Chapter 2

Introduction to Trawl Shrimp Fishery in Bangladesh

2.1. Fishery in Bangladesh- An Overview:

Fish is an essential item of food for the people of Bangladesh and is the major source of animal protein. The fisheries sub-sector currently contributes about 6% to GDP and about 8% of the total merchandise export. It ranks third to jute and leather in total export. About 80% of the country's animal protein supply is'contributed by fisheries. Nearly 10% of the population directly or indirectly depends upon fishing and its ancillary industries for their livelihood.

Annual per capita consumption of fish in Bangladesh was 12 kg in 1962-1963 and decreased to 7 kg in 1982-1983. With the introduction of modern fish culture practices in inland waters and captures technology in deep-sea waters, per capita production has risen to 8.80 kg per annum in 1993-1994, but this is far below the Asian average of 25 kg and the world average of 12 kg per annum. But despite continuous increase in fish production, it has not been able to cope with the fast

Table 2.1

Year-wise Fish Production of Bangladesh (1994-95 to 1998-99)

Source	1994-95	1995-96	1996-97	1997-98	1998-99
Inland Fisheries	**9,08,218**	**9,88,238**	**10,85,764**	**11,90,761**	**12,42,620**
Inland Openwater (Capture)	**5,91,145**	**6,09,151**	**5,99,900**	**6,15,949**	**6,49,418**
River and Estuaries	1,52,782 ,	1,65,637	1,59,660	1,56,894	1,51,309
Sundarban	6,951	7,265	9,225	7,031	11,134
Beel	58,298 '	60,768	62,798	67,812	69,850
Kaptai Lake	5,556	6,148	5,764	5,932	6,689
Flood Lands	3,67,558 ..	3,69,333	3,62,453	3,78,280	4,10,436
Inland Closewater (Culture)	3,17,073	3,79,087	4,85,864	5,74,812	5,93,202
Ponds	2,67,282	3,07,974	4,03,830	4,83,416	4,99,590
Baors (Ox-bow Lake)	2,460	2,764	3,014	3,378	3,536
Shrimp Farms	47,331 •	68,349	79,020	88,018	90,076
Marine Fisheries	**2,64,650**	**2,69,702**	**2,74,704**	**2,72,818**	**3,09,797**
Industrial	11,715 ,	11959	13,564	15,273	15,818
Artisanal	2,52,935	2,57,743	2,61,140	2,57,545	2,93,979
Total	**11,72,868**	**12,57,940**	**13,60,468**	**14,63,579**	**15,52,417**

Source: DOF, Bangladesh

growing population. The country's fish production has increased from 6,40,000 metric ton in 1975-1976 to 13,73000 metric ton in 1996-1997, whereas per capita fish consumption has decreased from 33 gm to 20 gm. This has happened simply because fish production increased at an arithmetical rate whereas the human population increased in geometrical proportion.

Fisheries in Bangladesh are broadly categorized as (i) inland and (ii) marine fisheries. Rahman (1989) lists 260 species of fresh water fish belonging to 55 families that abound the fresh waters of Bangladesh. About 56 species of palaemonid and penaeid prawns occur in the fresh water, estuarine water and marine waters (Kibria, 1983). In the marine waters, the species of finfish recorded, so far, are 475, of which only about 65 are commercially exploited (Hussain, 1971).

Bangladesh produced about 15,52,417 metric tons of fish in 1998-1999, of which about 12,42,620 metric tons (80.04%) came from the inland and 3,09,797 metric tons (19.96%) from marine fisheries. Inland openwater capture fishery constituted about 6,49,418 metric tons (52.26%) and ciosedwater culture fishery 5,93,202 metric tons (47.74%) of the total inland fish production. Marine fish catch from artisanal fisheries and industrial (trawl) fisheries were 2,93,979 metric tons (94.89%) and 15,818 metric tons (5.11%) respectively (Table 2.1).

2.1.1. Inland Water Fishery:

Bangladesh is situated in the deltaic plain of the three main river systems - the Padma (Ganges), the Meghna and the Jamuna-Brahmaputra and their tributaries. The size of the riverine (flowing river and estuaries) and other large inland perennial water bodies has been estimated to be about 12,200 square kilometer i.e. over 8% of the area of Bangladesh (Table 2.2). It has vast inland open waters, rich in fisheries resources. The waters of these rivers and their many branches and tributaries have been central to the economic and social lives of both fishers and non-fishers. In addition to riverine and estuarine fisheries, other important categories of inland fisheries are beels (natural depressions), baors (dead rivers), haors (low-lying natural depressions), pukur and dighis (ponds and tanks), floodlands (seasonal floodplains), an artificial lake (Kaptai lake), the Sundarban, shrimp firms and bheries (salt water fish enclosures or farms) (DOF, 1986). Historically, inland open waters were the major source of fish production of the country. According to the World Bank (1989), Bangladesh is the world leader in per unit area fish production in fresh water with an average production of 4,016-kg/square kilometer (China 411 kg/hectare; India 391 kg/hectare; World average 90 kg/hectare). Even the per capita production of 5.5 kg demonstrates Bangladesh's lead compared to other major fresh water fish producers (China 4.2 kg; India 1.8 kg). The inland open water fishery resources contributed about 90% of the country's fish production in the 1960s (BOBP, 1997), but due to man-made causes, such as overfishing in the absence of fisheries management and conservation measures, implementation of flood control and drainage projects, fish production in the inland open water, particularly in the rivers and floodplains, has declined significantly during the last three decades.

Seasonally Flooded Land: The area of floodplains was estimated at 5.5 million hectare (MPO, 1985). The downward trend in the late 1970s saw a 20%-25% decrease in the contribution to production from inland open water sources. This contribution to the country's fish production has continued to drop and is about 51% at present (DOF, 1994). This decline has been comparatively high in the case of important and valued fish like major carp (Rui, Catla, Mrigal, etc.). The major carp, which earlier contributed about 30% of the fish production, has now dropped to 5%-6% (Tsai and Ali, 1987). The species composition in open water has been out of balance because of the disturbance to natural reproduction of the fish by overfishing and other causes. In the open water production system, floodplains play an important role in fish production. Floodplains are the low-lying areas, which are flooded by

rivers and rainwater congestion. About one-third of the total area of Bangladesh is flooded every year and remains under water for 4-6 months. The floodplains, naturally rich in nutrients and fish food, are the feeding and grazing grounds of almost all inland fish, and the breeding grounds of many of the aquatic species. During the flood seasons (June-November), fish and shellfish grow in the floodplains and are harvested by the rural people. When the water recedes, fish accumulate in the deeper part of the floodplains, called beels, or they migrate to rivers, which retain water throughout the year. Due to the decline of fish population in inland open water and obstruction in the migration route, recruitment of fish in the floodplains has declined and resources in the floodplains are not fully utilized.

Table 2.2
Inland Water Resources and Its Area

Inland water resources	Water area (hectare)
Open water	
River and brackish water	10,31,563
Beel	1,14,161
KaptaiLake	68,800
Floodplain	28,32,792
Total	**40,47,316**
Closed water	
Ponds (12,88,222 in number)	1,46,890
Baor (Ox-bow lake)	5,488
Coastal shrimp farm	1,37,996
Total	**2,90,374**
Grand Total	**43,37,690**

Source: DOF (1999)

Beels, Haors and Baors Fishery: The number of beels in the Northeast Region is between 3,440 (covering 58,500 hectare with a mean size of 7 hectare) and 6,149 (covering 63,500 hectare with a mean size of 10 hectare) (Bernacseket *et. at.,* 1992). About 58% of the beels in the Northeast Region are permanent and the remainder is seasonal. Bernacsek er a/., (1992) also provide a list of the most important fish producing haors in the Northeast Region of the country. They estimate the area of haors is about 1,13,430 hectare. In the other region of the country, the haor-like basins are not seen but beels are seen almost all over the country. All low-lying areas inundated and submerged for a number of months, usually from June to September and becoming dry in the dry season are termed as beels in other regions of the country.

In the southwest region of the country, some of the meandering rivers, becoming old, changed their courses and, in the process, left ox-bow bends, which got cut off from the main stream and become isolated, forming baors or ox-bow lakes. There are 37 large ox-bow lakes, covering an area of about 4000 hectare, and 50 smaller ones in Jessore, Kushtia, Faridpur and Khulna. Most of the larger ox-bow lakes are located in the Jessore region. Ox-bow lakes range in size from about 25 hectare to a maximum of 500 hectare (Hasan, 1990). The total area of baors is about 5,488 hectare. Baor production (1992-1993) was reported to be 1,803 tons with an average annual production rate of 329 kg/hectare (DOF, 1993).

Pond Fish Culture: Bangladesh has got a large number of ponds scattered all over the country. There are over 1.3 million ponds covering an estimated area of 147,000 hectare, representing 3.53% of total inland water resources excluding FCD/FCDI and burrow-pits. The

size of the individual ponds varies from 0.02 hectare to 20 hectare. Currently, the average production in fresh water ponds is 1.4 metric ton/hectare and that of brackish water shrimp farms is only 160 kg/hectare (GOB, 1998; BOBP, 1997). Country production figures show that 2,02,167 tons of fish about 19.8% of the total country production are produced in ponds in Bangladesh with an average annual catch of about 1376 kg/hectare from ponds (1992-1993) (DOF, 1993).

FCD/FCDI Areas and Burrow Pits: The total area under FCD/FCDI component is estimated be 0.7 million hectares, of which 7,000-hectare area is now being developed under different projects for integrated aquaculture. Burrow-pits, after implementation of irrigation, drainage and embankment projects, usually lie unused. Poor people catch some fish, which grow naturally in sdme of these pits. These pits could be turned into nursery ponds and could be used for growing of quick-yielding species. Up to 1.25 million fingerlings per hectare can be produced by modifying the size and depth of these pits besides about 1.5 of high-yielding fish, like *Sarpuntiand Tilapia.*

Paddy Fields: It has. been estimated that Bangladesh's paddy fields cover an area of about 8 million hectare. Fish production in inundated paddy fields is at present, mainly a subsistence capture fishery and, generally, no culture measures are taken. However, paddy-cum-fish culture is now considered an ideal method of land-use. Fish culture in paddy fields has enormous potential in Bangladesh and the present low-yield could be increased to 250 kg/hectare/crop by adopting scientific management practices.

Riverine and Estuaries: All the major rivers meet the Bay of Bengal in the south of the country. Near the confluence of the sea and the rivers, freshwater is replaced by a mix of saltwater and freshwater producing brackish water, and forming a distinct estuarine zone. A wide range of salinity gradients is encountered in the rivers up to a considerable distance upstream from the shoreline of the Bay of Bengal. In the Southwestern region, the principal ecological feature is the presence of the largest mangrove forest in the world, known as the Sundarban. It is criss-crossed by an intricate network of large and small rivers, canals and creeks. The total water area is estimated to be 175,600 hectare (Ali, 1991). Many marine species of fish such as hilsa *(Hilsa ilisha)* use the Sundarban estuaries to migrate upstream into the freshwater portions for spawning. Conversely, many freshwater species such as giant freshwater prawn *(Macrobrachium rosenbergify* migrate from freshwater to the estuaries for breeding. Many marine species of fish utilize the Sundarban estuaries as nursery and grazing grounds for their larvae, fry and juveniles or/and as spawning ground. The Sundarban estuaries also provide good commercial fisheries for ribbonfish, clupeids, polynemids, anchovies, pomfrets, chirocentrids and similar other salt water fishes. In addition, shrimps including tiger shrimps, giant freshwater prawn and brown shrimps are also harvested.

Hilsa is the largest single species fishery in Bangladesh, contributing nearly 25% of the total fish production. There is also thriving fishery for the young Hilsa, generally known as *Jatka.* It has been estimated that some 4,000 tons of *Jatka* are annually caught from a section

of the river Meghna. Some estimates suggest that a 10%-20% conservation of *Jatka* would be equivalent to an additional 40,000-100,000 tons of Hilsa (BOBP, 1997).

2.1.2. Marine fishery:

There are two types of marine fishery in Bangladesh. One is artisanal fishery and the other one is industrial fishery. The artisanal fisher folk operate in inshore (coastal and estuaries) area and the industrial fisher folk operate in offshore (deep sea) area. Both types of fisher folk use fishing gears (different types of nets) and crafts (boats, trawlers etc.). Most of the fishermen in Bangladesh are, however, small-scale fishermen, who use both motorized and non-motorized boats. Some commercial firms use trawlers for catching fish in the deep sea. The artisanal fisheries sector operated mainly with five types of gill nets (drift gill net, fixed gill net, large gill net, bottom-set gill net and mullet gill net), two types of set bag nets (estuarine set bag net and marine set bag net), trammel nets, bottom long lines, beach seines, fine mesh push nets, fixed bag nets and drag nets in harvesting the major catch by applying the primitive^ethods and techniques (Table 2.3).

Table 2.3.

The Area/Depth of Fishing Gears and Crafts Engaged in Different Fisheries

Type of fishing	Major shrimp exploited.	Annual shrimp prod, (ton)	Area/Depth (meter) of Production.
Industrial Trawl Fishing:			
Shrimp Trawler	Adults	4,641	40-100
Fish Trawler	Adults'	232	40-100
Artisanal:			
Gill net:			
Drift			Up to 30
Fixed			8-10
Large mesh drift			30
Bottom			South Patches
Mullet			5-10
Set bag net:			
ESBN	Juveniles	72,786	5-20
MSBN	Adults and Pre-adults	26,111	10-30
Large mesh net		-	10-20
Trammel net		1,753	8-20
Bottom long line		2,853 -	10-13
Beach seine	Small	8,090	8-10
Ghar Pata Jal		-	Up to 10
Cast net		-	Up to 10
Push net	Larvae,	1,294 million	Up to 10
Fixed bag net	Larvae.	741 million	Up to 5
Dragnet	Larvae.	14 million	Up to 2

Source: Khan, M. G. (1994).

A frame survey of traditional and mechanized boats was carried out in 1984-85 and according to the survey a total of 17,331 boats were in operation in the marine artisanal fishery of which 3317 were mechanized boats. According to another estimates the totai

number of traditional and mechanized boats in the estuaries and coastal waters of Bangladesh is 20,000 and 12,700 respectively. Recently, coastal and marine fisheries strengthening project of DOF has reported a total number of artisanal boats as 50,530, of which 28,700 are non-mechanized and 21,830 are mechanized including 3317 registered mechanized boats. Mechanized boats, with minimum 6 to maximum 10 crewmembers, are operated with engines of horsepower as low as 9 to the highest 33. The gross capacity of these boats is 7-8 tons. But per trip of 4-6 days of these boats produces average catch 2-3 tons normally.

The number of motorized boats increased from 276 in 1974 to 1,000 in 1975, growing more than three times in a year. The number of motorized boats increased from 1,300 to 2,000 between 1979-80 and 1980-81 and from 2,100 to 3,347 between 1982-83 and 1983-84. After some fluctuations, it finally settled at the current number of 3,317 (Table 2.4).

Table 2.4

Numbers of Fishing Crafts and Gears During 1972-1973 to 1996-1997.

Years	Trawlers number	Mechanized Boats	Non-mechanized Boats	Gill nets	Set bag nets	Long lines	Trammel nets	Other nets	Total fishing gears
72-73	10	200	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
73-74	21	276	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
74-75	21	1,000	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
75-76	26	1,000	n.a.	n.a.	•n.a.	n.a.	n.a.	n.a.	n.a.
76-77	26	1,050	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a,
77-78	26	1,100	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a,
78-79	26	1,200	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
79-80	26	1,300	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
80-81	24	2,000	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
81-82	35	2,050	n.a.	n.a.	n.a.	n.a,	n.a.	n.a.	n.a.
82-83	53	2,100	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a,
83-84	73	3,347	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
84-85	67	3,300	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
85-86	45	3,137	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
86-87	49	3,317	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
87-88	52	3,317	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
88-89	52	3,317	n.a.	n.a.	'n.a.	n.a.	n.a.	n.a.	n.a.
89-90	53	3,317	14,014	6,389	12,615	2,084	500	2,222	23,810
90-91	53	3,317	14,014	6,389	12,615	2,084	500	2,222	23,810
91-92	53	3,317	14,014	6,389	12,615	2,084	500	2,222	23,810
92-93	53	3,317	14,014	6,389	12,615	2,084	500	2,222	23,810
93-94	53	3,317	14,014	6,389	12,615	2,084	500	2,222	23,810
94-95	53	3,317	14,014	6,389	. 12,615	2,084	500	2,222	23,810
95-96	53	3,317	14,014	6,389	12,615	2,084	500	2,222	23,810
96-97	54	3,317	14,014	6,389	12,615	2,084	500	2,222	23,810

Source: Statistical Year Book of Bangladesh, 1998 (Note: n.a, stands for not available).

There are two categories of exploitable fishes in marine- Pelagic and Demersal. Estimation of stock of two categories marine fishes- Pelagic and Demersal - are not made continuously in Bangladesh through survey and thus annual time series data of stock level are not available. However, some occasional surveys on marine resources were made and those survey data are available.

Pelagic Fishes: Detail surveys for pelagic fishery resources have not yet been carried out in Bangladesh marine water. Saetre (1981) estimated standing stock of pelagic fish at 60,000- 120,000 metric tons through an acoustic study. Both Dr. Fridjof Nansen (1979-1980)

and Thai-Bangladesh joint survey (1979) reported a good abundance of large pelagic i.e. tuna and tuna-like fishes and sharks in Bangladesh marine waters. These surveys were also aimed at demersal studies and some extra efforts were made for pelagic studies with offshore drift gillnet. In the course of these studies, 10 types of tuna and tuna-like fish; 4 types of mackerels; 4 types of sardines; 13 types of sharks and rays; 13 types of carangids and clupeids (mainly *Hilsa ilisha* i.e. shad) were identified.

Demersal fishes: Several surveys have been conducted in Bangladesh marine waters to assess particularly the demersal fish resources since 1968. Results of these surveys exhibit different estimates of demersal fish stock ranging from 55,000 -3,73,000 metric tons. Significant works were carried out by West (1973), Saetre (1981), Penn (1983), Khan et al. (1983) and Lamboeuf (1987). Amongst them, Lamboeuf (1987), on the basis of 17 cruises covering 581 stations estimated standing stock of demersal fish as 157,000 metric tons in 10-100 meter depth and as 1,88,000 metric tons in 10-200 meter depth. On the average, the figure stands at 157,000 metric tons. Two other estimations, Saetre (1981) and Khan et al, (1983) although do not cover huge number of cruises as like as Lamboeuf, do not greatly vary from the estimation made by Lamboeuf. Saetre (1981) reported standing stock of demersal fish as 1,60,000 metric tons and Khan et al. (1983) reported as 152,000 metric tons. The MSY was estimated at 40,000-50,000 metric tons within 10-100 meter depth and 47,000-88,500 metric tons within 10-200 meter depth zone (Lamboeuf, 1987). The finfish species those presently exploited are mainly demersal fishes, shallow water estuarine species, some mid-water species arid a few pelagic species. Most of them are common to both artisanal and industrial fisheries.

2.2. Shrimp Fishery in Bangladesh':

There are two types of shrimp fishery in Bangladesh, one coastal aquaculture shrimp fishery and the other one is capture shrimp fishery i. e. marine shrimp fishery.

2. 2.1. Coastal Aquaculture:

Brackish water aquaculture, also known as coastal aquaculture, is rapidly expanding farming activity and plays an important role in the overall fisheries development effort in Bangladesh. Brackish water aquaculture has been a definite economic activity since the early 70s when Bangladesh started exporting shrimp. Amongst the coastal districts, brackish water aquaculture activities are most visible in Satkhira, Khulna, Bagerhat, Cox's Bazar and Chittagong. Extensive areas in the coastal belt are, however, under brackish water aquaculture, which is entirely shrimp-based. The total area currently under aquaculture is 2,92,378 hectare of which 48% is under brackish water aquaculture. Brackish water aquaculture products are largely export-oriented and account for 52% by volume and 64% by value of the total fisheries export. Again, brackish water products contributed 86% by volume and 84% by value, of total exported aquaculture products. Well over 200,000 people are

directly employed in brackish water aqua farming which has also led to the establishment of various rural based cottage industries i.e. making of bamboo screens, cages, traps, baskets, mats, nets, wooden sluices, rickshaw vans, boats etc. Brackish water aquaculture, particularly of shrimp, is fast expanding in Bangladesh due to the high demand for its products in the world market. The most commercially important brackish water shrimp are Bagda *(Penaeus Monodon)* and the white shrimp *(Penaeus Indicus).*

Shrimp culture area has expanded from 20,000 hectare in 1980 to over 140,000 hectare in 1994 and production has increased from 2,220 tons in 1982-1983 to 57,000 ton in 1994-1995. While gross production has increased, production per unit area, however, is very low. It is 100-160 kg/hectare in traditional extensive systems and about 250-350'kg/hectare in improved extensive systems. Semi-intensive culture, through higher stocking, supplementary feeding, aeration and water exchange has indicated productions of 2,50 kg/hectare {BOBP, 1997).

Tiger shrimp larvae is of high demand for aquaculture and the process of collection of tiger shrimp larvae is destroying million of other fish and shrimp larvae. Fine-mesh push nets, fixed bag nets and drag nets are used throughout the coastline for harvesting of post laivae of tiger shrimp. It is estimated by the DOF/BOBP survey (Paul *et* a/.1993, BOBP, 1993) that 2,92,397 persons including women and children are involved in the collection of shrimp seed and 2,28,658 gears of different types are engaged in this fishery.

More than 2,035 million tiger shrimp post larvae are collected annually (Paul, af *al,* 1993) which is only over 1% of the total catch of the push net fishery. The rest of the catch is thrown *on* the sand to die, which is equivalent to about 200 bilJion of the larvae of other shrimp and fishes. Presumably the amount is increased by at least two times in number at present. This is considered as a serious growth overfishing. Seed is the main input for any aquaculture operation. At present, a major portion of the seed of Bagda shrimp is collected from natural resources. But the availability of seed from nature is erratic, unreliable and is on the decline due to various reasons. Mortality of seed collected from nature is high, due to the crude methods used in collection and transportation. It is estimated that over 50% of the seed collected dies before reaching the shrimp farms. Jt has been estimated that over 3 billion *Penaeus Monodon* seed are annually collected from natural sources. Along with the desired *Penaeus Monodon* post-larvae, fry of a number of other finfish and shellfish are caught, but are destroyed as they are discarded on the shore. Studies undertaken by the FRI indicate that for every single *Penaeus Monodon* post-larvae collected, 40 other shrimp and 10 finfish seed are destroyed (Majid, 1994).

With the expansion of shrimp culture area and also intensification, the demand for shrimp seed has increased, but the collection from nature is not able to meet the demand. Only in recent years have a few hatcheries been established in Bangladesh, but their production capacity is very insignificant. These hatcheries are also facing several problems. As a result, as such adverse conditions in meeting the demand, seed are being imported from neighbouring countries.

As an ancillary to shrimp fishing, freezing plants and frozen storage (shore based) facilities have developed as industry in Bangladesh in a very big way. There were 115 processing plants by 1993-1994, having a total daily capacity of 800 metric tons of shrimp or fish (approximately annual capacity of 180,000 metric tons on the basis of 220 days of operation in a year). As against this installed capacity, shrimps for export amount to only around 40,000 metric tons live weight or about 25,000 metric tons headless weight. Capacity utilization for shrimp freezing was only 19% in 1992-1993. As a result, most shrimp processing plants are either lying idle or have diversified into finfish processing and freezing. Of the 115 plants only 4 are in the public sector (BFDC) and have a daily freezing capacity of 51 metric tons. The private sector exporters mainly use BFDC plants as service facilities. (BOBP, 1997).

The major export markets during 1992-1993 for frozen shrimp and prawn from Bangladesh were the USA (40.22%), EEC (33.50%), Japan (12.64%) and Germany (10.41%). Regional countries in the South East Asia are buying only 2.88% of this commodity. Market share of frozen shrimp and prawn are shown in Table 2.5.

Table 2.5

Major Export Markets of Bangladesh Frozen Shrimp (million US $)

Year	Market Share	USA	EU	Japan	South-East Asia	Total
1991-1992	uses)	45.88	56.43	11.83	4.93	119.71
	%	38.33	47.15	9.88	4.12	100%
1992-1993	US($)	62.50	*68.27*	19.65	4.48	155.48
	%	40.20	43.91	12.64	2.88	100%

Source: BOBP (1997)

2.2.2. Trawl Shrimp Fishing:

Marine Environment: Bangladesh has a land area of 1,47,570 sq. km. and is bounded by India on the west, north and northeast, by Myanmar (Burma) on the east and southwest, and by the Bay of Bengal on the south. Bangladesh declared an Exclusive Economic Zone (EEZ) of 200 nautical miles in her seawater in1974. Bangladesh EEZ lies from the base line to 200 nautical miles seaward. As a result along with 710 km. (coast line) an area of about 1,66,000 sq. km., which is greater than actual land of Bangladesh, is now under the economic jurisdiction of the country for exploitation, exploration, conservation, and management of its living and non-living resources (Table 2.6). The shelf area covers roughly 66,440 sq. km. and

Table 2.6

Total Marine Water Area of Bangladesh

Description	Area (Sq. Km.)
Coast line	710
Internal water up to 10 fathom (base line) from the coast line •	25,140
Territorial water up to 12 n.nx from the base line	9,060
EEZ (200 am. from the base line) territorial water	1,40,860
Total Marine Water (EEZ + Internal Water)	1,66,000

Source: Fisheries Information Bulletin, GOB, 1986.

the coastal waters are very shallow; with depths less than 10 meter covering 24,000 sq. km (Table 2.7). The shelf area down to about 150 m appears to be very smooth with very few obstacles to bottom trawling. The continental edge occurs at depths between 160 m and 180 m. In the case of Bangladesh trawl shrimp fishery, Penn (1983) estimated 5,180 square kilometer as the effective shrimp fishing area. The actual shrimp-fishing zone is shown in the Figure-2.1.

Diagram shows that there are four major fishing grounds in the Bay of Bengal of Bangladesh. There are South Patches (3662 sq. km.), South of South Patches (2583 sq. km.), Middle Ground (4600 sq. km.), and Swatch of No Ground (3800 sq. km.) (Khan, 2000).

Biological Description of Marine Shrimp Catch: There are altogether ten different types of shrimp of Penaeus (or Meta-Penaeus) family available in the zone of marine trawl fishing in Bay of Bengal of Bangladesh. Biological names along with common

Table 2.7
Area of Shelf of Bangladesh

Depth Zone (Meter)	Area (Sq. Km.)
Up to 10	24,000
10-24	8,400
25-49	4,800
50-74	5,580
75-99	13,410
100 -199	10,250
Total	66,440

Source: Saertre, 1981.

names are listed below. Pictorial presentation of each of the types mentioned here is also provided. Though majority of the shrimp types listed here are common to both artisanal and industrial fisheries, there are differences in nature of catch. While the industrial fishery harvests mostly the adult, the artisanal fishery harvests the pre-adults, post-juveniles, and juveniles because shrimps usually reside in the brackish water estuaries during the early phases of their life.

i) *Penaeus monodon* Giant tiger shrimp
ii) *Penaeus semisulcatus* Tiger shrimp
iii) *Penaeus iaoonicus* Tiger shrimp
iv) *Penaeus indicus* White shrimp
v) *Penaeus merguiensis* Banana shrimp
vi) *Metapenaeus monoceros* Brown shrimp
vii) *Metapenaeus brevicornis* Brown shrimp
viii) *Metapenaeus affinis* Brown shrimp
ix) *Parapenaeopsis sculptilis* Pink shrimp
x) *Parapenaeopsis stvlifera* Pink shrimp

Among all these varieties, *Penaeus Monodon* (giant tiger shrimp) is the most valuable and targeted species and fetches a very good price both in local and international markets but the highest contribution in the total production (63%) is made by *Metapenaeus Monoceros* (brown shrimp),

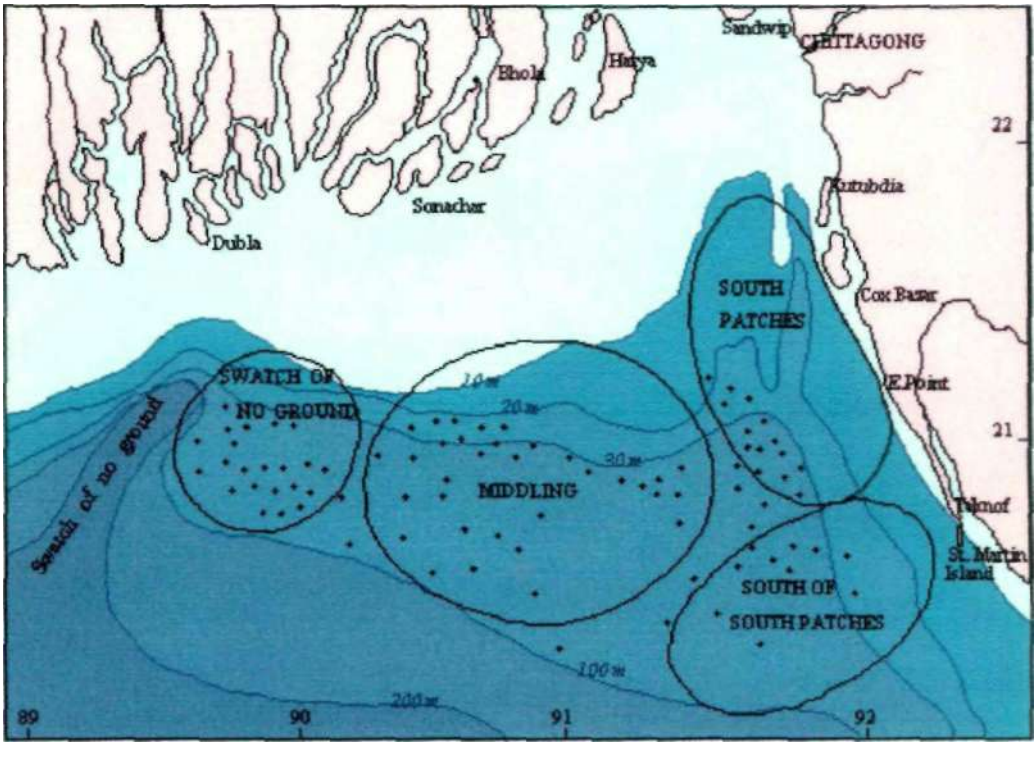
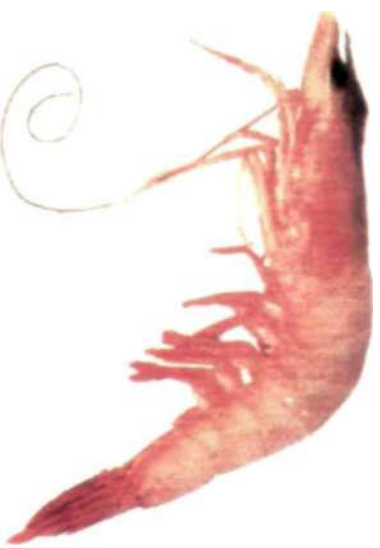


Figure 2.1. Geographical Location of Trawl Fisheries in the Bay of Bengal of Bangladesh

(a) ***Penaeus monodon***

(b) ***Penaeus semisulcatus***

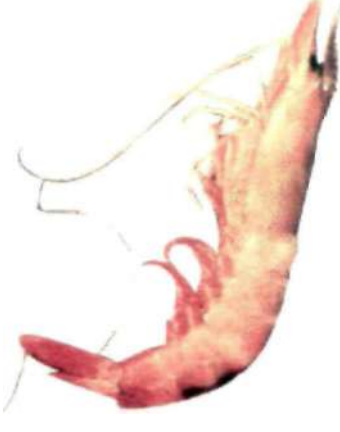
(c) ***Metapenaeus brebicornls***



(d) ***Penaeus indicus***

(e) *Metapenaeus monoceros*

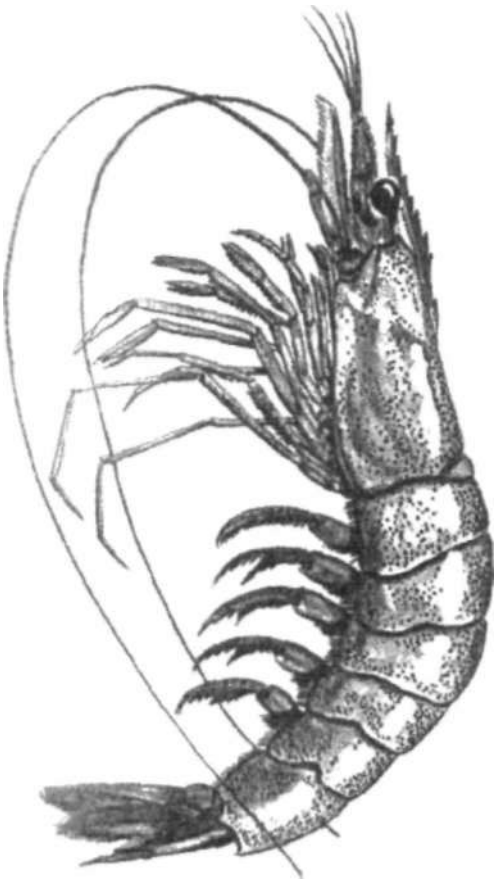
(f) *Penaeus japonic us*



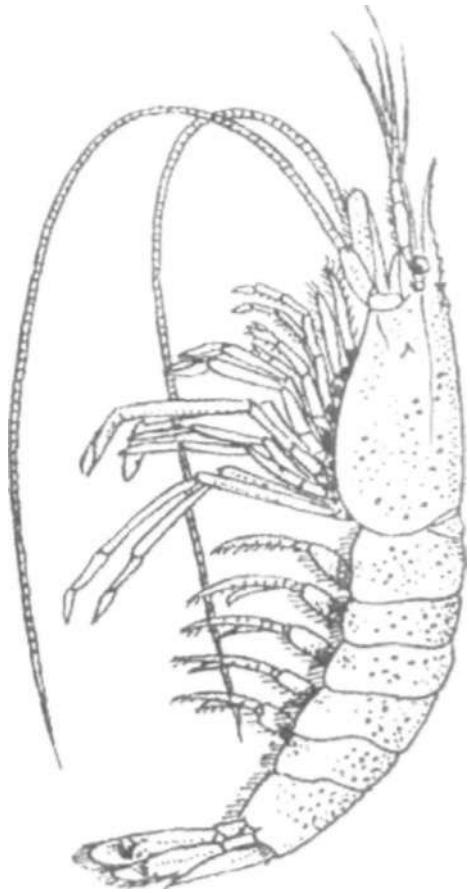
(g) *Parapenaeopsis sculptilLs*

V

(h) *Penaeus merguiensis*



(i) *Metapenaeus affinis*



(j) *Parapenaeopsis styltfera*

The surveys and researches so far carried out in the Bay of Bengal give a fair idea of distribution of shrimp in different depth strata. The distribution of shrimp by depth strata is 45.2% in 10-20 meter, 31.2% in 20-50 meter, 12.7% in 50-80 meter, and 10.9% in 80-100 meter {Hye, 1994).

Several studies indicate that shrimp migrate to deeper waters as they grow older and larger (Blomo et al, 1982). The literature provides a range of shrimp sizes by depth zone but not migration rates or numbers. During the shrimp life cycle, which is about 1-2 year, the shrimp stock is subject to natural and fishing mortality. Moreover, juvenile shrimp, which grow in marshes (brackish/inshore waters), move to deep waters as they grow. Thus, a trade-off occurs in calching shrimp in various seasons and locations. Small shrimp caught in the inshore are less valuable than larger shrimp caught in the offshore, but catches by the inshore fishermen reduce the stocks available to offshore fishermen. The open access, common property nature of the fishery in the inshore motivates fishermen to harvest as much and as fast they can. This phenomenon may lead to uneconomic use of the resource and a major concern of the policy maker.

Life cyck Patterns of Penaeid Shrimp: Penaeid shrimp live and spawn in offshore waters beyond the 40-meter depth zone. The larvae enter the estuarine habitat with the tidal currents. There they find an environment suitable for feeding and living at that age. As they grow bigger, their physical and biological demands change gradually and so they move back towards the sea. When they reach the parent stock they have grown to adulthood and have matured to participate in the spawning process, During the different phases of their life cycle. the penaeid shrimp population encounter a variety of fishing gear in different areas and depths of the sea (Figure 2.2) starting with shrimp fry collecting gear at the post-larvae stage, followed by the ESBN and beach seine in the open brackish waters and estuaries, when they are at the juvenile stage. The survivors are then captured by the MSBN at post-juvenile and pre-adult stages, by the trammel nets at adult size and finally, the residual population is caught by the shrimp trawlers in the marine environment. Thus, members of a single *stock* are exposed to a multi-gear fisheries exploitation system.

Fleet of Trawlers: Bangladesh started with a fleet of 10 trawlers after liberation i.e. 1972-1973. The numbers of trawlers more than doubled to 21 in a year and then jumped to 26 two years later. The number of trawlers changed abruptly in the early eighties and reached a maximum of 73 in 1984. The numbers then fall gradually and stabilized at a little more than 50. The current number of trawlers is 54 of which 41 are shrimp trawlers and the remaining are fish trawlers (Table 2.4).

The trawlers operate in the shelf area beyond the depth of 40 meters in the EEZ. The effort in the trawl fishery during the last one and a half decade have been rotated around 5,000 -6,000 standard fishing days to produce 3,500-6,000 mt of shrimp. This is, however, no agreement on MSY of penaeid shrimp of Bangladesh. The MSY of penaeid shrimp is estimated as 7,000-8,000 mt and the optimum effort for producing the said amount is 7.000-

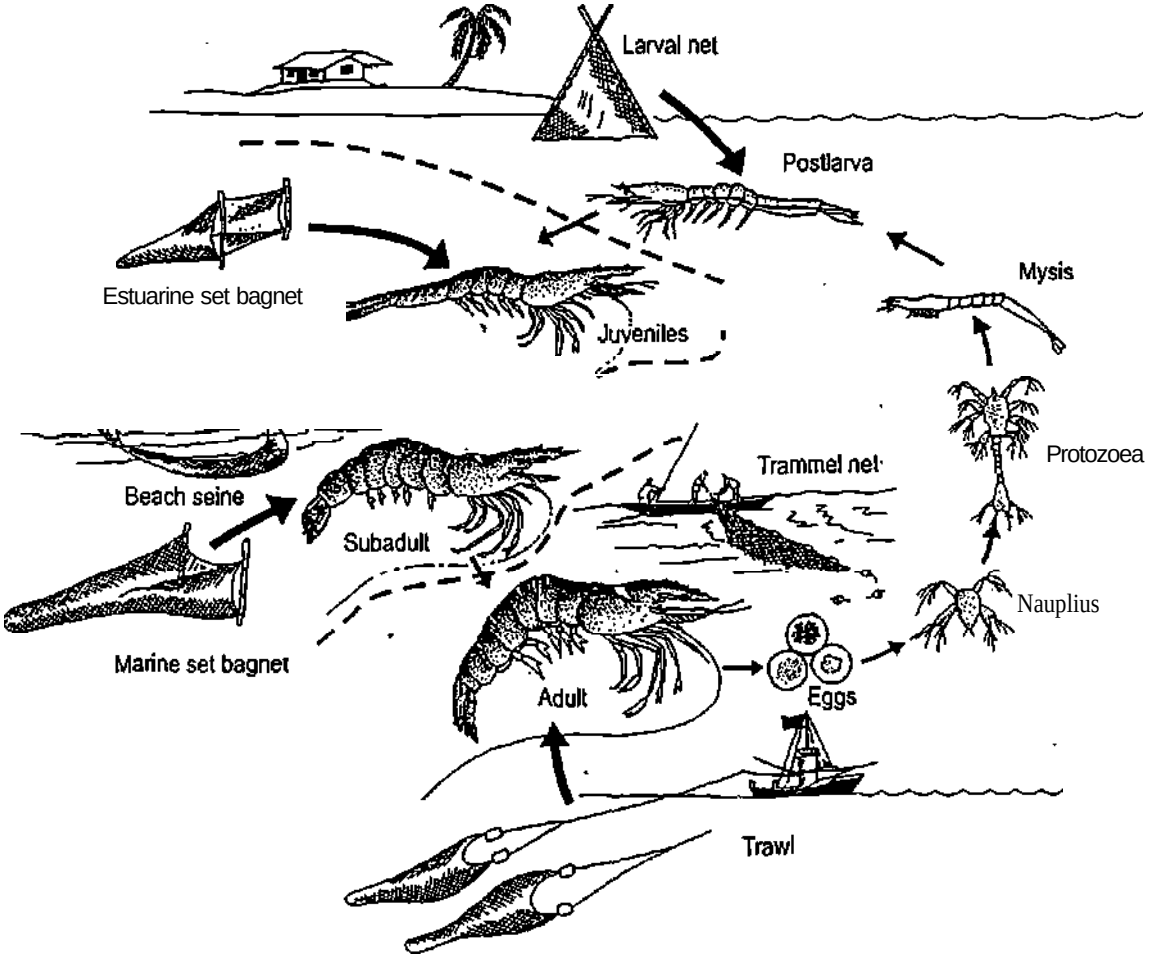


Figure 2.2: Graphical Presentation of Penaeid Shrimp Life Cycle and Harvesting by Different Types of Nets at Various Stages in Bangladesh (Source: Khan and Latif, 1997)

8,000 standard days (BOBP, 1997). The estimated value of MSY of penaeid shrimp is shown as 4145 mt (using Schaefer model) and 4329 mt (using Fox model) in another occasion.

Stock of Marine Shrimp: Several surveys have been conducted in Bangladesh marine waters to assess, particularly the demersal fish/shrimp resources. Result of these surveys differs significantly estimation-to-estimation starting from 1,550 metric ton to 11,400 metric tons. Estimation, considered important by different researcher, of West (1973), Saetre (1981), Penn (1983), Rashid (1983), Khan et. al. (1983), White and Khan (1985), VanZalinge (1986), and Lamboeuf (1987) etc.

2.3. Institutions of Fishery Management and Policies:

At present, marine fishery of Bangladesh is supervised and managed by the ordinance called Marine Fishery Ordinance (MFO) that was enacted in 1983. This ordinance was passed for management, development, and conservation of marine fisheries in Bangladesh Fishing Water (BFW). Under the provisions of MFO all mechanically propelled vessels require a license for fishing. Normally, a vessel is required to obtain a certificate of inspection, which is a precondition for registration. A registered vessel can then apply and receive a license from DOF. Type of fishing gear, method of fishing, and location of fishing or the fishing ground are specified in the license. The Marine Fisheries Ordinance (MFO) 1983 provides "Area for fishing with trawiers are earmarked for operation beyond 40 meters of marine waters at its highest tide". The area up to 40-meter depth was kept reserved under the preview of the ordinance for the benefit of small-scale fisheries. Most of the fishermen in Bangladesh are, however, small-scale fishermen, who use both motorized and non-motorized boats. Some commercial firms use trawlers for catching fish in the deep sea. Specific provisions have been made in MFO, 1983 regarding area and gear restrictions. Beyond 40-meters of marine waters at its highest tide is earmarked as area for the fishing with trawlers.

All licensed shrimp trawl use net (boom) with low opening, the minimum mesh size 45 millimeter at the cod end, where as for fish trawl net, mesh size at the cod end is 60 millimeter. Every frozen fishing vessel engaged in trawl fishing may be allowed sailing permission for a period not exceeding 30 days and every non-frozen fishing vessel engaged in trawl fishing may be allowed sailing permission for a period not exceeding 15 days at a time.

2.4 Concluding Remarks:

Bangladesh is a small country with limited natural resources. The long run development and prosperity of the country is, therefore, largely depend on sustainable use of natural resources, particularly replenishable natural resources. The concept of replenishable use of renewable resources gives birth the notion of sustainability. The objective is to take off advantages of the benefit provided by resources up to the point where the rate of extraction from the nature equals the rate of renewal by the nature. So, in agriculture, forestry, livestock and fisheries - marine and inland etc exploitation/utilization must be equal to the extent of capacity of regeneration or refurbishment. Does the scientific management of such resources

enhance or keep steady inherent rates[1] of renewability without jeopardizing the implicit basic principles of sustainability i.e. Knowability, Homoeostasis, Bioethics- both internal and external? (Turner, 1992).

Similar to the theme introduced by Kerry Turner (1992) between 'sustainable growth' and 'sustainable development' many draw upon a distinction between 'sustainable utilization' and 'sustainability'. Sustainability has been considered as a much broader phenomenon embracing ethical norms pertaining to the survival of living matters and the rights of the future generations. Thus institutions responsible for ensuring that such rights are fully taken into account in policies and actions are under the preview of the concept. While the first two of the above mentioned premises of sustainability, those pertaining to Knowability and homoeostasis, apply to the concept of sustainable utilization, others which embrace a more bioethical perspective with implications for a great variety of rights and obligations, impinge more directly on the notion of sustainability. Sustainable utilization is a prior condition for sustainability, but not a sufficient one. But, at the same time, the objectives of sustainable utilization cannot be met without incorporating the principles of sustainability.

In this context, the management of one of the major marine resource exploitation in Bangladesh deserves to be studied critically. The present management system of marine fisheries is a complex one. The marine wing has practically no control over the fishermen and fishing along the coast. The size of the fisher folk and their socioeconomic condition makes it hard to implement any management and conservation measures. In addition, there is a scarcity of manpower in the marine sector. The Marine fisheries Ordinance has been identified by experts as the most relevant and dominates of all legislation in managing fishing. It defines territorial seas and economic zones and other marine waters over which it claims to have jurisdiction. However, management through MFO, 1983 does not ensure the optimum utilization of this resource and its sustainability. In the following chapters, we will study the optimum dynamic behaviour of trawl shrimp fishery only.