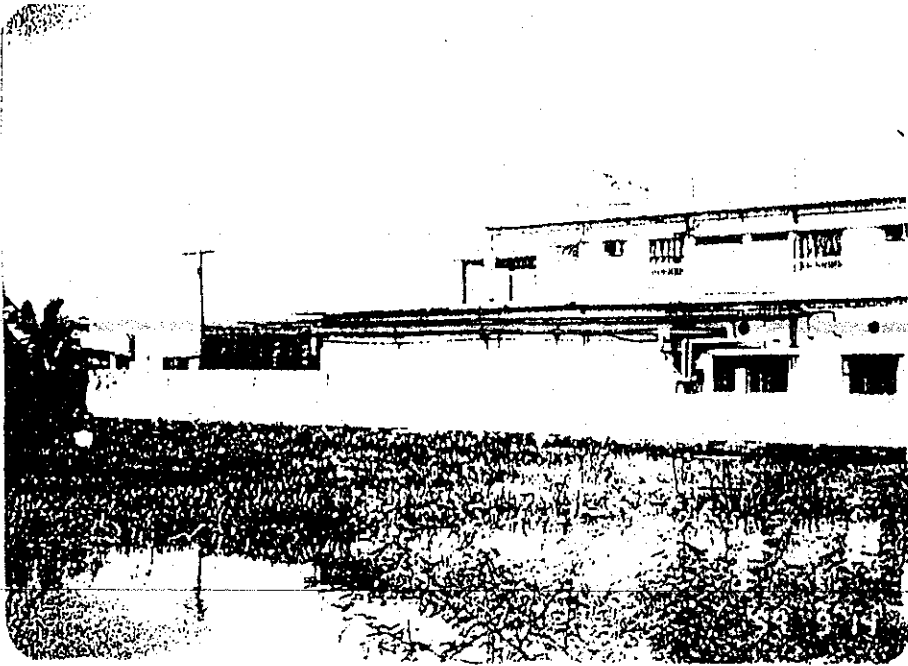
Fish landing at Dublarchar



Fish drying yard at Dublarchar

APPENDIX II (Cont'd)

Fish Processing Industry in Satkhira



APPENDIX III
RETAIL PRICE OF FISH IN KHULNA MARKETS

<u>Local Name</u>	<u>Habitat</u>	<u>Price (Tk)</u>
Bhetki	River/ghear	150
Bhetki	Sea	100
Kakchi chela	River	55-65
Narkeli chela	Beel	85
Bhola	River	80-115
Tapasi	Estuary	120-140
Datina	Ghear	80
Datina	Sea	50
Bata	Ghear/pond	60-75
Punti	Beel/ghear	40-60
Tengra	Beel/ghear	80-110
Khaira	River	60-100
Mochan	Sea	50-60
Shapla pata	Sea	20-30
Magur	Beel	100-150
Shingi	Beel	80-160
Sarpunti	Pond	50-60
Koi	Beel	100-250
Silver carp	Pond	30-60
Mirror carp	Pond	60-80
Saipan rui	Pond	45-60
Perse	Ghear	60-100
Bain	River	100-120
Bain	Beel	60-100
Rui	River/pond/ghear	60-160
Chuli dati	Sea	55-90
Ilish	River	60-110
Kharsola	River	80-110
Nilotica	Pond	60-90
Tilapia	Pond/ghear	40-50
Pangas	River	80-200
Tatkini	Pond	100-120
Taki	Beel	30-60
Dagri	River	70-80
Golda chingri	River/Estuary	250-350
Harina chingri	Estuary	100-140
Tiger chingri	Estuary	60-80
Misti chingri	Estuary	45-100
Chali chingri	Estuary	60-100

APPENDIX IV
LIST OF FISH PROCESSING PLANTS IN KHULNA REGION

- 1 International Premas Export Ltd., Bagmara, Khulna.
- 2 Eastern Sea Food Ltd., Rupsha Stand Road, Khulna.
- 3 Asian Sea Food Ltd., Laban Chara, Khulna.
- 4 Khulna Frozen Foods Exports Ltd., Bagmara, Khulna.
- 5 Penguin Ice and Fish Processing Ltd., Shyamnagar, Satkhira.
- 6 Bagerhat Sea Food Ltd., Town Noapara, Bagerhat.
- 7 Shipsha Sea Foods Ltd., Bagmara, Khulna.
- 8 Fresh Foods Ltd., Khulna.
- 9 New Foods Ltd., Khulna.
- 10 Anowara Sea Food Ltd., Ramnagar, Khulna.
- 11 Ananda Sea Food Ltd., Sinher Char, Khulna.
- 12 Emon Ice and Cold Storage Ltd., Ramnagar, Khulna.
- 13 Aqua Resources Ltd., Shiramoni, Khulna.
- 14 N U C Food Ltd., Jumjumpur, Jessore.
- 15 M M Frozen Foods Ltd., Shiramoni, Khulna.
- 16 Orastal Fish Processing and Culture Ltd., Khanjahan Ali Road, Khulna.
- 17 Sabi Fish Processing Ltd., Nutan Bazar, Khulna.
- 18 Jaminee Sea Food Ltd., Jabusa, Khulna.
- 19 Delta Fish Ltd., Debhata, Satkhira.
- 20 National Sea Food Industries Ltd., Khulna.
- 21 Glina Sea Food Ltd., Bagmara, Khulna.
- 22 Bionic Fish Processing Ltd., Bagmara, Khulna.
- 23 Bangladesh Sea Food Ltd., Laban Chara, Khulna.
- 24 Meghna Frozen Foods Ltd., Binerputa, Satkhira.
- 25 Modern Sea Food Ltd., Purba Rupsha, Khulna.
- 26 Rupali Fish Processing Ltd., Purba Rupsha, Khulna.

- 27 Shahanewaz Sea Food (Pvt) Ltd., Bagmara, Khulna.
- 28 Southern Foods Ltd., Ilajpur, Khulna.
- 29 Satkhira Foods Ltd., Chuknagar, Khulna.
- 30 Sundarban Fish Processing (Pvt) Ltd., Birarputa, Satkhira.
- 31 Haji A Malek Ice and Cold Storage Ltd., Laban Chara, Khulna.
- 32 A Fish Ltd.,-2, Gazir Hat, Satkhira.
- 33 Khulna Fisheries Ltd., Bagmara, Khulna.
- 34 Satkhira Fisheries Ltd., Uttarkatia, Satkhira.
- 35 Sundarban Sea Food Ltd., Rahimnagar, Khulna.
- 36 Coape-Commercial (Pvt) Ltd., Shiramoni, Khulna.
- 37 Rupsha Food and Allieds Industries Ltd., Rahimnagar, Khulna.
- 38 Bangladesh Cold Storage Ltd., Chararhat, Khulna.
- 39 Duglegs Export Ltd., Machghat, Khulna.
- 40 C-I Products Ltd., Machghat, Khulna.
- 41 Bangladesh Matshyajibi Samabya Samity, Deara, Khulna.
- 42 Star Sea Food Ltd., Milki Deara, Khulna.
- 43 Bengal Fish Processing Industries Ltd., Milki Deara, Khulna.
- 44 Shakha Ice and Cold Storage Ltd., Milki Dewara, Khulna.
- 45 Royal Shrimp Industries Ltd., Sener Bazar, Khulna.
- 46 Gazi Ice and Fish Freezing Ltd., Milki Dewara, Khulna.
- 47 Himalya Ice and Fish Freezing Ltd., Sener Bazar, Khulna.
- 48 Dhaka Fisheries Ltd., Mongla, Bagerhat.
- 49 BFDC Fish Processing and Ice Plant, Mongla, Bagerhat.
- 50 Fish Export Ltd., Bajua, Khulna.
- 51 Chalna Marine Products Ltd., Dacope, Khulna.
- 52 Bangladesh Foods and Associate Productions, Shymleagat, Bagerhat.
- 53 Gazi Fisheries Ltd., Purba Rupsha, Khulna.
- 54 Sundarbans Trade Syndicate, Sutiakhali, Khulna (Ship).

- 55 A Fish Ltd., Rupsha Stand Road, Khulna.
- 56 Karmendal Fisheries Trade Ltd., Satkhira.
- 57 United Fish Export Ltd., Purba Rupsha.
- 58 Patuakhali Fisheries Ltd., Patuakhali.
- 59 Barisal Fishing Ltd., Rupatali, Barisal.
- 60 Madhumati Sea Food Ltd., Madharipur.

