Fisheries resources of Bangladesh: Present status and future direction

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Abstract
Bangladesh is considered one of the most suitable regions for fisheries in the world, with the world’s largest flooded wetland and the third largest aquatic biodiversity in Asia after China and India. This paper reviews the performance of fisheries in Bangladesh using data collected from the Bangladesh Department of Fisheries, and related un-published grey literatures. The findings within describe recent growth within Bangladeshi inland fisheries, primarily in the inland aquaculture sector (2014–2015). This increase in the aquaculture production has been made possible with the implementation of scientific and technological modernization. From 2000 and 2016, aquaculture production increased from 712,640 and 2,060,408 metric t, a much larger quantity than wild capture production (1.023 million t) in 2016. There has also been a recent increase in the value of fishery exports, with more than US $34.08 billion in 2010 rising to more than US $46.60 billion in 2015. However, fisheries production is well below production targets despite the large gains seen in the aquaculture sector.

1. Introduction

Bangladesh, with its rich inland waters and river systems, has significant capture fishery and aquaculture potential. The favorable geographic position of Bangladesh comes with a large number of aquatic species and provides plenty of resources to support fisheries potential. Fish is a popular complement to rice in the national diet, giving rise to the adage ‘Maache-Bhate Bangali’ (‘a Bengali is made of fish and rice’) (Ghose, 2014). The fisheries can broadly be classified into three categories: inland capture fisheries, inland aquaculture and marine fisheries, of which the inland aquaculture sector is contributing more than 55% of the total production (DoF, 2016). The fisheries sector plays a very important role in the national economy, contributing 3.69% to the Gross Domestic Product (GDP) of the country and 22.60% to the agricultural GDP (FRSS, 2016). Over the last 10 years (2004-05 to 2013-14 FY), the fisheries growth was fairly steady and at an average of 5.38% per year (FRSS, 2015). This sector experienced more or less consistent growth rate, ranging from 7.32% growth in 2009-2010 to 4.04% growth in 2013-2014 (Bangladesh Economic Review, 2014). More than 2% of Bangladeshi export value comes from the inland fisheries sector. Given proper government support, the fisheries sector has ample potential in creating various types of ancillary industries in rural areas that often have a high rate of economic return. These employment opportunities for poor rural citizens would also stem their migration to urban areas. Fish supplements about 60% of Bangladeshi people’s daily animal protein intake (DoF, 2016). More than 17 million people including about 1.4 million women depend on fisheries sector for their livelihoods through fishing, farming, fish handling, and processing (BFTI, 2016, p. 1215). A different survey revealed that more than 80% of laborers engaged in the fish processing industries were women (DoF, 2015).

Bangladesh has one of the biggest and most active deltas, fed by three mighty rivers: the Padma, the Meghna and the Jamuna. This contributes to a high potential for fresh and brackish water capture and culture fisheries, in addition to the vast marine resources. Despite Bangladesh’s long coastline and large freshwater and marine water bodies, fisheries are underdeveloped compared to other industry sectors. Inland fisheries production has escalated over the years, but the productivity per hectare water area is not yet attained at its optimum. In recent years, the bulk of the production has been obtained from marine (16.78%) and freshwater (83.22%) wild capture fisheries. In 2015–2016, Bangladesh was the 5th in world
aquaculture production, which accounted for half of the country’s total fish production (55.15%) (DoF, 2016). In 2014–2015, total fishery production of Bangladesh was 3,684,245 metric tons, of which 1,023,991 metric tons was obtained from inland capture fisheries, 2,060,408 metric tons from inland aquaculture and 599,846 metric tons from marine water production (FRSS, 2016) (see Table 1). There have been few reviews of the development and potential of fisheries and aquaculture in many parts of Bangladesh published and no studies have been published on the present status of fisheries in Bangladesh.

2. Production

2.1. Inland open water (capture) fishery

The fisheries sector in Bangladesh is broadly divided into three sub-sectors: inland capture, inland culture and marine fisheries (DoF, 2016). The inland fishery is further divided into two sub-sectors: the inland capture fishery and inland culture fishery. The inland capture fishery has five types of habitat containing approximately 853,863 ha of river and estuary, 177,700 ha of Sundarbans, 114,161 ha of beel, 68,800 ha of Kaptai lake, and 2,695,529 ha floodplain (haor); and the inland culture fishery, which has six types of habitat containing an area of 371,309 ha of pond, seasonal 130,488 ha of cultured water body, 5,488 ha of baor, 275,274 ha of shrimp/prawn farm, pen culture 6,775 ha, and 7 ha of cage culture (FRSS, 2016). An analysis of time series data for 2000–2014 reveals the declining trend of capture fishery habitat area (a decrease of 0.16 million ha), while the trend of culture fishery habitat area is increasing (by 0.35 million ha). Fig. 1 shows the district-wise magnitude of capture fish production for 2015.

Total fish production in Bangladesh in 2014–2015 was reported to be 3,684,245 MT, of which 1,023,991 MT (27.79%) were from inland open waters, 2,060,408 MT (55.93%) from inland closed waters and 599,846 MT (16.28%) from marine waters (Table 2). These new methods have the potentiality to greatly increase fish production in Bangladesh.

A total of 260 fish and 24 prawn species are known to inhabit in the freshwaters of Bangladesh with 12 exotic fish species have been recorded in the Bangladesh (IUCN, 2000, pp. 1–116; Rahman, 1989, pp. 1–352). At present, major carp species such as Catta catta, Labeo rohita, Cirrhinus mrigala and Labeo calbasu along with exotic carp, such as silver carp (Hypophthalmichthys molitrix); grass carp (Ctenopharyngodon idellus); and common carp (Cyprinus carpio) are the available carp species in the market. There are about 40–50 small indigenous fish species which grow to a maximum length of 25 cm (Felts, Rajts, & & Akhteruzzaman, 1996, pp. 1–41). Some more commonly found species of this variety include Puntiusticto, Amblypharyngodon mola, Colisalatits, Anabas testudineus and Glossogobius giuris. The IUCN (2000) reported that many of the small indigenous fish are now endangered or critically endangered. Among them, only carp species contribute 33.57% in total annual production (freshwater and marine water) followed by pangas (11.404%), and tilapia (8.44%) (FRSS, 2016). However, the inland water resources of Bangladesh offer major potential for the development of freshwater capture and culture fisheries (Hossain, 2014).

2.2. Inland closed water (culture) fishery

Aquaculture is the farming of fish and other aquatic organisms, with ‘farming’ implying some form of intervention to increase productions, and some form of private rights of the stock under intervention (Beveridge and Little, 2002). The entire area of inland closed (culture) water fisheries bodies is 0.29 million ha with littoral shrimp farms (National Fisheries Policy, 1998). In Bangladesh, the overall pond area is 1.46,890 ha and ox-bow lakes (baors) are 5,488 ha (DoF, 2015). Among various segments of the fisheries sub-sector, the inland aquaculture has generally experienced the fastest growth, with the establishment of new technologies, species, and intensification and improvement of farming.

### Table 1

| Types of fisheries | Fisheries sector | Water Area (Hectare) | Production (Metric Tons) |
|--------------------|------------------|----------------------|-------------------------|
| Inland Fisheries   | Inland open water (capture): Rivers, Estuary, Sundarbans, Beel, Kaptai Lake, Floodplain | 3,906,434 | 1,023,991 |
|                    | Inland closed water (culture): Pond, Seasonal cultured water body, Baor, Shrimp/Prawn Farm, Pen Culture, Cage Culture | 794,361 | 2,060,408 |
|                    | Total | 4,700,795 | 3,084,399 |
| Marine Fisheries   | Industrial (Trawl) fishing | 12,111,000 | 84,846 |
|                    | Artisanal fishing | 4,252,000 | 515,000 |
|                    | Total | 16,363,000 | 839,846 |

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Fig. 1. District wise inland open water (capture) fisheries production (Source: FRSS, 2015).
particularly in pond aquaculture, entirely over the country (Planning Commission, 2016) (Fig. 5). Aquaculture now provides around half the fish for direct human consumption in Bangladesh and is set to grow further. Aquaculture industry contributes to the economy with increasing production capacity and high export opportunities. Over the last 10 years, the average growth rate of fisheries is 5.4%, while aquaculture has grown 8.2%. This recent and rapid development has boosted Bangladesh to 5th in world aquaculture production (DoF, 2015).

Two types of aquaculture practices are going on in Bangladesh such as, freshwater and coastal aquaculture. There is no marine aquaculture currently practiced in the country and no marine or coastal fin fishes are farmed. Freshwater aquaculture is mainly comprised of pond farming of carps (indigenous and exotic), Mekong pangasid catfish, tilapia, Mekong climbing perch, and a number of other domesticated fish, though in lesser scale (Table 3). Coastal aquaculture is mainly comprised of shrimp and prawn farming in ghers (coastal pond or enclosures). In Bangladesh, aquaculture production systems are mainly extensive and improved extensive, with some semi-intensive, and intensive systems, in very few cases (Hossain, 2014). The present unit area aquaculture productions (MT/ha) are 3.60, 1.50, 0.95 and 0.71 for the pond, seasonal waterbody, baor (oxbow lake) and shrimp gher, respectively. Inland pond culture represents the mainstay of aquaculture in Bangladesh, accounting more than 80% of the total recorded aquaculture production, and is presently dominated by carps (indigenous and exotic), Mekong pangas and tilapia (Fig. 6). This sector contributed 55.93% of the total fish production in 2014–2015 (Fig. 2). Pond aquaculture is mostly practiced closed water fisheries in Bangladesh and contributed 43.79% (1,613,240 MT) to the total fish production in 2014-15. The brackish water giant tiger prawn (Penaeus monodon) and giant river prawn (Macrobrachium rosenbergii) are the main cultured species in coastal areas of Bangladesh (Azim, Wahab, & Verdegem, 2002).

2.3. Marine fisheries

The coastal and marine environment of Bangladesh is blessed with a warm tropical climate and high rainfall, enriched with nutrients from the land, creating one of the world’s richest ecosystems with high productivity (Hossain, 2001; Islam, 2003). Exploration, exploitation and management of living and non-living resources of the Bay of Bengal have potential to substantially contribute to the economy of Bangladesh. Particularly after the recent decision of the International Tribunal for Law of the Sea (ITLOS) regarding the Bangladesh-Myanmar maritime boundary, 2012 and the decision of the Arbitral Tribunal of the UNCLOS on India-Bangladesh maritime boundary, 2014 established sovereign rights on more than 118,813 km² area of territorial sea and 200 nautical miles (NM) of Exclusive Economic Zone (EEZ) and all kinds of living and non-living resources under the continental shelf up to 354 nautical miles from the Chittagong coast (Fig. 7)(MoFA, 2014). Currently, 32,440 km², starting from the coastline to 40 m depth, in the Bay, are open to around 67,669 unlicensed fishing boats, of which about 51% are non-motorized boats (Shamsuzzaman, Xiangmin, Ming, & Tania, 2017). In Bangladeshi marine waters, fish resources are extracted in three tiers: (1) up to 40 m in depth from the coastline where normal fishing boats operate; (2) from 40 m to 200 m in depth where mid-water trawlers operate; and (3) from 200 m in depth to the end of the EEZ where long-liner trawlers run (Islam et al., 2017). There are only 242 trawlers that are allowed for fishing in those regions by the government (MoFA, 2014).

The Bay of Bengal is blessed with rich coastal and marine ecosystems, hosting a wide range of biodiversity, such as fishes,
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3. Exports and imports

Fisheries and aquaculture sector have emerged as the second most important contributors to the export earnings of Bangladesh (Chose, 2014). It is the second largest export industry in Bangladesh and produces 2.5% of the global production of shrimp. The value of aquatic products in international trade (export and import) in 2015 was US $649.1056 million. Exports were 75,337.93tons, worth about US $605.878 million and imports reached 88,593.50 tons, with a value of approximately US $43.2276 million. The worth of export in 2010, 2011, 2012, 2013 and 2014 was approximately US $443.1063, 598.4771, 611.5135, 560.6393 and 636.7686 million, respectively (Table 7).

Bangladesh mainly exports ten categories of fishery products (Frozen freshwater fish, frozen marine water fish, frozen shrimp, chilled fish, live fish, dry fish, salted dehydrate, live kusia, live crab, and fish scale/shrimp scull) to more than 55 countries. In 2015, more than 45% of fishery exports, by quantity, were exported to European Union (EU), which has always been among the top markets. USA, Japan, Russia, China, Thailand, Vietnam, India, European Union (EU), which has always been among the top markets. USA, Japan, Russia, China, Thailand, Vietnam, India, Malaysia, Philippines, Saudi Arabia and others make up the other 55% (Table 8). The USA and EU together account for around 80% of the total shrimp export. The shrimp export for Bangladesh is primarily in the EU (Islam, 2008).

The total imported fishery products in Bangladesh consisted of approximately 69.373% frozen marine fish followed by 25.353% chilled or iced fish (Fig. 8 and Table 9) (FRSS, 2016).

4. Legal arrangements for the Bangladesh fisheries sector

Formal fisheries management in Bangladesh has a long history. As early as 1793, the British rulers had given large tracks of lands to the landlords who were supposed to collect tax from the assigned estates. Few fisheries, which are historically important for the regulations and improvements of fisheries and fish species, are still implemented with some amendment (Shamsuzzaman, Xiangmin, & Islam, 2016). Among these laws the Private Fisheries Protection Act, 1889 passed during the British colonial era. three acts, such as the Protection and Conservation of Fish Act 1950, the Government Fisheries Protection Ordinance 1958, and the Protection and Conservation of Fish (amendment) Act 1963 were enacted during the period of Pakistan control. The fisheries laws, such as the Fish and Fish Products (Inspection and Quality Control) Ordinance 1983 and the Marine Fisheries Ordinance 1983 have prevailed since the independence of Bangladesh. Moreover, the government has formulated policies.
such as national fisheries policy 1998 for the protection and development of fish species and fisheries environment (Table 10).

5. Discussion and conclusion

Fisheries sector of Bangladesh face several challenges such as over-fishing, fisheries resources degradation. A number of factor are responsible for fisheries resources degradation which construction of roads and embankments, together with drainage, flood control and natural siltation, the use of pesticides and fertilizers, pollution, upstream damming in major river systems (Islam, 2012). The massive infrastructure of roads and embankments, urbanization and housing projects has blocked many water bodies. This condition has adversely affected breeding and spawning of many

![Fig. 3. The yield of Inland open water (capture), Inland closed water (culture), marine fisheries and Total fish production in Bangladesh from 2000–2001 to 2014–2015 (units: metric tons) (Source: DoF, 2016).](image1)

![Fig. 4. Species-wise annual fish production in inland and marine fisheries 2014–2015 (source: FRSS, 2016).](image2)
Fig. 5. District-wise inland closed water (culture) fisheries production (Source: FRSS, 2015).
indigenous fish species. Consequently many water areas, previously rich in fisheries, now fish became scanty. Main strategies to reverse these effects should be as follows: control pollution, prevent further deterioration of water flows and shrinkage of water-bodies through infrastructures, like embankment, roads, urban housing projects, and industrialization. Establish and maintain fish and wetland sanctuaries in certain eco-sensitive areas like the Sundarbans, Kaptai Lake, rivers, floodplains and coastal and marine waters. The conservation strategy could potentially include the seasonal ban, gear restriction, species restriction.

The inland aquaculture production is constrained mainly by three problems related to -seed, feed, and extension service (Planning Commission, 2016). To overcome these constraints, it is needed to maintain purity of brood stock of indigenous carp and other indigenous fish species conserving the natural breeding, spawning, nursery and grow-out areas to complete the whole production process.
Fig. 7. Maritime area of Bangladesh (Source: Chowdhury, 2014).
lifecycle and natural reproduction process. Production, import and marketing of fish and shrimp feed, feed ingredients, minerals and vitamin premix, and other inputs, in which private sector is the key player, needs to be constantly monitored by the government. Species promoted for cage and pen culture should include all indigenous carp species, mono-sex tilapia, shorputi, shrimp, prawn, and selected exotic carps. The sustainable exploitation of marine fishery resources is constrained by (a) lack of knowledge of the species-wise current stock, location of the breeding ground and the grow out areas, and the potential maximum sustainable yields by species, season and location; (b) over-fishing; (c) encroachment by trawlers of neighboring countries. Strategies to overcome these will include: a rapid assessment of fisheries stocks by species in recently resolved South-West waters of EEZ, formulation of national marine fisheries policy, registration of all mechanized fishing boats and fishing licensing, strict surveillance should be continued for fishing to ensure compliance to all relevant acts, rules and regulations and impose seasonal ban to exploit fish and shrimp to protect spawn and juveniles (Islam et al., 2017; Shamsuzzaman et al., 2017).

A number of steps were taken by the government for increasing fish production. These steps included increasing total water area for aquaculture, augmenting open water capture fishery, ensuring access of the poor and genuine fishers to fish cultivation, accelerating aquaculture farming, developing technologies through supporting fishery research, disseminating evolved technologies through strengthening extension services, promoting private sector, improving fish marketing and processing system, quality control etc. The average annual hilsa production during the period of 2001-02 was 284.60 thousand MT, respectively whereas in 2013-14, hilsa etc. The average annual hilsa production during the period of 2001-02 was 284.60 thousand MT, respectively whereas in 2013-14, hilsa production increased to 385.14 thousand MT.

| Year | Imports | Exports |
|------|---------|---------|
| 2010–11 | 2011–12 | 2012–13 | 2013–14 | 2014–15 | 2015–16 |
| Quantity (tons) | Million US $ | Quantity (tons) | Million US $ | Quantity (tons) | Million US $ |
| 2010–11 | 28,981.19 | 13.1846 | 96,469.23 | 443.1063 |
| 2011–12 | 37,180.12 | 18.72 | 92,479.18 | 596.4771 |
| 2012–13 | 63,062.81 | 28.08 | 84,904.50 | 611.5135 |
| 2013–14 | 69,778.11 | 39.4914 | 77,328.86 | 560.6393 |
| 2014–15 | 97,383.67 | 39.5161 | 83,524.37 | 636.7686 |
| 2015–16 | 88,593.50 | 43.2276 | 75,337.93 | 605.8787 |

**Table 5** 
Standing stock (in tons) of demersal fish, pelagic fish and shrimp of the Bay of Bengal during the 1970s and 1980s (source: FAO, 2014).

| Demersal fish | Pelagic fish | Shrimp | Reference |
|---------------|--------------|--------|-----------|
| 264,000–373,000 | -- | 9000 | West (1973) |
| 160,000 | 90,000–160,000 | -- | Saetre (1981) |
| 200,000–250,000 | 160,000–200,000 | 4000–6000 | Penn (1983) |

**Table 6** 
Most abundant marine fish species caught from the Bay of Bengal (source: DoF, 2016).

| Local Name | 2005–2006 | 2006–2007 | 2007–2008 | 2008–2009 | 2009–2010 | 2010–2011 | 2011–2012 | 2012–2013 | 2013–2014 | 2014–2015 | 2015–2016 |
|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Hilsa/Illish | 98,363 | 198,850 | 196,744 | 200,100 | 202,951 | 198,574 | 225,325 | 232,075 | 252,757 | 257,626 | 251,815 |
| Bombay Duck | 37,924 | 39,331 | 36,009 | 36,980 | 58,263 | 58,464 | 60,750 | 62,817 | 71,745 | 51,673 | 53,950 |
| Indian Salmon | 1074 | 1018 | 969 | 1040 | 7733 | 7733 | 4521 | 3030 | 2445 | 1960 | 1020 |
| Pomfrets | 12,035 | 12023 | 13,061 | 16,728 | 46,643 | 50,245 | 40,478 | 39,537 | 29,693 | 23,355 | 11,437 |
| Jew Fish | 31,730 | 32,528 | 35,214 | 33,803 | 38,144 | 35,514 | 36,399 | 37,929 | 30,600 | 36,170 | 31,826 |
| Cat Fish | 19,037 | 18,151 | 18,131 | 20,354 | 16,515 | 16,722 | 17,193 | 19,790 | 8,594 | 9,719 | 9,476 |
| Sharks, Skates & Rays | 4085 | 4448 | 4790 | 4767 | 3933 | 4794 | 4205 | 3865 | 5017 | 5648 | 5093 |
| Sardine | -- | -- | -- | -- | -- | -- | 20187 | 29636 | 27590 | 27590 | 32835 |

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preserving fish sanctuaries; banning fish catch during certain periods and ensuring community-based fisheries management; protecting dry season water flows, restoration of habitat and fish species; integrated coastal fisheries resource management; maintenance of ecosystem health and management of pollution; and coping with climate changes has yielded positive results.

In conclusion, the Bangladesh fisheries have ample scope of development to strengthen the national economy. To realize the potential, there is a need to adjust the existing laws and legislation of the country for integrated resource management and for conservation of the fisheries resources. Bangladeshi fishers, fish farmers, traders, processors, and general people as a whole need to understand these issues, to be involved in the formulation of management plans, and to benefit from the whole process. The

| Country Name | Import | Export |
|--------------|--------|--------|
| EU | – | 33498.73 |
| USA | – | 4012.20 |
| Japan | – | 2588.21 |
| Other countries (Rasa, China, Thailand, Vietnam, India, Malaysia, Philippine, Saudi Arab etc.) | – | 35219.04 |
| India, Myanmar, Oman, Pakistan, Thailand. (Most of from India, Myanmar) | 88593.50 | 103318857.71 |

Table 8
List of foreign markets for exported Bangladeshi fishery products in 2015 (Source: FRSS, 2016).

Table 9
Most common Imported and Exported fishery products in Bangladesh (Source: FRSS, 2016).

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management measures should include regulating fishing intensity at a sustainable level, control gear selectivity, gear type and size of fish, implementation of closed season, prohibition of destructive fishing, closed fish sanctuary, and allocation of resources (finance, manpower) for fisheries. Concerned government departments, development partners, researchers and non-government organizations can play important role in the wide-ranging advancement of the fisheries sector.

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