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# *Suggested ways for improving the management of the Bay of Bengal shrimp trawl fisheries:*

A literature study on challenges and bycatch mitigation in shrimp trawl fisheries around the world and examples on how it is implemented in the management regimes in various nations.

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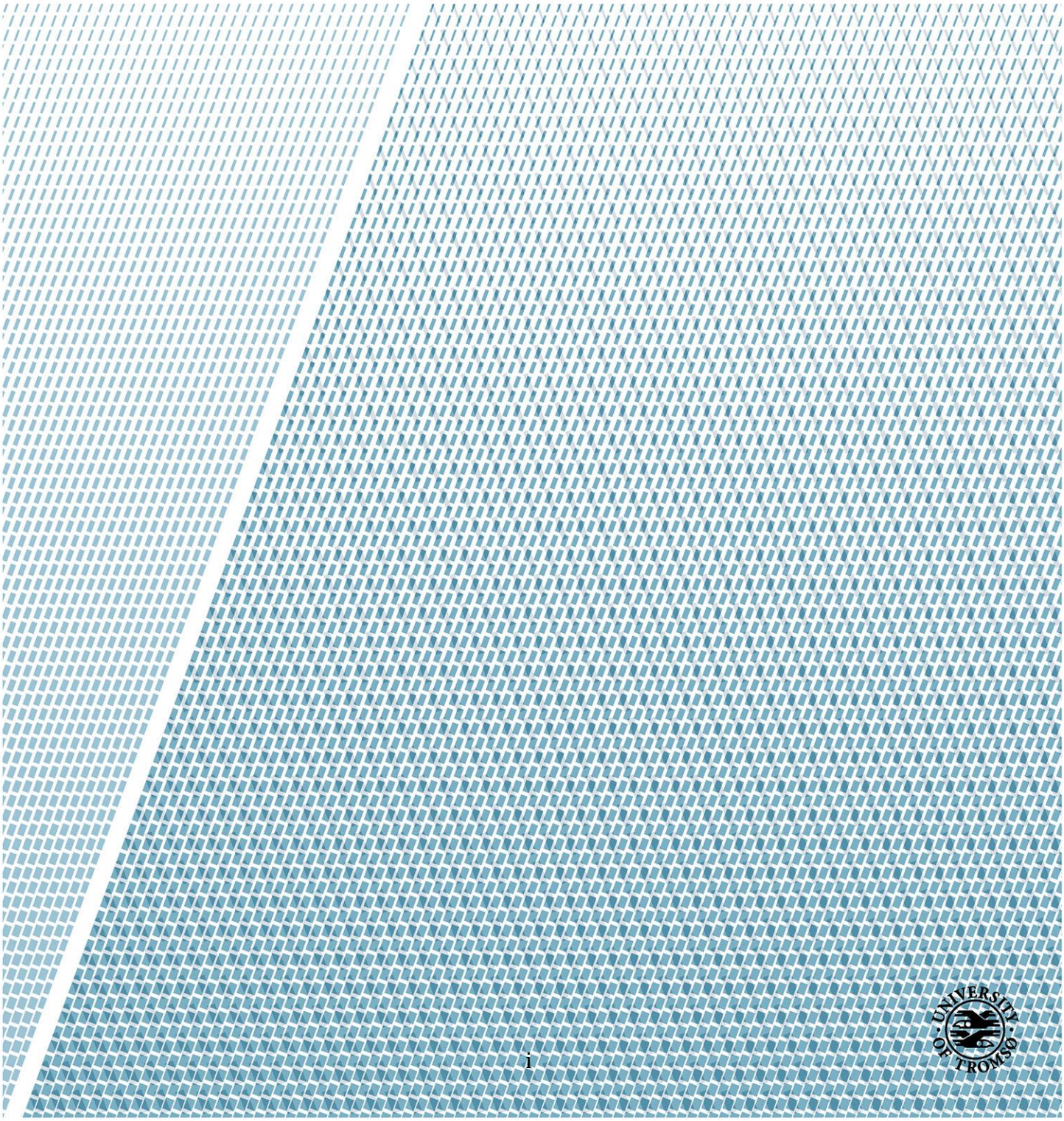
*FSK-3910 Master's Thesis in International Fisheries Management/ April 2018*



## ABSTRACT

India, Sri Lanka and Bangladesh have border with Bay of Bengal. Sri Lanka and India has good consciousness on bycatch situations in their part. But Bangladesh has very little intension on bycatch strategies. This paper has main intention to write about Bangladeshi part of Bay of Bengal on bycatch situation.

As a littoral state of the Bay of Bengal, Bangladesh has ample coastal and marine resources. Bangladesh has marine fisheries resources with 475 species of fish, 36 shrimp, 5 lobsters, 12 crabs and 33 sea cucumbers and many other aquatic fauna and flora.

Though there are several rules and regulation are already existing by the marine authority, but there is no bycatch and discards data and any preventive measures have taken by the Government of Bangladesh in The Bay of Bengal which is very important factor in marine resources.

This paper mainly focuses on improving current bycatch situation on the Bay of Bengal (Bangladesh Part). Here, mainly several literature reviews are done.

The paper has four parts; first part explains the overall bycatch situation on Bay of Bengal (Bangladesh Part) like fishing fleet, shrimp trawling, management regimes with mitigation procedures taken by the Bay authority. Second part shows the explanation of bycatch and discards. Thirdly, it reveals current overall bycatch views and strategies taken by USA, Norway, Australia, Canada, South Africa. Fourthly, it shows some strategies which can be taken by current fishers and marine authority of Bangladesh to handle the bycatch for maintaining sustainability and earning healthy revenue based on some experienced countries who manages bycatch very adequately.

Recently, Bangladesh get reasonable marine areas which makes more volume of its own areas. In this case, this time is very crucial for Bay authority in Bangladesh to take proper action in Bangladesh.

Presently, Bangladesh is heading for being strong economy compare to earlier years. If the Marine authority could be more conscious to aware on bycatch on the Bay, marine sector must be very effective stand for the growing of national economy.

If we see the current technical and management measures what are practicing right now in Bangladesh still are very effective according to the environment and culture of fishers. But, present ongoing measures in successful nations over bycatch is also a important part for future outcomes.

## DEDICATION

I dedicate this work to my mother `Monowara Begum` where I feel totally safe. Also, the most important dedication is to my brother `Mohammad Wahiduzzaman Khan` who really wants my existence from heart.

## ACKNOWLEDGEMENTS

Special thanks go to my Supervisor Roger B. Larsen, who really helped me from his heart to complete the work.
My coordinator, Ane-Marie Hektoen, felt so kind for me during whole of my study period. I am very grateful for her very special care.

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## 1. Introduction

India, Sri Lanka and Bangladesh have border with Bay of Bengal. Sri Lanka and India has good consciousness on bycatch situations in their part. But Bangladesh has very little intension on bycatch strategies. This paper has main intention to write about Bangladeshi part on bycatch situation.

Mainly, there is no bycatch and discards data and any preventive measures have taken by the Government of Bangladesh in The Bay of Bengal which is the great source of marine resources for the country. Among several limitations, the main lacking is uncontrolled management regimes on Bay.

In developed countries, there are already a lot of strong practical practices are currently going on to minimize bycatch and more uses of bycatch for utmost proper utilization of marine organisms. In this case, marine authority of Bangladesh should introduce all modern adjustable practices for fishers and fishing companies to make a habit of proper utilization of marine sector.

It is very important for Marine fishery sector in Bangladesh to concentrate on controlling 'Bycatch' on the Bay so that it is possible to earn more revenue, job opportunities, national demands, utilization of catches and sustainability of fishery resources.

This study includes worldwide sketch of bycatch and discards in shrimp fishery with their mitigation measures which can be possible to take under consideration as practical preventive measures for the Bengal capture Fishery.

Study also will emphasize the Marine Department to have a clear concern on capture fishery in terms of mitigation of bycatch and discards.

In this paper, the main focus of this study is to inform the 'Government of Bangladesh' to introduce bycatch and discarding preventive measures for the fishers of Bay of Bengal for maintaining sustainability approach during capture to make a strong fishery resources in world economy.

Moreover, I introduce some effective ways to deal with bycatch to the Fishing Authorities in Bangladesh. My aim will be maintaining the improved sustainable fisheries management.

I focused literature studies on the shrimp and prawn fisheries and I am explaining different parts of world highlight how different techniques have been implemented in the management of these trawl fishery.

### 1.1.Scientific questions

1.What is the overall condition of bycatch in Bay of Bengal (Bangladesh)?
2. What is Bycatch and Discards with their appropriate reasons?
3.What is the overall condition of bycatch in rich resourceful countries like USA, Norway, Australia, Canada, South Africa?
4.How current fishers and marine authority of Bangladesh can handle bycatch for maintaining sustainability and earning healthy revenue based on some experienced countries who manages bycatch very adequately.

### 1.2. Bay of Bengal Fishery

The Bay of Bengal is the arm of the Indian Ocean. It is bordered on the west by Sri Lanka and India, on the North by Bangladesh, on the East by Myanmar and Thailand.
Bangladesh has a strong maritime boundary of 2,07,000 square kilometres in 1974 according to UNCLOS- III. (Abu Syed Muhammad Belal, BIPSS). In 2013, a Hague-based international court has awarded 19,467 square kilometres to Bangladesh.
The Hague-based Permanent Court of Attribution (PCA) awarded Bangladesh an area of 19,467 sq km (7516 sq miles), four-fifths of the total 25,602 sq km (9,885 sq miles) disputed maritime boundary in the Bay of Bengal with India, on July 7, 2014. Bangladesh got full rights to the entire area of four deepwater blocks (DS-10, DS-15, DS-20 and DS-25), 90% of four deepwater blocks (DS-09, DS-14, DS-19 and DS-24) and two shallow-water blocks (SS-01 and SS-05). (Ravi Prasad, 2014).
It has a coastline of 720km, territorial waters of 12 nautical miles, 200 nautical miles of Exclusive Economic Zone, 350 nautical miles of sea bed. (Convention on the Law of the Sea (UNCLOS-III) in 2001).
Bay of Bengal is in latitudes 5°N and 22°N and longitudes 80°E and 100°E a northern extended arm of the Indian Ocean. It is surrounded in the west by the east coasts of Sri Lanka and India, on the north by the deltaic region of the Ganges-Brahmaputra-Meghna river system, and on the east by the Myanmar peninsula extended up to the Andaman-Nicobar ridges.
Bangladesh is situated at the head of the Bay of Bengal which occupies an area of about 2.2 million sq km and the average depth is 2,600m with a maximum depth of 5,258m. The southern

boundary of the Bay is approximately along the line drawn from Dondra Head in the south of Sri Lanka to the north tip of Sumatra.

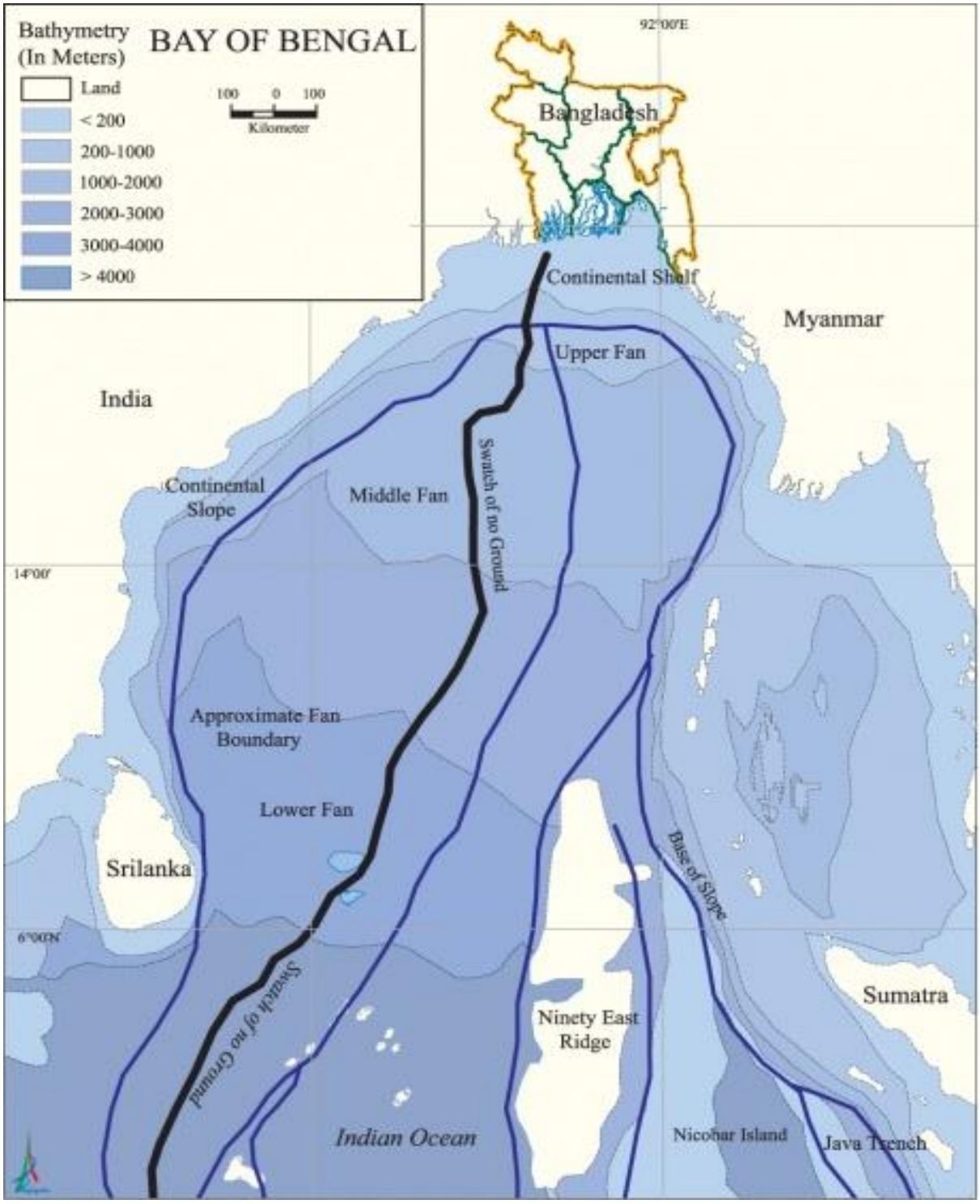


Figure.1: Bay of Bengal

Bengal Fan is the world's largest submarine fan. The mean annual temperature is about 28°C in the surface water. The open part of the Bay has the surface salinity from 32% to 34.5% (parts

per thousand, ie grams per kilogram of sea water). Tides: there are two high and two low tides in the semi-diurnal type during the period of 24 hours and 52 minutes.

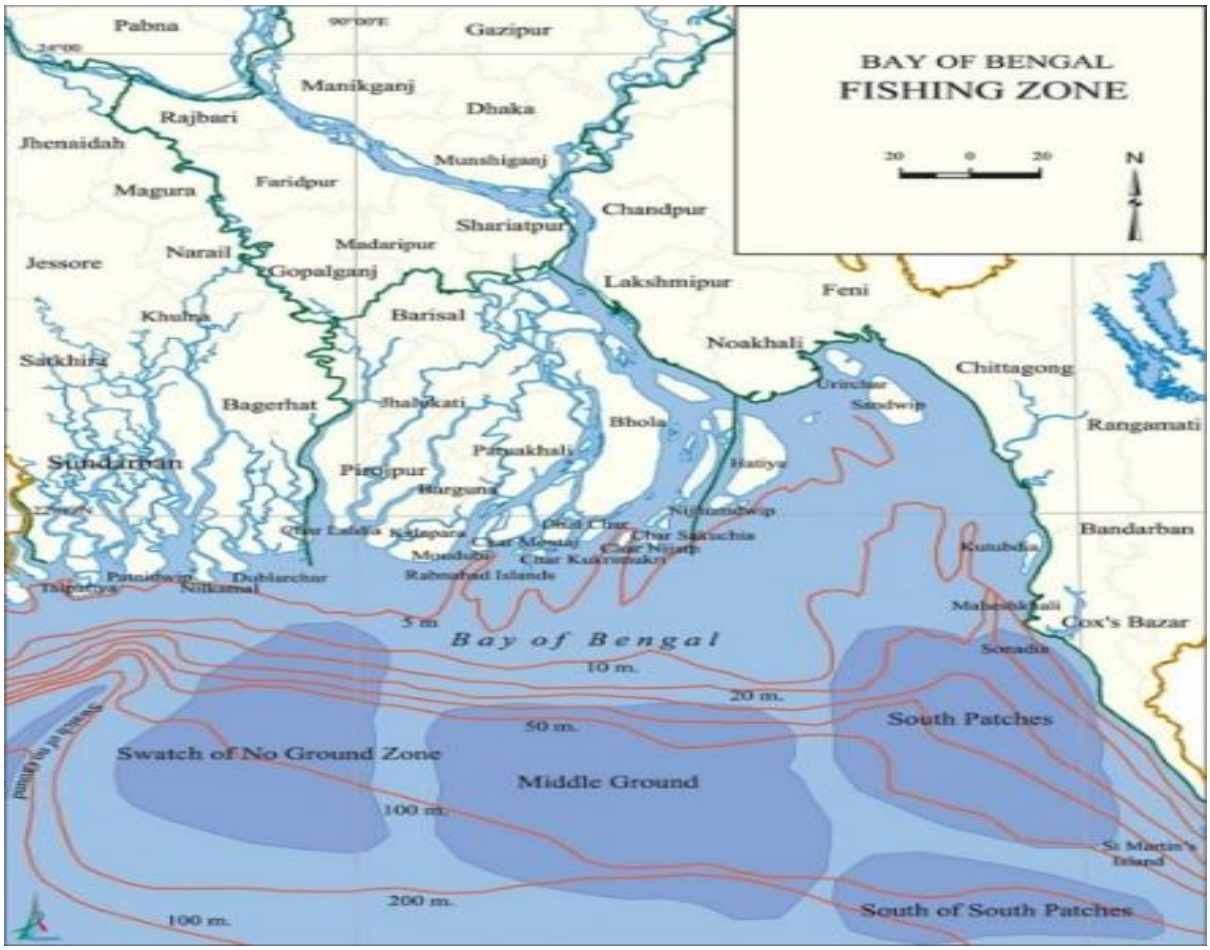


Figure.2: Fishing zone of Bay of Bengal

A variety of shrimps and fishes are available in the Bay of Bengal because of fishing its hydrological conditions. Four fishing grounds have been identified like south patches, south of south patches, middle ground and Swatch of no Ground in.

Fish and shrimp are potentially reserved in all these fishing grounds. These areas are harvested by trawlers or mechanized fishing boats. Most of the known commercial species of shrimps and fishes. According to Hossain Zamal commercially important shrimp and fish species include tiger shrimp, karuma shrimp, cat fish, Bombay duck, snapper, flounder, Indian salmon, crocker, seabream, jawfish, mullet, pomfret, ribbon fish, anchovy, hilsa, oil sardine, tuna, mackerel and skipjack.

### 1.3. Bangladeshi Fishing fleet

In Bangladesh, Bay trawling is one of the leading shrimp trawling and exporting enterprises. It focuses the first immense potential of the Bay of Bengal. Currently, 200 are active among 247 permitted industrial trawlers in fishing operation during 2015-16. In Bangladesh, marine watery EEZ, nearly 68 thousand mechanized and non-mechanized boats engaged in fishing.

The former is using solely trawlers and the latter is using relatively simple gear such as gillnets, set bag nets, trammel nets by the mechanized and non-mechanized boats 'array. 3-5 fishermen's Non-mechanized boat is used in daily fishing by nature in very low depth close to coastline. Typically, Mechanized fishing boat is for 5 to 10 days within 40 m depth contour using ice cube.10-25 fishermen are varied based on types of gear used.

The new 104 heavily-built modern ships have the generic identity 'mid-water trawler' attached with almost 3 times more engine power- 8 times more vertical opening of the trawl (net) and modern gears that can easily operate in far and deeper sea for pelagic fish species and have more capacity to operate bottom trawl in greater depth for demersal species too. one can now use the same trawl net in the surface, into mid-water, and onto the bottom with the improved fishing gear technologies.
Bottom-trawling is one of the unstainable and environmentally destructive fishing methods around the globe. So, banning the bottom trawling initiative could have been good news for sustainable marine fisheries in the Bay of Bengal, Bangladesh.

The industrial trawlers mainly harvest demersal fishes and shrimps, but in recent years mid-water trawlers are used in the fleet for fishing pelagic specie. Grossly the capacity of the industrial fishing fleet lies in terms of tonnage ranged between the 56 to 148 MT wooden body and the 251 to 668MT steel hull trawlers. The overall length is marked from 18.5 to 26.50 meters for wooden hull trawlers and 34 to 54 meters for steel hull trawlers where engine powers ranges from the 420-600 BHP for wooden hull and 716-1850 BHP for steel hull, but mostly fall within 500-1000 BHP.

Shrimp trawlers usually have 150-250 tones gross tonnage capacity with 500-900 BHP main power engine. Maximum per fishing trip is 30 days. Every day usually completes 5-6 hauls for 3-4 hours in a period of time (Uddin et al., 2012).

The table showing below is expressing the latest number of vessels are performed per year from 2009 to 2016.

**Table-1(a): Number of vessels operating in the IOTC area of competence, by gear type and size**

| Type of fishing | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 |
|---|---|---|---|---|---|---|---|
| 1.Industrial | | | | | | | |
| a) Shrimp Trawler | 37 | 35 | 33 | 32 | 30 | 32 | 30 |
| b) Fish Trawler | 117 | 123 | 132 | 152 | 169 | 175 | 174 |
| Total | 154 | 158 | 165 | 184 | 199 | 207 | 204 |
| 2.Artisanal (Craft) | | | | | | | |
| a) Mechanized boat (MB) | 21726 | 21726 | 21726 | 21726 | 30164 | 33859 | 32859 |
| b) Non-Mechanized boat (NMB) | 23651 | 23651 | 23651 | 23963 | 27699 | 33810 | 34810 |
| **Total** | **45377** | **45377** | **45377** | **45689** | **57863** | **67669** | **67669** |
| 3. Artisanal (Gear) | | | | | | | |
| a) Gill net | 108040 | 108040 | 131326 | 131326 | 114353 | 115028 | 119958 |
| b) Set Bag net (SBN) | 51522 | 51522 | 52824 | 52824 | 40824 | 40824 | 40824 |
| c) Long line | 25538 | 25538 | 25538 | 25538 | 12538 | 11863 | 11863 |
| d) Trammel net | 7122 | 7122 | 7122 | 7122 | 422 | 422 | 422 |
| e) Other gear | 31636 | 31636 | 25644 | 25640 | 15640 | 15640 | 15640 |
| Total | 223858 | 223858 | 242454 | 242450 | 183666 | 183777 | 188707 |

Source: Humayun, N.M., Das, A.C., Barua, S., Al Mamun, A. and Singha, N.K., 2016

The table below shows the national fleet structure in industrial and artisanal fishing zones.

**Table 1(b): National fleet structure based on 2015-16 report of MFO**

| **Industrial Fishing vessel over 24 m** | | | | | **Artisanal Fishing vessel below 24 m** | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Trawler type | Number | Gear used | Species caught | Tuna and Tuna like fish caught | Vessel type | Number | Gear used | Species caught | Tuna and Tuna like fish caught |
| Shrimp trawler (steel hull of 30-43 LOA, 450-750 BHP) | 37 | shrimp trawl | Shrimp and fish as by catch | no | Non mechan-ized | 34,810 | ESBN[1], Gillnet, Stake net | Multispecies and hilsa with varied stages | no |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Fish trawler ( steel and wooden hull 24-54 m LOA, 520-1450 BHP ) | 112 | fish trawl | Mixed species mainly sardines, croakers , catfish , redfish, ribbon fish etc | about 2-3 % of tuna and tuna like fishes | Mechanized | 32,859 | Gill net , MSBN[2] Bottom hook and line for Jew fish | Hilsa, different species of shrimp jew pomfret, anchovies , ribbon etc | some tuna and tuna like fish is caught in Hilsa gillnet which is estimated to be about 0.5 to 0.6 % only |
| Mid water trawler ( steel hull, 36-45 LOA, 1050-1850 BHP) | 98 | Mid water trawl | Mixed species mainly sardines, croakers , catfish , redfish , ribbon fish etc | about 2-3 % of tuna and tuna like fishes | - | - | - | - | - |

[1] Estuarine Set bag net [2] Marine Set bag net

Source: Humayun, N.M., Das, A.C., Barua, S., Al Mamun, A. and Singha, N.K., 2016

Moreover, there is another table which describes the characteristics of traditional and motorized fishing fleet.

Table 1c

CHARACTERISTICS OF TRADITIONAL AND MOTORIZED FISHING FLEET

| Type of boat | Length of craft (m) | Breadth (m) | Depth (m) | No. of crew | Propulsion | cost ('000 TK) | Fishing gear |
|---|---|---|---|---|---|---|---|
| A. Traditional | | | | | | | |
| Dinghi | 6 - 7 | 1.0 – 1.2 | 0.9 | 1 - 2 | oar/sail | 10-15 | gillnets/ longlines |
| Chandi | 10-15 | 1.4 – 1.8 | 1.0 | 7-15 | oar/sail | 20-30 | gillnets |
| Balam (medium) | 10-15 | 1.5 – 2.0 | 1.2 | 10-15 | oar/sail | 35-40 | gillnets |
| Balam (large) | 15 -20 | 2.0 – 2.5 | 1.2 – 1.5 | 20-30 | oar/sail | 45 – 60 | gill/behundi nets |
| B. Motorized | | | | | | | |
| Cox's Bazar type | 12-14 | 3.0 – 3.2 | 1.2 – 1.5 | 8 | 22-33hp | 140-180 | gill/behundi nets |
| Modified Cox's Bazar type | 12.0 | 3.0 | 1.2 | 6 | 22 hp | – | -do- |
| Chandi | 12-13 | 1.6 – 1.8 | 1.0 | 10 | 9 hp | 50-60 | gillnets |
| Longliner | 6 - 7 | 1.0 – 1.2 | 10,9 | 6 | 10-15 hp | 40 – 50 | longline |

Source: Humayun, N.M., Das, A.C., Barua, S., Al Mamun, A. and Singha, N.K., 2016

### 1.4. Trawling Gear

Historically, the country fishermen used to fish in the sea (not too far from the sea shore) with paddle (oar) and sail boats. In fact, fishing in the Bay of Bengal's marine water was more artisanal rather than a commercial practice by the traditional fishermen.

Therefore, mainly fishing was carried out for subsistence earnings. Until the independence of Bangladesh in 1971, fishing which is technology-based leading to a capital intensive commercial fishing was quite unknown, and the fishermen were unfamiliar with modern trawl fishing as a business venture.

After the independence of the country, Government offers, coupled with assistance offered by DANIDA, Swedish Government and others especially the Soviet Union, led to several primary attempts to modernize the fishing techniques and physical inputs.

Since then the uses of motorized boats was introduced in the marine fisheries sector. With the newer advent and sophisticated technologies, a sharp distinction has emerged between the traditional and commercial fishing which are the two major fishing types.

The marine fishing sector is governed by the Marine Fisheries Ordinance, 1983, Marine Fisheries Rules, 1983 followed by subsequent Rules. No fishing vessel is allowed in invalid fishing license in Bangladesh marine waters. All industrial trawlers and mechanized fishing boats must have fishing license which is the prerequisite for fishing. The allowed trawlers can catch fish/shrimp in area of no shallower than 40-meter depth.

Allowed Mechanized fishing boats can go within 40-meter depth. Industrial fishing fleet has mandatory regulation to have sailing permission (SP) from Marine Fisheries Office under Department of fisheries (DoF) by submitting supporting documents and stipulated fee. Caught logged submitted sheet of previous trip is prerequisite for sailed permitted application of next trip. Randomly inspected are done in vessels by personnel of Marine Fisheries Office of DoF before and after trip randomly as shore based inspection.

On the industrial fishing fleet, MCS activities are well monitored by Bangladesh NAVY's patrolling vessel and Coastguard. Recently, personnel of Marine Fisheries Office of DoF are being on board as observer in Bangladesh NAVY's patrolling vessel and working in concert with them.

In Bangladesh, industrial fishing is operated by wooden trawler (ice trawler) and steel made trawler which is known as freezer trawler. 72 are fish trawlers and 19 are shrimp trawlers among 91 industrial freezer trawlers from the recorded deep-sea fishing industry in Bangladesh. In 1990, there were only 5 freezer trawlers with a total capacity of 490 ton which increased up to 21,737 ton in 2014 by 91 trawlers.

The calculated production of marine capture fisheries by freezer trawlers increased from 2940 ton (1990) to 150113 ton (2014) that is about 1 to 21 % of the FAO landings and 0.5 to 12 % of the reconstructed total national production respectively.1.83 million ton of fisheries products were captured from the Bay of Bengal in last two decades (1990- 2014).

Sea Resources Group has shored up its foothold by dealing with two Danish companies to manufacture fishing gear and hydraulic machinery. The twin deals would cut import-dependency and help the local company explore global markets. One of the joint venture deals was with Cosmos Trawl, a Danish fishing gear maker. In line with the agreement, a state-of-the art unit will be set up for net and trawl doors to meet rising demand by deep-sea fishing trawlers in Bangladesh and beyond.

According to Amanullah Chowdhury, to make hydraulic machinery in Bangladesh, Sea Resources has signed another agreement with AS-SCAN, “We are trying to sharpen our competitive edge,” joint managing director of Sea Resources that boasts a 15 vessel fleet for deep-sea fishing. In the sector, there are 140 trawlers officially permitted to go for deep-sea fishing.

Usually, deep-sea fishing trawlers catch shrimp, pomfret, snapper and tongue sole in the Bay of Bengal -- home to 490 species of fish belonging to 133 families that 65 species have commercial importance.

Sea Resources earns about $12 million in exports a year. Officials said most of the fishing gear used by trawlers and hydraulic equipment are imported. According to Chowdhury, "The agreements will also allow us to use the know-how in making modern fishing gear such as customised net, trawl doors and hydraulic fishing equipment,” the joint venture would enable them to make modern fishing gear in Bangladesh at lower cost, giving it a competitive edge to explore business opportunities not only in Bangladesh but also in South and Southeast Asian regions. “In future, we want to tap regional markets.

Supported by the Danish Business-to-Business (B2B) Programme under Danida, commercially productive pilot phase of net is underway to establish a net loft on the bank of Karnaphuli river in Chittagong.

According to Chowdhury, the joint venture entity to be named SRL-Cosmos Ltd would start production of customised net and multi-flexible trawls by January. The agreement with AS-SCAN on manufacturing machinery is also expected to facilitate local capacity in manufacturing hydraulic equipment such as net drum, pump, motor and steering gear. The production unit will be set up on the premises of Sea Resources, one of the subsidiaries of Fishers Shipyard Ltd. "Initially we hope to make hydraulic machinery for deep-sea fishing vessels. In the long run, we will be able to provide hydraulic equipment for the emerging shipbuilding industry,"

According to Chowdhury, initial investments for establishing the net loft and hydraulic machinery unit would stand somewhere between $25-30 million. "After completion of these two projects, we will be able to improve our efficiency in deep-sea fishing and reduce our cost."

Figure.3: People use modern equipment to fish in seawater. Sea Resources Group, a local sector leader, has flagged deals with two Danish companies to make fishing gear and hydraulic machinery in Bangladesh. Photo: Sea Resources

The Sumber Samudra Sdn. Bhd. yard at Perak in Malaysia recently delivered a 37.80 metre fisheries research and survey vessel. The new vessel completed official sea trials and additional trials for the fishing gear have also been completed for the Bangladesh Department of Fisheries.

Meen Shandhani is scheduled to undertake fisheries research in the Bay of Bengal that is rich in fisheries resources but adequate research for sustainable allowable catches will be enhanced by the work on board the new vessel.

Meen Shandhani as a wide range of trawl gear and traps, has both wet and dry labs for scientists.


Figure.4: Trawls

SRL Cosmos Trawl Ltd.as the largest and leading netloft which can provide shrimp and bottom trawls in wide body as well as high opening design for single- and multi-rip fishing, pelagic and semi-pelagic mid-water trawls as well as purse seines and fish farm cages in Bangladesh, based upon more than 100 years of Danish fishing gear technology.

Figure.5: SRL Cosmos Trawler

The table below describes the species captured by gears in several measured trawls.

Table.2: Gear and its operation

| Name | Species caught | Depth of Operation |
|---|---|---|
| Trawl | Tiger and other penoid shrimps, Catfish, Jew fish, Ribbon fish, mackerels, seeds etc. | 40-100m |

*ESBN- Estuarine set bag net, MSBN- Marine set bag net.

### 1.5. Management Regimes of Bycatch reduction in Bangladesh

Marine Fisheries Management Measures Proactive to Shark Fishery. Forest Conservation Act have undertaken little initiative on the management conservation and development of shark in Bangladesh except ban of fishing in the Sundarban areas.

The management of marine fisheries has been undertaken to the proactive shark fisheries under considerable management measures.

These are:

**1. Limiting the fishing days for industrial trawlers**

• Freezer trawlers have fishing permission for 30 days.

• Non-freezer trawlers can sail up to 15 days.

**2. Measure to limit discard of by catch**

• At least 30% of fin fishes must be caught by shrimp trawlers

**3. Control of mesh size of different nets**

• Mesh size of cod end of set bag net must be at least 30 mm.

• Cod end of shrimp trawl nets must be 45 mm.

• Cod end of shrimp trawl nets have to be 60 mm.

• Mesh size of small meshed gill net have to be 100 mm.

• Mesh size of large meshed gill net need to be 200 mm.

**4. Formulation of marine fish exploration guidelines for the industrial fishing fleet**

• Proper exploitation of the fishery resources 3.5 Ban on throwing any fish into sea need to be ensured with formulated

Throwing any catch of fish or any aquatic resources except turtle in the sea has been restricted by government.

**5. Control of access to the fishing ground**

In general, the fishing ground is outside of control for sharks except zone restriction, assurance of licenses and declaration of marine reserve for the marine fisheries resources.

**6. Depth and area restriction**

• Fish and shrimp trawlers can fish beyond 40m depth zone during high tide.

• Set bag net, hook, lines, small and large meshed gill net have to be 40 m depth zone during high tide.

**7. Restriction of industries trawlers license**

• New licenses have restrictions by government during issuence for any industrial trawler till proper survey of the EEZ are being done.

**8. Encouragement to fish beyond 500m isobaths of EEZ**

• industrial fishing fleet to fish outside 500 m isobaths within EEZ is to be encouraged by government in order to reduce pressure in the coastal fish population.

**9. By-catch reduction, declaration of sanctuaries and closed season**

Shark fisheries have no sanctuaries or closed season and by catch reduction measures. But in general, four sanctuaries in the Bay of Bengal and four hilsa sanctuaries in the Lower Meghna river system have been declared by government.

### 1.6. Shrimp trawl fishery and landings

Bangladesh Marine fishery has artisanal fishery and industrial (trawl) fishery which are the two sub sectors.

Trawl shrimp fishing is the most important sector in Bangladeshi marine fishing scenery with respect to foreign exchange earnings, employment etc. Bangladesh started with 10 trawled fleet after liberation i.e. 1972-1973. At present, there are 41 shrimp trawlers and 78 fish trawlers in total (BBS, 1999; MFSMUC, 2007).

The trawlers operate in the shelf area beyond 40 meters' depth in the EEZ. The trawl fishery effort during the last two decades have been rotated around 5,000–6,000 standard fishing days to produce 3,500-6,000 metric tons of shrimp. However, this is no agreement on MSY of Bangladeshi penaeid shrimp. Estimated 7,000 - 8,000 metric toned MSY penaeid shrimp and

the produced optimum afforded said amount is 7,000-8,000 standard days (BOBP, 1997). Other estimated MSY penaeid shrimp are 4145 metric tons (using Schaefer model) and 4329 metric tons (using Fox model) (Khan and Hoque, 2000). Because of an unplanned and irrationally increased fishing efforts, many marine fish and shrimp stocks have already been declined (Khan and Hoque, 2000a; Khan, 2000).

### 1.7. Overall bycatch views of shrimp fishery during last 30 years

The Bangladesh trawl fishery has several regulations for the percentage limit of finfish caught, minimum mesh size, and commercial trawlers in waters less than 40m deep and prohibit discards. But According to Rahman (2001), the trawl fisheries do not observe these regulations and even operate in waters of as little as 10m depth. Kelleher (2005) uses a ration on shrimp trawl catch to discards was 4:1. Moreover, according to Rahman (2001), shrimp represents just 4.8 % catch composition in the fishery in waters deeper than 30 m for entirely by commercial trawlers. That figure is close to Ahmad's figure based on 44 commercial trawled survey in 2005. However, shrimp represent only 1.5 % catch in waters less than 30 m in partly commercial catch and partly artisanal catch. Bycatch is thus more than 20.8 times and 67 times greater than shrimp catch in deeper waters and in shallower waters respectively.

According to Ahmad (2005), approximately 3000t industrial trawl shrimp was caught in 2004. According to Rahman (2001), large artisanal shrimp trawl fleet operating in estuaries and coastal waters contributes five times more shrimp than do the industrial trawlers. The annually estimated artisanal shrimp trawl catch is 15,000 tons in 2000–2003.

Assuming, conservatively, that all the industrial trawl shrimp catch is caught outside 30 m depth, and that all the artisanal catch is caught in water less than 30m depth, the industrial fleeted by catch would have been an estimated 60,000 tonnes (3000 x 20), and the artisanal fleeted by catch would have been an estimated 930,000 tonnes (15,000 x 62). The total estimated bycatch in the shrimp trawl fishery was 990,000 tones.

According to Davies et al. (2009), the total shrimp trawl for 2000–2003 (990,000 tons), finfish trawl (92,000 tons) and bag-net fisheries alone (125,000 tons, respectively) add up to 1,207,000 tons bycatches.

The target catch is estimated at only 54,860 tons (based on target catches of 3000 and 15,000 tons from the industrial and artisanal prawn trawl fleet, respectively, 23,000 tons from the finfish fleet and 13,860 tons from set bagnet fishing), so Bangladeshi bycatch fisheries contributes 95.7 percent of the actual catch of 1,261,600 tons.

The applied taxonomic breakdown to the shrimp trawl discards was based on weighted catch compositions of the bottom trawl fishery (Chowdhury *et al.* 1993).
For artisanal fisheries, there is very little discarding where local people or fishers sell and consume all the catch. (Khan 2010). However, shrimp (*P. monodon*) post larvae (PL) collection (mostly by push net and fixed bag-nets) is a very critical issue.
It's devastating nature is responsible for billion killed species at the larval stage (Khan and Latif 1995; Hoq and Haroon 2012). In 1970, shrimp seed collection began and push net's use increased considerably. Before that, shrimp PL was caught by only fixed bag-nets. Discards in 2002 are assumed to be the same as those in 1999. Since Bangladeshi government imposed a ban on wild fry collection in 2002, it is assumed that as free discarded sector after 2002. There has been concern over intensive fishing prawn PL, s effects since the late 1980s (Ahmed, 2000).
Indiscriminate wild PL's fishing with high levels of bycatch (i.e. non-target species caught incidentally) and the impacts of coastal Eco systematic biodiversity have provoked to impose the restrictions on wild PL collection (Ahmed 2003).
According to Department of Fisheries in 2000, imposed a ban on wild PL collection. The rationale ban was to protect biodiversity from the harmful effects of intensive PL fishing in the coastal zone. (DOF, 2002).
However, alternative livelihoods having some lacking for poor people in PL fishing is one of the principal constraints on implementing such a ban.

**Legal and illegal capture of bycatch**

The under-reporting form has illegal, unreported and unregulated (IUU) in the Bangladeshi commercial fisheries. Approximately 50% industrial trawlers under-report or in non- report their catch at all (Ullah, H. World Fish Center. pers. obs.). For this under reporting, we take 50% reported industrial landings for each year as unreported industrial catches. At least 15-20% catch is under-reported in artisanal catches (Ullah, H. World Fish Center. pers. obs.). We use averagely 17.5% and estimate artisanal unreported catch values.
The respondents have identified many reasons for the widespread use of this illegal gear. The main reason is that the fishers can get a higher catch. The monofilament gillnets harvest species with different sizes, thus the catch per unit effort is increased. This type of net is cheaper, widely available in the market and requires less manpower to operate than conventional fishing gear.

Maximum fishers use prohibited monofilament gillnets (locally known as current jal) in the hilsa sanctuaries.

## 2. Explanation of Bycatch and Discard

### 2.1. Definition of Bycatch

FAO defined

Alverson *et al* (1994) point out there are at least three ways of definitions of the word 'bycatch'. In some circles bycatch is used to refer to catch which is retained and sold but which is not the target species for the fishery. In others (particularly the Northeast and Western Pacific and in American legislation) bycatch means species/sizes/sexes of fish which are discarded (Hall, 1996) and in other circles bycatch is used to mean all non-target fish whether retained and sold or discarded.

The paper produced by the Australian Government for the OECD on Policy Options for Fisheries Bycatch (Truelove 1997) states that- where bycatch has immediate or potential commercial value, is unavoidable during fishing and does not include marine wildlife species subject of separate nature conservation legislation, or utilization does not undermine broader management arrangements, it should be fully utilized.

From FAO review of the literature, they conclude that 'bycatch' has customarily been used to identify (1) species retained and sold, (2) species or sizes and sexes of species discarded as a result of economic, legal, or personal considerations, and (3) non-targeted species retained and sold, plus all discards.

There are some other definitions are as follows.

According to Hall (2000), Bycatch is the most affecting significant issue among fisheries management today and Incidental mortality of the long –lived and low reproductive rated species is a conservation problem affecting marine mammals, sea birds, sea turtles, sharks and other groups.

Bycatches can affect biodiversity through impacts on top predators, the removed individuals from many species, or by eliminated prey.

The bycatch issue is also a waste which dumps the million-toned protein in the ocean, and often condemns the animal lives' waste on moral grounds.

It generates additional costs with the non -affected revenues, and may hinder profitability for the economists.

For the fishers, it causes conflicts, a bad public image for fishers, regulated and limited uses of resources and frequently has negative effects on the resources harvested through the juvenile mortality and the targeted undersized individual species before reaching their optimal size from the view point of future yield.

Fishing industries and fishermen may be detrimental with by-catch due to bait loss, valuable time spent removing non-target animals from gear, the resulting damage to gear, and the diminished caught targeted species (Løkkeborg 2003, Marıa-Brotons et al. 2008).

A multi-gear approach with bycatch would allow for cumulative effects of multiple fisheries on particularly species which are to be evaluated, for the assessed of populated consequences of by catch and for management, the most problematic fisheries to be identified and prioritized. (Moore et al.2008).

Bycatch is a catch which might be unused and unmanaged and the highly pervasive By catch spans the spectrum of marine fauna and fishing gear including turtles on hooks, juvenile fish in nets, and benthic invertebrates in trawl and dredge gear. (Davies et al.2009).

### 2.2. Definition of Discard

FAO defined

The terminological concerns used to identify by catch or addressed discards at a by catch workshop in Newport, Oregon (U.S.A) in February 1992. (McCaughran 1992).

The authors have finalized to use the proposed following definition at the Newport Workshop as operational definitions within this monograph:

Discarded catch means the returning a portion of sea catch to the sea for an economic, legal, or personal considerations.

Usually, discarded catch in European discussions are widely perceived as a problematic fisheries management. For the most part, this is seen as an economically wasted species cause a scarce on commercial resources.

The problematic discarded of endangered species had not been viewed particularly seriously until recently.

However, acting as a catalyst, this is the rapidly changing 'wall of death' stories. It seems helpful to partition any discussion into commercial discarded considerations and on non-commercial mortalities and, in particular, on potentially endangered species which are often referred to as non-target mortalities.

According to FAO(1996b), 'Discards, or discarded catch is that portion of the total organic material of animal origin in the catch, which is thrown away, or dumped at sea for whatever reason. It does not include plant materials and post-harvest waste such as offal. The discards may be dead, or alive. *

It is an estimation that between 17.9 and 39.5 million tonnes (averaging 27 million tonnes) of fish are discarded each year in commercial fisheries. (Alverson *et al*, 1994). Ten years later, a second estimate by Kelleher that applied a different methodology and estimated the weighted average rate of discards in the world's fisheries to be substantially lower at 7.3 million tonnes.

In 1998, FAO's publication named 'The State of World Fisheries and Aquaculture' update the discard estimation like 27 million and a revised estimation is 20 million tonnes.

Kelleher (2005) put forward three reasons for a discard decline: (1) decrease in effort and change of target species in some major trawl fisheries, (2) changes in regulatory regimes that required greater selectivity in fishing, and (3) changes in regulatory regimes leading to a greater incentive to utilise what would otherwise be discarded.

According to FAO, the causes for declining of discards are like a. greater utilization of bycatch in all over the world for both aquaculture and human consumption; b. adoption of more selective fishing technologies and methods; c. a decline in the intensity of fishing for some species having high bycatch rates; d. a variety of management actions that prohibit discarding like quota, time schedule, marine protected areas, no trawl zones; e. broader attitudes by fishery managers.

There are three terms which are also used to describe discards well which are as follows.

a. Regulatory discards: Catch which is required by regulation to be discarded (from the sustainable Fisheries Act, United States)

b. Discretionary discards: Catch which is discarded because of undesirable species, size, sex or quality, or for other non-regulatory reasons (NMFS, 1998)

c. High-grading: Discarding of lower value commercial catch to maximize the value of quota. It is a part of 'discretionary discards' and are common in fisheries managed through individual vessel quotas.

There are some other definitions are as follows.
While bycatch may be sold but still it also can be unusable or unwanted for a variety of regulatory and economic reasons and subsequently thrown back to sea, often dead or dying (Harrington et al. 2006, Catchpole et al. 2007). This unutilised sub-set of bycatches is known as discards.

Hall et al. (2000), a marketable species which are discarded in accordance to retain the same species at a larger size and price or to retain another higher valued species.

### 2.3. Reasons for Bycatch

According to FAO

From the reviewed literature of FAO, bycatch has customarily been used as Non-targeted species or sizes and sexes of species discarded as an economic, legal result or personal considerations. Fish are used to bycatch for some reasons. Such as-

1. Non –specific targeted Species and sizes of fish in a fishery
2. Protected, endangered or threatened species
3. Juvenile fish
4. Unintendedly used organisms.
5. There is a poor gear selectivity and most caught species are used in multispecies/multi-gear, bycatch refers to the undesirable part of the catch because of detrimental ecological and/or economic consequences
6. Many countries include pre-catch mortality and ghost fishing in their legal explanation of bycatch where other countries think different.
7. Because of the very diversified nature of world's fisheries, historical differences in how bycatch has been defined nationally, ambiguities related with bycatch terminologies and individual fishers 'choice on how different portions of their catch will be used.

There are some other reasons by other researchers which are follows.

Moore, in 2008, reported that on a population-based multi-species, multi-gear approach to bycatch which emphasis to identify the priority areas where effective resources are needed most.

Fish are used to by catch for some reasons (Hall, 1996). Such as-

1) unwanted size of targeted species to preserve ecosystem structure and function
2) forbidden species or non-economic valued specie

**2.4. Reasons for discard**

According to FAO

Commercial and market considerations can cause discards by the fishing business operator- it is a business decision to discard.

Imperfect selective fishing methods and gears cause discards or because fishermen have pressure to catch more target species than they can market.

It is a major challenge of avoiding catches of unwanted individuals at an acceptable cost (be it economic or social).

Wasted or discarded fishes have a number of reasons, (Clucas 1996).

1. **Wrong fish** species (Non- targeted species for the particular operator).
2. **The wrong sized fish**. (Very less price on the worth landing market or the outside limits imposed by management for capture or landing of that species).
3. **The wrong sexed fish** (Normally, from the processing and marketing point of view where the important matter is gender)
4. **Damaged** fish (Caused by gear or predation in nets or miss-handling etc.)
5. **Incompatible fishes with rest of catches**
6. **Poisonous fish** or otherwise considered inedible
7. **Rapidly spoiled fish** (Causing problems with the rest of the catch).
8. **Lacked space on board** (Though fishing operations are successful and target species take precedence over lower value or non-target species).
9. **High Grading** (Certain attributed fish makes it more marketable and therefore more valuable than another and the less valuable discarded fish is often related to size).
10. **Reached quotas** (This may involve discarded small specimens of the target species

11. **Prohibited Species** (Where species-based fish quotas may be discarded from one vessel although another quoted vessel related to the errant species may have been able to land that same fish legally).
12. **Prohibited Season** (Where time bound constraints are made on catching particular species, the wrong season caught specimens can be discarded).
13. **Prohibited Gear** (A quota may be given for a particularly type of gear for a particular captured species - if the wrong gear catches the wrong fish then fish may be discarded).
14. Prohibited fishing grounds (Some fishing grounds may be closed for capture of one species but open for others-fishes can be discarded if wrong type caught)

There are some other reasons by other researchers which are as follows.
Mainly the definitions have already clarified the main reasons for the discarded fish species.
A fisher is a business-person who has the best intentions to make a living on it but he makes a decision whether or not to land it or to risk searching for higher priced fish during purely accidental catch.
Clucas (1997) summarized the main reasons:

1. Caught fish are of the wrong species, size or sex, or the damaged fish.
2. Fishes are incompatible with the rest of the catch
3. Poisonous fish
4. Rapidly spoiled fish
5. Lacked space on board.
6. High grading
7. Reached quotas.
8. The catch was of prohibited species, in prohibited season or fishing ground, or with prohibited gear.

**3. Literature studies based on 'USA, Norway, Australia, Canada, South Africa'**

Here, I am writing several bycatch issues are going currently on several countries. In this case, I select 5 countries like 'USA, Norway, Australia, Canada, South Africa' to understand the current situation of bycatch so that these fruitful practices can be used in Bangladesh after some adjustment on modification for fishers and fishing companies. I covered mainly bycatch problems during shrimp and prawn fishery, legal and illegal captures, other bycatch issues like related to finfish, shark turtles etc. which are very important for Bangladeshi marine

authority to understand the basic situations of six countries so that they can try to minimize bycatch or utilize properly for native resources by introducing exotic gears.

### 3.1. *USA*

**Bycatch Problems during shrimp fishery in USA during last 30 years**

Particularly discarded by-catch, is a serious conservation problem because wasted valuable living resources, endangered populations and rarely threatened species, heavily exploited stocks are further impacted and ecosystem changes in tropically webbed overall structure and habitats may result (Morgan and Chuenpagdee 2003).

The shrimp trawl and bottom trawl fisheries contribute to 72% discards by gear type, and the crustacean and demersal fisheries contribute to 86.3% discards by target species type (Harrington et al. 2005). They estimated 1.06 million tonnes of discarded fish for 3.7 million tonnes targeted landings annually. This amounted to discards equalling 28% target landings or 22% nominal catch. Clearly, shrimp fisheries still discarded some largest fish, despite great efforts to reduce by catch by gear modification (NMFS 1998).

Note that some discards of under complex regulatory planned fisheries were due to management requirements, not just fishing practices. Showed that the estimated discarded tonnage fish for all federally managed USA fisheries combined was 28% landed tonnage or 1.06 million metric tons. This number is higher than FAO's estimate that 8% discarded world's landed catch (Kelleher 2005), is comparable to the FAO by caught estimate for the USA (927 599 tonnes or 21.7% of the total nominal catch).

The USA may have the highest discard rates in the world to make a high number by-catch in fisheries. According to Kelleher (2005) the discard database indicates particularly shrimp trawl fisheries, and tropical shrimp fisheries which are the single greatest discarded source for 27.3 percent (1.86 million tonnes) total estimated discards. 62.3% aggregate or weighted discarded shrimp trawl fisheries have consistently high discard rates deriving from a range of factors.

1. 1.Shrimp is often less than 20% demersal biomass on many shrimp fishing grounds.
2. The relatively small mesh size required to capture shrimp inevitably results in large quantities of bycatch.

3. Designed vessels for shrimp retention have limited freezing and hold by caught capacity.
4. Discouraged Transhipment by vessel owners at sea is often prohibited by authorities because of concerns about theft, or illegal/unrecorded transhipment.
5. The shrimp grounds are often at a considerable distance from the by caught markets rendering its uneconomical retention and transport.
6. Small sized by catches' relative low value makes by catch retention uneconomical.
7. Enforced regulations on minimum by caught landings and on discard reduction may be deficient.

According to Alverson et al. (1994), these trawls have the highest discard/catch ratios which go from 3.1 to 15.1 kg in per land. 14 shrimp or prawn trawls among 16 worse offenders. These fisheries are perceived by the public as extremely wasteful, and environmentally harmful, not only by the bio massed removal diversity, but also by the potential impact on habitat, and the discarded impacts on pelagic and bottom communities.

In some fisheries, marketed lack results in the most discard caught with the shrimps or prawns; high by catches, and the moral fishery's condemnation follows these wasteful practices. Of particular significance in the Mexican Gulf is the incidental mortality of juvenile red snappers (Graham, 1996) that is the frictional cause between different groups of fishers.

Non-target species' incidental capture from prawn trawling has recently intentioned worldwide. Primary concerns from the perception that prawn trawls catch and discard large numbers of targeted juveniles of species in other commercial and recreational fisheries. Shrimp and prawn trawls cause Sea turtle problem.

Large marine vertebrates like sea turtles, marine mammals and seabirds, have little or no commercial value because of becoming entangled or hooked accidentally by intended fishing gear for valuable target species like swordfish Xiphias gladius orm tuna Thunnus spp. (Crowder and Murawski, 1998). This incidental take, or BYCATCH, occurs in all fishing fleets (Hall, 2000).

Albatross populations have declinations to LONGLINE fishing effort, and TRAWL-fishing to the Deadest Sea turtles that wash up on beaches (Lewison, et al. 2003). Small cetacean populated threats have been linked to GILLNET, DRIFTNET, PURSE SEINE and trawl fisheries (Read, and Wade, 2000).

Mostly habitat damaged studies focused on dredges and bottom trawls, and a lesser extent on pots and traps and gillnets.

### 3.2. Norway

**Bycatch problems during shrimp fishery in Norway during last 30 years**

Fisheries bycatch in shrimp trawl has years of assessment problem both in the Barents Sea and along the coast.

Besides, large quantities of small sized Greenland halibut caught during the shrimp fishery is definitely an unwise harvesting of a heavy exploited fish resource at the fishing grounds at Spitsbergen. Norwegian shrimp fisheries, shrimp trawling is known as ‘juvenile fish killer’.

Small sized cod and haddock, all redflsh bigger than 18 cm, flatfish/ northern waters is Greenland halibut, Greenland shark: (up to 3 meter) caught by shrimp trawl. Occasionally, shrimp trawlers caught stone, sponge and clay.

A widespread fishing method is Danish seine for cod and haddock along the Norway’s northern coast is also becoming common on offshore grounds in the Barents Sea, particularly in the Bear Island area. Undersized bycatches pose a problem similar to that experienced with bottom trawling.

undersized shrimp bycatches present a recognized problem in many areas, mainly in a situation where quota restrictions favor so called ‘high-grading’ where the valuable large shrimps are kept and sold and sorted smaller and less valuable shrimp out of the catch and discarded at sea.

The shrimp fishery off Greenland is known to be a common high grading. In Norwegian regulations express as 15 mm carapace lengthened shrimp is equivalent to 6 cm eye-tail length. The fishery on any ground is stopped Where the catch contains more than 10 % undersized shrimp.

According to Research, bycatch in the shrimp fishery may reduce finfish (cod/flounder, roundfish, flatfish and small redfish). Though cod bycatches are low but still Capelin bycatches can be very troublesome.

During Shrimp trawls, Atlantic cod (*Gadus morhua*), haddock (*Melanogranzmus aeglefhms*), saithe (*Pollachius virens*), redfish (*Sebastes spp.),* and Greenland halibut (*Reinhardtius hippoglossoides*) fish bycatch are captured on 1980s.

Fisheries scientists and managers have devoted increasing attention to the bycatch problem and particularly connected with prawn trawl fisheries since 1990s. Prawn trawling is mainly wasteful in some cases, with extremely high retained: discard ratios (Kelleher 2005), stemming from the trawled reluctance to retain the wide variety of small-sized. Prawns are caught with Low-value species which is a function of the small mesh sizes used and the tropical location of prawn fisheries.

Demersal fishes live close to the sea floor and include cod and haddock species. The otter trawl fishery catches the largest number and cod weight in the North Sea. The large mesh fleets targets whitefish, the small mesh fleet targets *Nephrops* within the North Sea otter trawl fishery, but also takes whitefish as a bycatch. Different regulations cover the different fishery sectors.

Globally illegal, unreported, and unregulated (IUU) prevalent fishing has detrimental effects on commercial fish stocks and non-target species. Proper monitoring and enforcement aimed at reducing IUU fishing level in extensive, remote ocean fisheries requires international collaboration. Recently, IUU fishing comprises a range of different legal and illegal activities, spanning from coastal areas to the high seas.

Legal IUU activities can include recreational fisheries which are not mandated to record or report without catch statistics and commercial catches. While, illegal activities might involve fishing in protected areas, non-compliance with regulations, and underreporting.

### 3.3. Australia

**Bycatch problems during shrimp/prawn fishery in Australia during last 30 years**

Six prawn (shrimp) species with twin demersal trawl gear are targeted by The Northern Prawn Fishery (NPF) that operates as three spatially and temporally distinct sub-fisheries.
Nine species of prawn (shrimp) are caught by The Northern Prawn Fishery (NPF) in Australia.

Australia's largest prawn and most valuable fishery is the NPF which takes more than 30 000 tonnes of bycatch each year (Pender et al., 1992). Sea turtles, teleost fish, sharks and sea snakes are adversely affected by prawn trawling.
Northern Australia's prawn-trawl fisheries involve turtles and the discard of a large diversity of fish species as the main bycatch issues. In South Australia's Gulf St. Vincent, the prawn-trawl industry itself was mainly responsible for the chief bycatch issue and the by-catch of small prawns and fish.

Tiger prawns are generally widely dispersed, generally (~3 h) long trawls are responsible for the large catches of unwanted and discarded dead bycatch. More than 95% bycatch of the catch includes invertebrates (234 taxa), teleosts (366 spp.), elasmobranchs (51 spp.), turtles (8 spp.) and seasnakes (13 spp.) (Stobutzki et al., 2001a; Griffiths et al., 2004).
Japanese longline vessels targeting tuna killed large numbers of seabirds each year within the Australian Fishing Zone (AFZ). Seabird bycatch in the AFZ has been in the order of 0.15 birds/1000 hooks in recent years, translating to mortalities of 1000–3500 birds per year.

### 3.4. Canada

**Bycatch problems during shrimp fishery in Canada during last 30 years**

The scallop dredge fishery (23 000 tonnes, 20 percent discard rate), groundfish trawl (over 11 000 tonnes) and the lobster and crab pot fisheries (over 25 000 tonnes) are responsible for major discards. The swordfish longline fishery contributes in minor discards (9 percent).

Discards of arrow-tooth flounder, dogfish and ratfish in the order of 9 000 tonnes (discard rate 8.9 percent) are produced by The British Columbia Pacific hake demersal trawl. The shrimp beam trawl fishery has a considerably higher discard rate (29.1 percent) than the shrimp otter trawl fishery (7.8 percent). The discard database does not have any record of Discards in herring and salmon fisheries.

The North Atlantic (Canada, Norway, Iceland) account for approximately 13 000 tonnes of discards were concentrated for *Pandalidae* spp. Most of these fisheries mandatorily use Nordmore grids and other BRDs that cause a relatively low discard rate (weighted discard rate of 5.4 percent). The North Pacific fisheries do not have any record in the discard database.

Conservation organizations endorse the spot prawn (*Pandalus platyceros*) trap fishery in British Columbia owing to the minimal bycatch assumption. However, reported capture of juvenile rockfish (*Sebastes* spp.) in prawn traps has raised concern due in lack of abundance of many rockfish stocks.

Researchers document on the 10 years observed bycatch (1999–2008). According to fishery-independent research survey, employed traps are similar to the traps used in the commercial spot prawn fishery.

Research traps produced 0.16–0.20 kg of non-target catch per kg of spot prawn catch, with bycatch consisting mainly of a variety of molluscs, non-target crustaceans, echinoderms, and fish.

The low rate of rockfish catch was 0.015 rockfish per trap. The annual rate of rockfish bycatch has increased since 2004, to 0.039 rockfish per trap in 2008 when catch rates of other species are in relatively constant.
According to researchers, a low amount of bycatch by weight is produced by spot prawn traps. However, they also suggest that the commercial prawn fishery should quantify rockfish mortality due to prawn trapping to determine how this source of mortality may affect rockfish stocks.

Incidental catch of nontargeted bycatch species is a management concern for all fishing fleets (Hall et al. 2000). Resource managers and the fishing industry face the high level of overlap between the distribution of bycatch species and fishing activity.

A current area of particular concern is the endangered loggerhead (Caretta caretta) and leatherback (Dermochelys coriacea) sea turtle bycatch in the pelagic longline fishery (Spotila et al. 2000; Lewison et al. 2004a; Pinedo and Polacheck 2004). Pelagic Leatherbacks throughout their lives are captured in the fishery as subadults and adults (Watson et al. 2005).

According to Kelleher (2005), discard amounts in the Canadian Atlantic a scallop dredge, groundfish, lobster/crab fisheries are 23,000; 11,000; and 25,000 tonnes, respectively. 9000 discarded tonnes in the British Columbia Pacific hake demersal trawl fishery were For Canada's Pacific fisheries Kelleher (2005).

In addition, however, more than 13,000 tonnes of cod bycatch and to catch by Canadian and other trawlers in the Grand Banks off Canada's east coast reported more than 13,000 tonnes of

cod bycatch and other high- value commercial species (Rosenberg et al. 2005). The total of 81,000 tonnes of bycatch came from these four totals represents 8.1 percent of the annual total landings of 1,000,000 tonnes.
Loggerheads are the threat under the Convention on International Trade in Endangered Species (CITES) and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Canadian waters have the blue shark recorded off southeastern Newfoundland, the Grand Banks, the Gulf of St. Lawrence, the Scotian Shelf and in the Bay of Fundy. At certain times of the year, eastern Canadian waters probably have the most abundant large shark species (Templeman 1963). According to the conclusion of Blue shark catch and by-catch in the Canadian Atlantic, unreported by-catch was about 20 times larger than reported catch (Campana et al. 2002).

### 3.5. South Africa

**Bycatch Problems during shrimp fishery in South Africa during last 30 years**

Turtles are captured by several fisheries in region like the purse seine, shark nets, and shrimp trawl and pelagic trawl fisheries. (Dudley & Cliff 1993, FAO 2007, Fennessy & Isaksen 2007). These fisheries in other regions have mortality document (Silvani et al. 1999). However, the level of mortality caused by these fisheries off southern Africa is less well understood.
At present, pelagic purse seine targeting sardine *Sardinella* spp. and trawl fisheries for horse mackerel *Trachurus* spp. operate in South African waters and could impact turtles, although preliminary investigation reveals that these fisheries are unlikely to catch large numbers (Nel et al. 2007). Up to 55 000 turtles are killed by Global shrimp trawl fisheries each year (Magnuson et al. 1990). South Africa's trawl fishery targeting shrimps has the record turtle bycatch. (Fennessy & Isaksen 2007).
In spite of being small (two vessels are active at present), this fishery operates along the north coast of KwaZulu-Natal in the vicinity of breeding localities and thus significant numbers of turtles may be captured by it.

Fishers illegally use gillnets to target linefish, e.g. D. capensis, are also negatively buoyant, but are often staked overnight or set without marker buoys to eradicate detection.

A pelagic longline fleet targeting tunas *Thunnus* spp. and Swordfish *Xiphias gladius* are supported by them for a total of 41.5 million (average 5.2 million per year) and 10.2 million hooks (average 1.3 million per year), 1998–2005, respectively.

Turtle populations are mainly threatened by pelagic longline fisheries. The first assessment of turtle bycatch is represented by this study in the South African pelagic longline fishery for tunas and Swordfish. A total of 181 turtles were caught on observed sets, 1998–2005, at a rate of 0.04/1000 hooks (0–15.5/1000 hooks, SD 1.28).

The South African pelagic longline fleets targeting tuna *Thunnus* spp. and Swordfish *Xiphias gladius*, caught 20 bycatch species 1998-2005, six of which are considered Vulnerable and one (Scalloped Hammerhead Sphyrna lewini) Endangered.

The South African fishery had an observation of 14 million hooks or 2 412 sets accounting for 6.8% of total effort from 2000 to 2006. Only 41 seabirds were killed (0.003/1000 hooks) of 107 seabirds caught (0.008/1000 hooks).

## 4. Current and Prospective Mitigation Techniques of Bycatch reduction in Bangladesh

There are several laws and legislations are organized by the marine authority in Bangladesh. All laws are totally adequate for the people and environment who are associated with marine fishery. Each law has basic focus to conserve resources.

The policies of governing the fisheries and aquaculture sector under the administrative control of the Ministry of Fisheries and Livestock have the department of fisheries (DOF) as the main implementing agency. However, the implementation of the policies, laws and regulations governing the fisheries sector remain the main huddle to the sustainability of this sector and the long-term conservation of the marine, coastal and estuarine ecosystems which help the livelihoods of the wider coastal population of Bangladesh.

Moreover, the FAO Code of Conduct for Responsible Fisheries, the National Water Policy, National Agricultural Policy, National Rural Development Policy, National Land Use Policy, National Environmental Policy and Coastal Zone Policy among others have existence in this sector (DOF, 2006).

There are several act or ordinance are made by the authority in time to time when necessary for the total fishery sector.

There are several laws and policies in Bangladesh which are given in a following table.

Table.6: Different fishery policies, laws, rules, acts and ordinances in Bangladesh (Moniruzzaman, 2006; DOF, 2006,2010)

| Title of the Policy/law/rule/act/ordinance | Aspects covered |
|---|---|
| Forest Act, 1927 | Allocation of fisheries management responsibilities to the forest Department in mangrove areas |
| The Protection and Conservation of Fish Act, 1950 | Conservation of Fisheries Resources as a whole |
| Embankment and Drainage Act, 1952 | Protecting crops, not allowing cuts in embankments to produce shrimp |
| The Government Fisheries Protection Ordinance, 1959 | Protection of Government owned water bodies against unauthorized fishing |
| Bangladesh Water and Power Development Board Ordinance, 1972 | Develop water management infrastructure for shrimp farming |
| Territorial Water and Maritime Zone Act, 1974 | Conservation of marine fisheries |
| The marine fisheries ordinance, 1983 | Conservation of marine fisheries |
| Fish and fish product (Inspection and quality control) ordinance, 1983 | Quality control of fish and shrimp, mainly targeting export |
| The protection and conservation of fish rules, 1985 | Farming rules for enforcement of various provision of fish act 1950 |
| Shrimp state (mohal) management ordinance,1992 | Allocate suitable state (khas) land for shrimp culture |
| Shrimp farm taxation law, 1992 | Imposing higher tax on shrimp land to cover cost of polder infrastructure |
| Bangladesh Environment Conservation Act, 1995 | Conservation of natural resources and ensure eco-friendly development |
| Bangladesh Environment Conservation Act, 1997 | Conservation of natural resources and ensure eco-friendly development |
| Fish and Fish product (quality control) rules, 1997 | Quality control of fish and shrimp, mainly targeting export |
| National Fishery Policy, 1998 | Conservation, management, exploitation, marketing, quality control and institutional development |

| | |
|---|---|
| Fish and Animal Food Act, 2010 | Safe fish and animal feed production, processing, quality control, export, import, marketing and transportation |
| Hatchery Act, 2010 | Hatchery development to ensure quality fish and shrimp seed |

All laws have more explanation inside itself where all covers mostly overall resource management regimes and sustainability.

Shrimp trawlers have Turtle Extruder Device (TED). Mid-water trawlers are being modified by Demersal Fish trawlers gradually.

Shall introduce provision of reporting the catch of turtle in fish trawl and gillnet fisheries and take measures to reduce catch and survival of turtle.

In addition, there are also some resolutions made by the responsive authority.

**Table 9**. Scientific requirements contained in Resolutions of the Commission, adopted between 2005 and 2015.

| Res. No. | Resolution | Scientific requirement | CPC progress |
|---|---|---|---|
| 15/01 | On the recording of catch and effort by fishing vessels in the IOTC area of competence | Paragraphs 1–10 | Have records of the industrial fishery as group, no species wise tuna catch recorded. |
| 15/02 | Mandatory statistical reporting requirements for IOTC Contracting Parties and Cooperating Non-Contracting Parties (CPCs) | Paragraphs 1–7 | Have statistical report of industrial and artisanal fishing. |
| 15/05 | On conservation measures for striped marlin, black marlin and blue marlin | Paragraph 4 | No deep sea long lines |
| 13/04 | On the conservation of | Paragraphs 7– 9 | No purse seine, so not applicable |

| Res. No. | Resolution | Scientific requirement | CPC progress |
|---|---|---|---|
| | cetaceans | | |
| 13/05 | On the conservation of whale sharks (*Rhincodon typus*) | Paragraphs 7– 9 | No purse seine or FAD, so not applicable, as well this spp. Not yet recorded in BD marine waters |
| 13/06 | On a scientific and management framework on the conservation of shark species caught in association with IOTC managed fisheries | Paragraph 5–6 | NPOA for shark is drafted which may incorporate the IOTC requirements |
| 12/09 | On the conservation of thresher sharks (family alopiidae) caught in association with fisheries in the IOTC area of competence | Paragraphs 4–8 | No thresher shark yet identified in Bangladesh marine waters |
| 12/06 | On reducing the incidental bycatch of seabirds in long line fisheries. | Paragraphs 3–7 | Long liner not yet introduced in the existing industrial fishing fleet of BD |
| 12/04 | On the conservation of marine turtles | Paragraphs 3, 4, 6–10 | TED is used in shrimp trawler. Demersal Fish trawlers are being converted to Mid-water gradually. Provision of reporting the catch of turtle in fish trawl and gillnet fisheries in future for conservation of turtle. |
| 11/04 | On a regional observer scheme | Paragraph 9 | No regional observer scheme |
| 05/05 | Concerning the conservation of sharks caught in association with fisheries managed by IOTC | Paragraphs 1–12 | NPOA for shark is being developed which may incorporate the IOTC requirements |
| | Bangladesh government has planned to explore its marine resources from deep and distant waters within the EEZ and ABNJ. | | |

Fishers not only get training on the FAO-CCRF but join a regular bi-monthly meeting arranged by the Bangladeshi govt employees like navy, Bangladesh coast guard, RAB, Police. These meeting discuss about rules and regulations for the conservation of marine resources and will help fishers to maintain all rules. According to marine fishers' ordinance, 1983, a fishing license is mandatory for all fishing activities.

Mass awareness campaign are organized among fishers and the representatives of local people to discourage the deleterious impacts of destructive fishing methods and to encourage for Acts and Rules promulgated to restore our biodiversity and to protect the resilience of the marine environment. Strong monitoring, control and surveillance (MCS) procedures try to increase boat registration and issuance of fishing licenses and illegal, unregulated and unreported (IUU)

fishing in the EEZ waters of Bangladesh are reduced by (NPOA). Besides these, catch and compliance are monitored from the only marine fisheries surveillance check post at patenga, Chittagong.

Several institutions and organizations are crucial to this sector including the donor community, fisheries and prawn farming cooperatives and the local union councils (locally known as parishad) (Pokrant and Bhuiyan, 2001).

If the authority of Bangladesh take some more strong consideration on bycatch reducing solution then it is hundred percent right that it will bring more revenue and more strong sustainability.

The functions of the multitude of institutions in the Bangladeshi fisheries sector have needed for heavily reconstruction which encompass several ministries divisions and departments as well as government and non-governmental agencies (Maniruzzaman, 2006).

The industrial trawl fishery in Bangladesh (Bay) are facing several problems. The main basic problem is lack of well-planned management approaches. The managerial organizations are practicing mainly based on economic gains from the resources which should not be.

Many fishery development policies can not be implemented for various reasons. Corruption at different ways of management systems, illegal fishing and the use of illegal gears are the main stands for preventing laws implementation. High population is also a major issue for over exploitation of resources. In this case, government should be very strict to implement laws frequently and making people more conscious for birth control.

The bycatch of industrial trawl fishery, destroys large number of species year after year. But to decrease the loss of bycatch, an alternate option should must be tried, targeting only definite fish or shrimp. Like Bangladesh with high population and less land area, big amount of bycatch can be used in many ways like fish meal, poultry meal, etc.

## 5. Discussion

According to the present condition of the Bay of Bengal of Bangladesh, the marine capture fishery is so much resourceful. Moreover, a large area has added. Now, it is the high time to conserve the resources with maintaining utmost technical and improved management measures.

Presently the fishing authority is trying hard to conserve their resources as much strictly as possible. But still it must be also best way to conserve resources by managing the bycatch situation.

Presently, Bangladeshi marine trawl shrimp fishery is managed based on Maximum Sustainable Yield (MSY) concept which reveals the practice of the management of renewable resources. This concept should be more adequate in terms of cost factor.

Moreover, according to the fishing authority in Bangladesh, there is a limited data on bycatch situations during capture. Several trawlers capture fishes daily but still there is no effective bycatch data. To collect fisheries data is the most important part to reduce bycatch on the Bay. In this case, the monitoring system should be very strict. Several Scientific researches should aim to establish accurate baseline information and to develop strong monitoring system to understand present situation and future predictions.

It is time to think about uses of more productive bycatch reducing gears and improved management regimes for bycatch control in the Bay. Bycatch can be reduced mainly by immediate interventions in trawl designs. A lot of techniques are already developed all over the world to improve species selectivity and size selectivity of trawl nets to reduce bycatches which should be introduced as soon as possible. In this case, Bycatch Reducing Device (BRD) can be more effective for the trawlers right now. Also, Fish Escape Device (FEDs) (Watson and McVea, 1977) , Turtle/Trash Exclusion Device (TEDs) (Watson et al., 1986; Kendall, 1990; Rulifson et al., 1992; Renaud et al., 1993; Robins-Troeger et al., 1995; Robins and McGilvray, 1999 ), Bycatch Excluder Device (BEDs) ((Naamin and Sujastani, 1984; Sujastani, 1984 ) are more efficient which can be introduced in Bengal fishery. In Russia, Nordmore Grate is very effective to reducing bycatch. Also, there is a good fame for Juvenile and trash Excluder device (JTED). In Canada, Arena, Rectangle and vertically oriented bar is so effective in lake of Ontario. Researcher in Bangladesh should study all of those device for finalizing the suitability in existing environment.

It is also very important to redisgn the present existing methods and gears to reduce the capture of unwanted species. To reduce mortality, way of quick release of non-target species will be more effective. In this case researchers should be more conscious.

Total ban on trawling by all types of trawlers should impose for the definite time of breeding period will be more acceptable.

In almost all vessel should have enough onboard sorting place so that fish should not be thrown. Also, there should be more storage spaces for species. Fish processing methodologies should also be improved.

Improved management regimes have also a great importance in bycatch mitigation. Several nations focus several effective measures. In Canada, dockside monitoring, at-sea observers, vessel monitoring system, logbooks, electronic monitoring are practiced.

It is very clear from research that, Marine protected areas are very effective for conservation. So, MPAs should be created as much as possible.
Most fishers are not educated and well trained in proper utilization of gears. Mostly are poor and lead very poor livelihood. In this case, it is very important to improve their leading of lives and proper facilities for education and practical training based knowledge.
There are several types of fish oriented products like fish paste, fish sausages, fish pappads, fish wafers, fish spirals, fish save, fish diamondcuts, fish jam, fish noodles and canned fish paste products cn be prepared from the by-catch species.
According to the literature review, in my thought, Bycatch creates problems in shrimp, prawn and other fishery in most nations during last 30 years. In this case, Bangladeshi Fishing authority can be aware from several nation's approach to bycatch. Compare to other nations like USA, Norway etc. the authority could be strict more in bycatch reduction by implementing several laws and management regimes.
In last but not the least, for the Bay authority, it is very important time for strictly not to permit overfishing and bycatch for successful capture fishery for better economy.
If we see the current technical and management measures what are practicing right now in Bangladesh still are very effective according to the environment and culture of fishers. But, present ongoing measures in successful nations over bycatch is also a important part for future outcomes.

## 6. Conclusion

Bangladesh is heading for being strong economy compare to earlier years. If the Marine authority could be more conscious to aware on bycatch on the Bay, marine sector must be very effective stand for the growing of national economy.
If the authority emphasises the fishing companies to habituate with the improved technical and management measures and proper fishing practices, then it must be a great resource for the future generation.
It is more precise that, sufficient investment in research and development with commercially viable changes in fishing gear and methods are the most prerequisite action to reduce bycatch in the Bay (Bangladeshi part). Also, voluntary initiatives by the fishing industry must be more effective in reducing bycatch.

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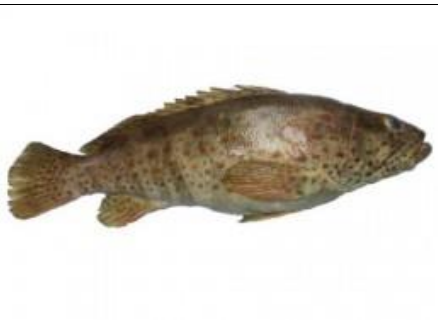
## 8. Appendix

### Appendix.1

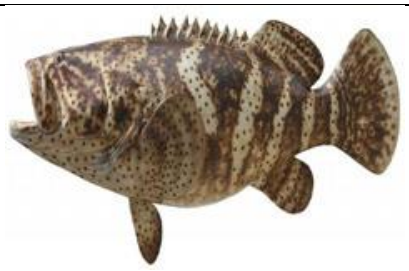
The Fisheries sector covers about the 3% Gross Domestic Product (GDP) of Bangladesh, 9% export earnings and nearly 10% of total employment. About 3/4 national animal protein consumption comes from fish (Nuruzzaman, 1994:76). In 1993/94, there was about 566,000 marine fishers out of 1.3 million fishers in the country.

**1.List of Export Marine Water Fishes in Bangladesh**

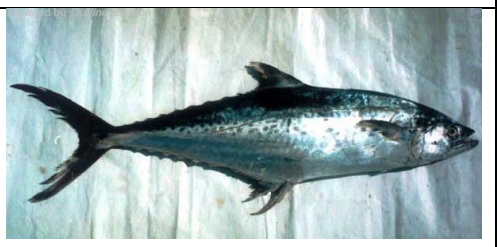
| Species name | Scientific name | Picture |
|---|---|---|
| Sea bass (barramundi) | *Lates calcarifer* |  |
| Snaper (white/red) | *Lutjanus* |  |

| | | |
|---|---|---|
| Grouper (reef cod) | *Epinephelus chlorostigma* |  |
| Mackerel | *Lutjanus campechanus* |  |
| Silver pomfret | *Pampus argenteus* |  |
| Hilsha | *Tenualosa Ilisha* |  |
| Bonito tuna | *Katsuwonus pelamis* |  |

| | | |
|---|---|---|
| Horse mackerel | *Megalaspis cordyla* |  |
| Sardine | *Sardinella longiceps* |  |
| Halibut | *Hippoglossus* sp. |  |
| Kwakwa | |  |
| Yellow tail scud | *Atule mate* |  |
| Paira chanda | |  |

| | | |
|---|---|---|
| Red jaw | |  |
| Yellow croaker | *Larimichthys polyactis* |  |
| Leather jacket | |  |
| Skipjack tuna | *Katsuwonus pelamis* |  |
| Eel | |  |

| | | |
|---|---|---|
| Ribbon fish | *Trachipterus* sp. |  |
| Threadfin bream mat | |  |
| Black promfet | *Parastromateus niger* |  |
| Golden snapper | *Lutjanus johnii* |  |
| Bombay duck | *Harpadon nehereus* |  |

| | | |
|---|---|---|
| Chinese pomfret | *Pampus chinensis* |  |
| Tongue sole | *Cynoglossus cynoglossus* |  |
| Golden conger eel | |  |
| Spanish mackerel | *Scomberomorus maculatus* |  |

**2.List of Export marine species except marine fishes in the Bay of Bengal**

| **Species name** | **Scientific name** | **Picture** |
|---|---|---|
| Cuttle fish | |  |

| | | |
|---|---|---|
| Squid | |  |
| Black Tiger/ Bagda/ Bagda Chingri | *Penaeus monodon* |  |
| Cat Tiger shrimp | *Penaeus semisulcatus* |  |
| Chaka, White Prawn | *Penaeus indicus* |  |
| Harina shrimp/ Brown Shrimp | *Metapenaeus monoceros* |  |

**Appendix:2**

**Management regimes in the Bay of Bengal for conservation of resources**

**i. Harvest limits and capacity control**

It is normal to limit the fishing effort or landings from different métiers for finite marine fisheries resources. This can include several harvest rules which limits the annual catch to within sustainable limits, with a quota that is shared between the different metiers fishing for the same species. Marine species like the penaeid tiger shrimp, hilsa, Indian salmon, croakers or pomfret have no limitations. With the exception of the trawl fishery, there are few input controls of vessel and gear numbers that are essentially open access fisheries to expand unrestricted.

**ii. Regulation**

The Marine Fisheries Ordinance (1983) supports Marine fisheries management which is implemented by the Marine Fisheries Wing (MFW) of the Department of Fisheries, empowering MFW to make rules covering licensing, catch reporting and the declaration of marine reserves. A series of rules (Marine Fisheries Rules, 1983) supports this that supplemented periodically by further legal rulings published in the Bangladesh Gazette. Changes in licensing fees to new technical instruments might be met by these such as minimum gear specifications or change of fishing practices.

The MFO (1983) is applicable between (i) the baseline (10 fathoms or 18.29 m) and 40 m (for the artisanal fishery) and (ii) beyond the 40m depth contour (industrial fisheries). However, according to Habib (1999), MFO covers certain activities by traditional fishermen inside 18 m, as are prohibitions covered in the Maritime Zones Act 1974 and Coast Guard Act 1994.
Any specific provisions have distinction within the MFO which required 18.29 m depth inside, have to be specified through the issuance of a notification. For the management of the trawl fisheries the Government has limited 73 allowed trawlers to operate in the EEZ of Bangladesh (Rahman 2001).

The Protection and Conservation of Fish Rules (1985) covers Coastal waters (together with inland waters). This regulation stands for methods of fishing, fish species that cannot be caught during a particular season, mesh size of fishing nets, prohibition of landing and carrying fish of a certain size.

**iii. Institutional capacity building**

Bangladesh management system has one major weakness and its potential evolution is the lack of institutional support within Bangladesh. There are no recognized gear technologists, and the existing assessments of the state of the stocks are very rudimentary.

Most of the historic recommendations for restrictions are distinctly unconcerned about stock recovery rates, and lack of awareness in the ability to alter means of application of fishing techniques. Therefore, considerable institutional strengthening in this sector needs action.

**iv. Monitoring, control and surveillance**

The MCS system is non-existent by the possible exception of the industrial trawl sector. It is considered as impractical, the size of the fleet, to contemplate extending resources to a dedicated MCS unit. Limited MCS unit in the coastal ports would be deployed for a more practical approach, but to rely heavily on stakeholder management.

The western part of the coast should be strengthened, particularly concentrated and decentralized on Capacity and infrastructure/logistics of the MCS agencies including the BFRI, DoF, and Coast Guard.

The marine fisheries sub-strategy has also emphasized on this long discussed and agreed problem but no solutions have come out as yet. Quick solution and political commitment are vitally necessary in this situation.

**v. Conflict resolution**

The zoning disagreement from the big vessels principally creates conflict. The big vessels claim about the weakness and question of GoB knowledge diffusion process.

• spawning beds of important shrimp and finfish feel disturbance for trawlers. Fishing operations of mechanized boats are restricted by these to operate in shallower water.

• Collection of brood shrimp for hatcheries by unconsidered shrimp trawlers as a viable and sustainable method has overfishing impact and can be better replaced by mechanized trammel nets

• ESBN operators complain about other boats to damage their nets. They request Government to demarcate and specify areas of operation of their boats. It is presently demarcated but this demarcation is not obeyed by the parties. This needs to be reviewed with scientific evidences and support and informed knowledge in order to get full participation

• ESBN operate in estuaries and river mouths and block/ restrict entry and movement of mechanized boats. Off-shore vessel owners complains about these vessels to restrict the fish to recruit in the fishing ground.

• In spite of regulating areas of operation of a number of boats, marine fisheries rules do not specify or demarcate those for artisanal boats.
• The trawler indiscriminately catches brood tiger shrimp for hatcheries and it competes with the same stock dependent people.

**vi. Management issues**

Management of marine fisheries is highly dependent on activities of industrial trawl sector. The fishing effort goes uncontrolled; all activities in the SRF area controlled by Forest Department (FD).

There has been a latest move to provide marine specialists to coastal districts to assist the delegated coastal District Fishery Officers (DFOs) by the government in 2005 to exercise the power of MCS under the rules of the MFO 1983 as a part of decentralization strategy, but this has yet to materialize.

In order to manage the coastal fishing fleet there are some complication, the poor capacity of the Marine Mercantile Department (MMD) has hindered the registration of fishing vessels and their subsequent licensing for fisheries purposes. Currently, half of commercial fleet and under ten percent of the entire fishing fleet is registered and licensed (Banks 2003).

**Management regimes to conserve marine resources in Bangladesh**

As a national fish of Bangladesh, it contributes nearly 12% of the country's total roduction.25 cm hilsa known as jatka should be protected at the time of rearing and spawning to ensure the unabated release of matured eggs.

The Marine Fisheries Ordinance 1983, after several amendments having 22 rules and regulations, is the main legal instrument for the management purpose. The restricted rules on different depth zones, mesh sizes, fish sizes, seasons and areas for different fisheries could be more than enough, if implemented properly.

Most of the rules are unenforced properly because of the poverty of the MCS operations.

Recently the government has formulated the National Fisheries Policy and National Fisheries Strategy, after implementation of those fisheries sector, hopefully will be able to overcome its many constraints.

The National Fisheries Policy of 1998 guides and regulates the management of fishery resources in Bangladesh that spelled out the country's objectives in fisheries: to increase fish production, alleviate poverty, improve the conditions of fishers, provide animal protein,

strengthen foreign currency earnings through export, and promote ecology, biodiversity and public health.

Key aspects of the policy are:

• Procurement, preservation and management of fisheries resources in the open water bodies.

• Fish culture and management in closed freshwater bodies.

• Culture of shrimps in the coastal regions.

• Exploitation, conservation and management of marine fisheries resources.

**Policy for marine fisheries development**

--marine fisheries development has many policies about marine resources assessment and the extended information to marine resource exploiters,

--Utilization of trash fish, alternate employment for fishermen during fishing holiday,

--industrial and artisanal fishery to reduce over-fishing for sustainable production,

--research for marine fisheries development, indiscriminate exploitation of marine fish, and marine pollution by dumping of harmful chemicals and radioactive materials in the sea.

**The National Fisheries Strategy**

In 2006, the Department of Fisheries consisted of on the light of the National Fisheries Policy, a pathway to achieve the objectives of the policy, several strategies for every sub-sector.

One of the largest, widest and most significant consultative exercises of its kind ever undertaken in Bangladesh fisheries is expressed by The National Fisheries Strategy formed by a series of studies, papers, discussions and meetings. Strategies and action plans for eight subsectors are included by the strategy.

Common to the National Fisheries Strategy and the sub-strategies is considered as a core of central principles and themes– such as decentralization, people's participation, poverty alleviation, gender equity. The Government's Poverty Reduction Strategy Paper, and by a number of international agreements signed by the government also guided the strategy.

**All laws and regulations taken by marine fishery department or DoF or Ministry of Fishery and Livestock for maintenance of resources in the Bay of Bengal**

**Fish laws**

The Marine Fisheries Ordinance, 1983 The ordinance is generally known as the Marine Fisheries Rules, 1983, which were amended in 1992. The salient features of the rules are as

follows a Director, posted at Chittagong, shall be responsible for the survey, conservation, development and management of marine fisheries resources, enforcement of laws and licensing, etc; an annual fishing licence (January-December) is compulsory for every fishing trawler and mechanised boat and is obtainable after the payment of prescribed fees (Taka 200-1,800).

Non-mechanised boats were brought under licensing in 1995.

The Marine Fisheries Rules, 1983

Protection and Conservation of Fish Rules 1985

The Territorial and Management Zones Rules, 1974

**In addition to the regulations, the following policies and guidelines are also in place for official control of fish products**

-National fisheries policy-1998

-National residue control plan policy guidelines, 2011(amended in 2012)

-National shrimp policy, 2014.

-Fish and fishery products official control protocol, 2015.

-Guidelines for the control of aquaculture medicinal products-AMPs, 2015

- Manual on good aquaculture practice – trainer manual

-Compliance guidelines for fish feed production, import and marketing

-Guidebook on waste management in fish and fishery industries

-Good aquaculture practice-a farmer's guide

-Compliance guidelines for shrimp hatchery

-ISO/IEC 17025:2005 general requirements for competence of testing laboratories

**Quota or License approbation procedure by marine fishery department for Fish capture companies**

Every fishing vessel must have all above documents according to article 388 of part ix of the Bangladesh merchant shipping ordinance,1983. All license holder vessels are subject to payment of fees which are set by the government based on the gross tonnage of the vessel. Although registration, COI and fishing license have been issued as one stop service by personnel from MMD and MED, it is proving increasingly difficult to organize combined camps and this is hindering compliance.