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Present status of hilsa shad (*Tenualosa ilisha*) in Bangladesh: A review

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Abstract

Hilsa (*Tenualosa ilisha*) is the national and most important commercial fish species of Bangladesh. Hilsa widely occurs mainly in marine and estuarine environment but started to decline gradually over 30 years and reach to minimum during 1991-1992 that continued up to 2002-2003. Realizing the decreasing trend of hilsa, government took initiative to increase production by implementing regulation on *jatka* catch and restriction on brood hilsa catch from the breeding season of 2003-2004 under the Protection and Conservation of Fish Act, 1950. Hilsa management strategies help to contribute 11 percent of the total fish production and 1 percent of the Gross Domestic Product (GDP) of Bangladesh. Based on secondary literature this study describes biology of hilsa, existing hilsa management strategy and its impact on hilsa. To improve the situation a number of suggestions are elicited for effective management of the hilsa fishery that could be incorporated in the national policy.

Keywords: Hilsa fishery; biology of hilsa; management strategy; economic profile; Bangladesh

1. Introduction

Hilsa is an anadromous fish, called 'Ilish' in Bengali and commonly known as 'Indian shad'. It is considered as the 'national fish' of Bangladesh^[1]. It migrates from the Bay of Bengal to the rivers Padma, Meghna and its tributaries for breeding and nursing purposes^[2, 3]. Three types of Hilsa species are available in the Bay of Bengal named as *Tenualosa ilisha*, *Hilsa kelee*, and *Hilsa toil* but the majority of Hilsa fish captured in our country is *Tenualosa ilisha*. Hilsa spends its early stage in the river channels and descend to the sea to attain maturity then matured brood hilsa back to sea again to complete its life cycle^[4]. Hilsa spawns all the year round but Bengali months of Ashwin- Kartik (September-October) are considered as the major spawning season based on the full moon phase^[4, 5]. Most of the brood hilsa has been caught during this period from the spawning grounds of the country. 60% of the total Hilsa catch also comes from Bangladesh while remaining part comes from India and Myanmar^[6, 7].

Hilsa contributes 11 percent of the total fish production of Bangladesh^[1, 3, 6, 8]. Hilsa constitutes 1 percent of the Gross Domestic Product (GDP) of Bangladesh and provide a good support to the economy of the country by earning foreign exchange^[9]. Hilsa is very popular in Bangladesh and South Asia as well not only for its economic aspects but also for its unique taste. Presence of oleic acid, stearic acid and different unsaturated fatty acid are mainly responsible for such delicious taste^[10]. Hilsa also consists omega-3 polyunsaturated fatty acid, protein, minerals and fat composition varies from 22 to 36 percent of the muscle weight^[3, 11]. The high nutritional value, taste and culinary properties of hilsa justify the popular Bengali saying '*macher raja ilish*', meaning 'king of fish'. Livelihood of a large number of people of our country directly or indirectly depends on hilsa fishery^[11, 12]. Approximately 0.5 million fishers directly depend on hilsa fishing for their livelihood another 2 million people indirectly depend on hilsa fishery by the activities like transportation, marketing, processing etc.^[1, 7, 13]. Considering the economic and nutritional importance of hilsa government of Bangladesh has taken initiative to protect brood and juvenile hilsa in the nursery and spawning grounds. Government of Bangladesh have prepared Hilsa Fishery Management Action Plan (HFMAP) and imposed ban on indiscriminate catch of hilsa during the specific time of the year. Fishing ban is implemented every year by the Department of Fisheries (DoF) with the help of law enforcing agencies like Coast guards, Bangladesh Navy, Naval Police and RAB. In these circumstances this study reviews the available articles to present biology of hilsa, existing hilsa management strategy with its impact on hilsa and economic importance of hilsa fishery

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to get overall idea on hilsa fishery of Bangladesh.

The study is mainly based on the information from different secondary sources. Collected information was studied through different analytical and interpretative methods. Data have been accumulated by reviewing articles of peer-reviewed journals, reports and periodicals. All of these gathered data were comprehensively reviewed; synthesized and relevant information was presented in this study.

2. Biology of hilsa

Hilsa (*Tenualosa ilisha*) belongs to the family Clupeidae. Hilsa is a widely distributed fish and occurs mainly in marine and estuarine environment. The fish is found in the marine environment of Arabian Sea, Red Sea, Vietnam Sea, China Sea, Bay of Bengal and Persian Gulf [14]. The estuarine environment covers the Padma, Jamuna, Meghna, Karnaphuli and other coastal rivers of Bangladesh [1], the Satil Arab, the Tigris and Euphrates of Iran and Iraq, the Indus of Pakistan, Irrawaddy of Myanmar and the rivers of Eastern and Western India [14].

The spawning of hilsa takes place almost around the year, but the major spawning appears to take place in October-November, with subsidiary spawning in June-July and February-March. The former two are considered "summer spawning" and the latter is "winter spawning" [6, 14]. Female hilsa laid their eggs in the freshwater of rivers and streams at a favorable temperature of 23 °C, and the eggs hatch 23-26 hours after [14]. The fecundity of hilsa increases with the body weight of the fish. The estimated range is from 0.1 to 2.0 million eggs for fish ranging in the length of 25 to 55cm. The diameter of the fully ripe ovarian egg has been found to range, between 0.70 and 0.90mm [14, 15]. The juveniles travel downstream to brackish waters for feeding and growth in the course of the next 5-6 months, developing into an intermediate stage called 'jatka', having an average body length of 12-20cm [14, 15]. The jatka (juvenile of hilsa) travel further downstream to the sea and spend one more year till reach maturity [1]. After this the new generation finds their way back upstream in freshwater rivers for breeding and spawning [1, 15].

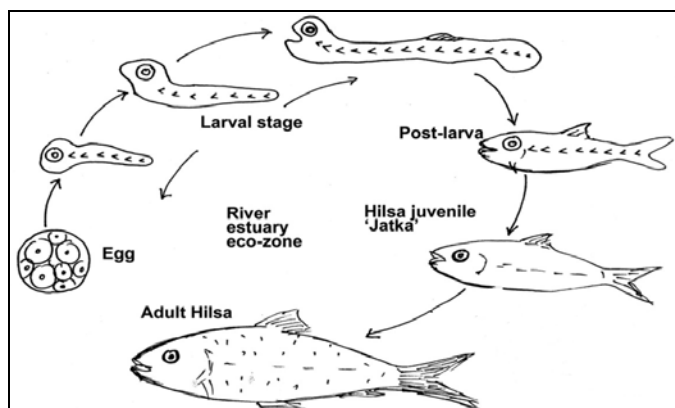


Fig 1: Life cycle of hilsa

The juvenile of hilsa is mainly available in the Meghna, Padma and the estuaries from December to May. The size varies from 4 to 16cm and after that time, they disappear from the rivers and migrate to the sea for feeding and maturation [4, 5]. The females attain larger sizes than the males. The males

are abundant up to 35-40cm length groups but beyond 46cm, males are not generally found. The maximum length of the females is about 55cm. The fish may attain maturity at the end of first year or at the beginning of the second year [15].

3. Migration strategy of hilsa shad

Hilsa generally start their upstream migration just before monsoon (rainy season) during January-March and start spawning with the onset of rainfall and floods in July-September. Two to three years into their life cycle the hilsa migrate into the freshwater rivers upstream from the Bay of Bengal in order to spawn [4, 5]. Migration distances of 50 to 100 kilometers are common, but hilsa have been known to migrate 1200 kilometers upstream to spawn in the Ganges system [14]. Although monsoon is the chief season for hilsa fisheries, another bout of fishing during migration earlier in the year is reducing catches and also seriously damaging the stability of the fish population through the capture of egg-bearing fish [16]. Hilsa faces a range of obstacles on their journey, including obstructive fishing nets on migratory routes, river siltation, construction of barrages, dams, sluice gates, industrial pollutant discharge, sewage, agricultural inputs, poison fishing, ship breaking, climate change, and natural disaster [3].

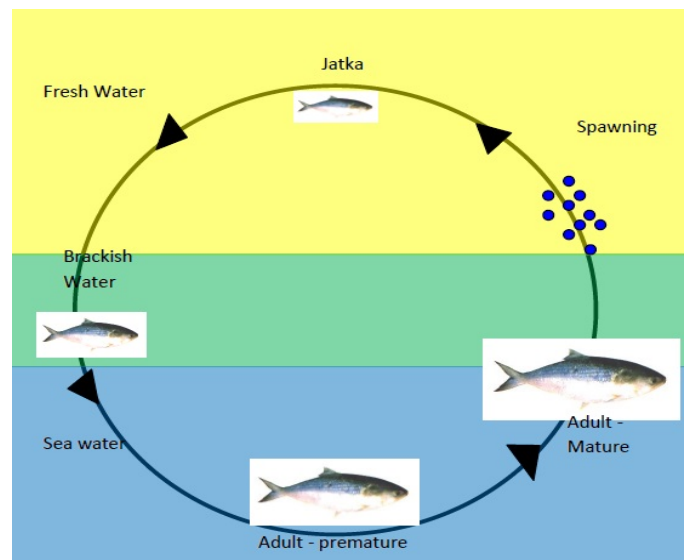


Fig 2: Hilsa migration [14]

4. Hilsa sanctuaries of Bangladesh

Adult brood hilsa mainly spawns in Bangladesh's major deltaic rivers, estuaries and coastal areas. The four most important spawning grounds in the country are: Dhalerchar of Charfashion in Bhola (about 125Km²); Monpura in Bhola (about 80Km²); Moulavichar of Hatia in Noakhali (about 120Km²); and Kalirchar of Sandwip (about 194Km²) [17]. Hilsa spawn throughout the year but the peak season is September and October [18, 19]. After hatching from free-floating eggs the fry remain in their nursery grounds to feed and grow. The largest river nursery ground is situated in the Meghna river system from Chandpur, Lakshimpur and Bhola. The juveniles ranges from 2 to 12cm appears these grounds from November to June. Comparatively larger size jatka (juvenile of hilsa) ranges from 11 to 15cm is found in the ground of Kuakata (Patuakhali) and Dubla Island (Khulna) during November to January [3].



Fig 3: Hilsa breeding grounds in coastal areas of Bangladesh [17]

Five sites of the Padma, Meghna, Tetulia and Andharmanik rivers have been declared as Hilsa sanctuary under the Protection and Conservation of Fish Act, 1950. Government of Bangladesh has declared these nursery grounds as hilsa sanctuaries to conserve juveniles in the nurseries and breeding grounds around 350 Km² [1, 3-5]. Department of Fisheries (DoF) has implemented Hilsa Fisheries Management Action Plan (HFMAP) in 2003 to protect *jatka* (juvenile of hilsa) and

imposed ban on hilsa fishing in a particular time of the year [3, 19]. Brood hilsa are protected for 22 days during the peak breeding season in October (before and after full moon). Catching hilsa has therefore been banned for two months (March to April) in every sanctuary except Andharmink (November to January). Catching, distribution, transportation, marketing and selling of *jatka* (juvenile hilsa) is banned between November to May [20, 21].

Table 1: Hilsa sanctuaries and implemented ban period

Sl. No.	Hilsa sanctuary areas	Ban period
1	From Shantol of Chandpur district to Char Alexander of Lakshmipur (100km of the lower Meghna estuary)	March to April
2	Madanpur/CharIlisha to Char Pial in Bhola district (90 km area of Shahbajpur river, a tributary of the Meghna)	March to April
3	Bheduria of Bhola district to Char Rustam of Patuakhali district (nearly 100 km area of the Tetulia river)	March to April
4	Whole 40 km stretch of the Andharmanik river in Kalapara Upazila of Patuakhali district.	November to January
5	Lower Padma river at Shariatpur district (20 km stretch of the Padma river)	March to April



Fig 4: Map of hilsa sanctuaries of Bangladesh

5. Hilsa fishery management strategy in the sanctuaries

Department of Fisheries (DoF) is working to manage the hilsa fishery by implementing Hilsa Fisheries Management Action Plan (HFMAP), 2003. DoF has imposed ban on catching, transportation and selling *jatka* (juvenile of hilsa) from November to June [19] and brood hilsa during full moon of autumn (October) in every year to conserve hilsa [19, 20]. Government has also taken initiative to support the livelihood of the fishing community along with the conservation strategy of hilsa [4, 5]. To compensate the loss of the fishers during ban period government has been provided 40 kg rice per household per month and training with cash support for alternative income generating activities [22, 23]. Government has also taken different initiatives to raise awareness among fishing community on hilsa conservation and livelihood development. DoF as a part of government organizes different meeting and workshop to aware the different communities of sanctuary areas [24]. DoF also distributes leaflets, poster and banner before and during the ban periods to raise awareness

among different hilsa stakeholders like fisher, money lender, boat owner, fish trader, law enforcement agencies and local government representatives [25].

5.1 Impact of management strategy on hilsa

Researchers of Bangladesh Fisheries Research Institute (BFRI) have found size of hilsa in all sanctuaries has increased [4, 5]. Hilsa research team of BFRI has found most of the hilsa around 35cm in Chandpur region of upper Meghna and greater than 35cm in the lower Meghna hilsa sanctuary of Bhola region (Table 2). More larger hilsa is available in the downstream particularly in Monpura and Hatia. The team has observed a good number (49.93%) of post spawn spent hilsa in the landing centers of the sanctuary areas and the percentage is much encouraging than previous year (36.6%). The findings of the research clearly indicate that due to effective management of DoF (imposition of 22 days ban instead of 15 days) has clearly increased the spawning of hilsa in the sanctuary areas than previous ban [5].

Table 2: Length of captured gravid Hilsa at different length group [5]

Sl. No.	Sampling area	Length group (cm)									Total (%)
		<35 cm				>35 cm					
		15-20	21-25	26-30	31-35	%	36-40	41-45	46-50	%	
1	Chandpur	1.27	8.02	14.22	16.38	39.89	34.05	25.55	0.51	60.11	100
2	Harina, Chandpur	2.36	11.5	18.69	31.36	63.91	22.37	13.2	0.52	36.09	100
3	Haimchar, Chandpur	1.93	7.87	12.98	25.86	48.64	31.92	17.86	1.58	51.36	100
4	Charvoirobi, Chandpur	0.59	17.27	15.27	20.1	53.23	26.18	18.18	2.41	46.77	100
5	Hizla, Barishal	3.69	11.01	36.54	24.99	76.23	17.49	5.71	0.57	23.77	100
6	Ulania,, Barishal	0.76	6.56	8.15	38.12	53.59	30.01	15.4	1	46.41	100
7	Char Ludhua	0.55	16.44	27.41	22.27	66.67	27.8	4.53	1	33.33	100
8	Ramgoti, Laximpur	0.46	4.72	13.14	18.42	36.74	51.76	9.5	2	63.26	100
9	Chairmanghat, Noakhali	0.39	4.3	9.03	19.32	33.04	46.29	16.03	4.64	66.96	100
10	Hatia, Noakhali	0.82	5.06	6.21	13.54	25.63	47.64	21.57	5.16	74.37	100
11	Ilisha, Bhola	2.11	6.69	9.72	18.43	36.95	30.07	26.16	6.82	63.05	100
12	Moulovichar, Noakhali	0.34	1.5	4.18	8.15	14.17	55.06	22.05	8.72	85.83	100
13	Monpura, Bhola	0.75	1	2.7	10.15	14.6	60.23	17.61	7.56	85.4	100

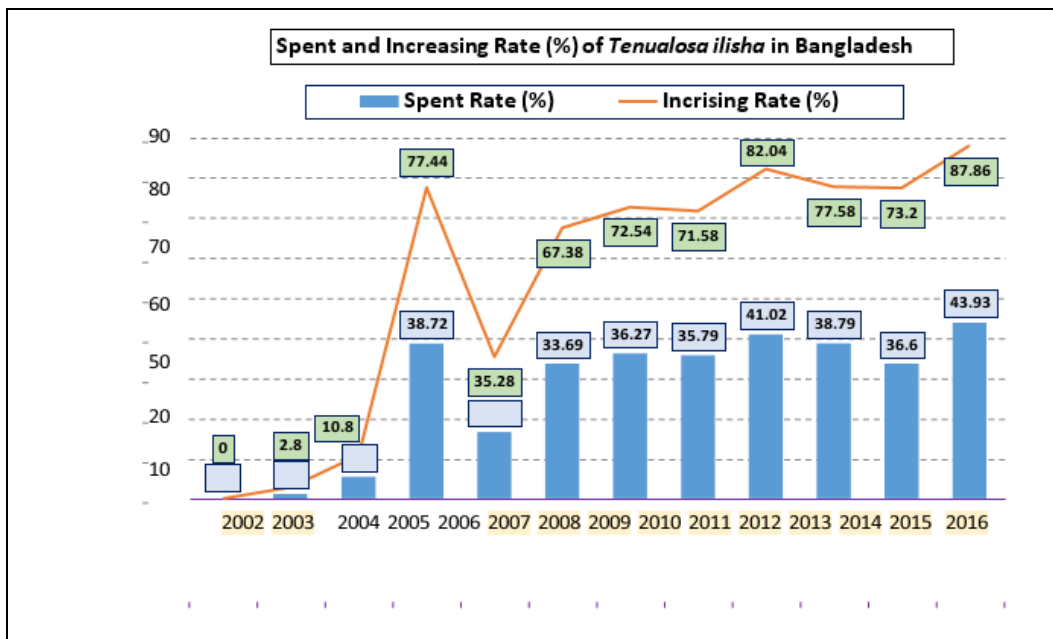


Fig 5: Spent and increasing rate (%) of *Tenulosa ilisha* in Bangladesh [5]

Freshwater and marine water catch is also increasing day by day due to implementation of conservation approaches properly particularly due to ban activities. Availability of Juveniles of other brackish and freshwater fish species has also increased along with *jatka* in the hilsa sanctuaries and

adjacent areas [4, 5]. Researchers of BFRI have found juveniles of 19 fresh water fish species abundantly than previous years [5] (Table 3). These findings are indicating the positive impact of hilsa fisheries management strategies on fresh and brackish water biodiversity.

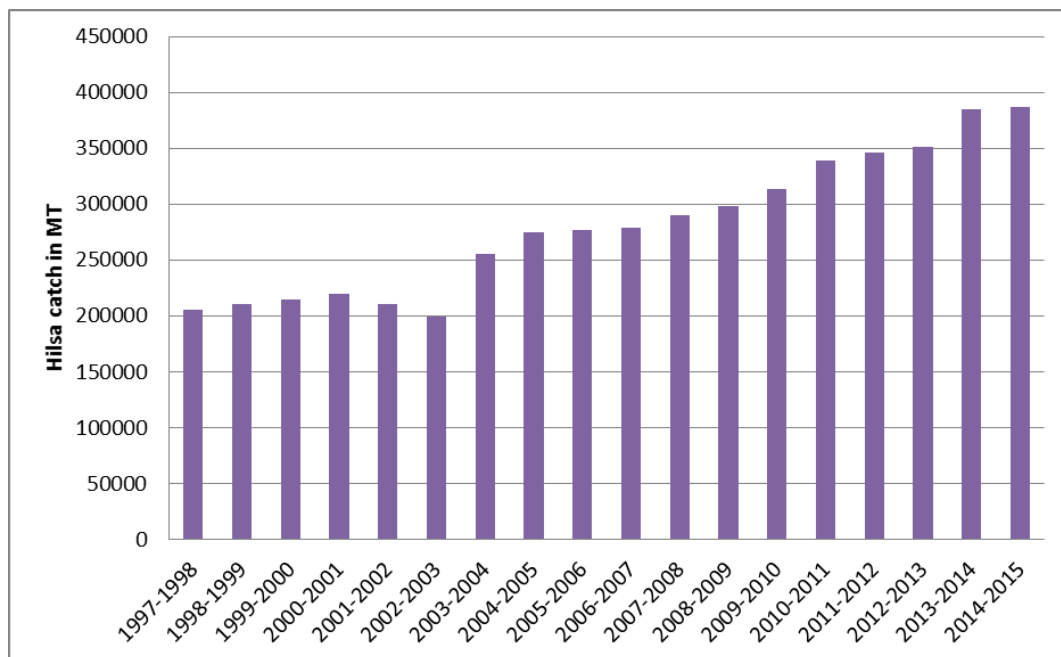
Table 3: List of identified fish species with conservation status ^[5]

Sl. No.	Bengali name/Local name	Common group	Scientific name	IUCN BD status 2015*	IUCN GB status 2015*
1	Poa	Fatheads	<i>Otolithoides pama</i>	LC	NE
2	Bele	Mudskippers	<i>Glossogobius giuris</i>	LC	LC
3	Silong	Catfishes	<i>Silonia silondia</i>	LC	LC
4	Chela	Barbs and Minnows	<i>Salmostoma acinace</i>	LC	LC
5	Kharshula	Mullets	<i>Rhinomugil corsula</i>	LC	LC
6	Kuchia	Eels	<i>Monopterus cuchia</i>	VU	LC
7	Kholisa	Labyrinth fishes	<i>Trichogaster fasciata</i>	LC	NE
8	Red Chewa	Mudskippers	<i>Odontamblyopus</i>	LC	NE
			<i>rubicundus</i>		
9	Koral	Pony fishes	<i>Lates calcarifer</i>	NE	NE
10	Vacha	Catfishes	<i>Eutropiichthys vacha</i>	LC	LC
11	Kachki	Clupeids	<i>Corica soborna</i>	LC	LC
12	Sada Chewa	Mudskippers	<i>Trypauchen vagina</i>	LC	NE
13	Olua	Anchovies	<i>Coilia dussumieri</i>	LC	NE
14	Kakila	Gars	<i>Xenentodon cancila</i>	LC	LC
15	Baim	Eels	<i>Mastacembelus armatus</i>	EN	LC
16	Pangus	Catfishes	<i>Pangasius pangasius</i>	EN	LC
17	Topse/ Taposi	Threadfins	<i>Polynemus paradiseus</i>	LC	NE
16			Crab		
17			Chingri (small Prawn)		
*LC: Least Concern; EN: Endangered; NE: Not Evaluated; VU: Vulnerable					
*BD: Bangladesh; GB: Global					

6. Economic profile of the hilsa fishery

Hilsa is found in inland, marine, and coastal waters round the year in Bangladesh. Hilsa was once available in 100 rivers of Bangladesh ^[3]. It was affordable fish for poor but hilsa fishery started to decline gradually over 30 years and reach to minimum (0.19 million tonnes) 1991-1992 that continued up to 2002-2003. Realizing the decreasing trend of hilsa government took initiative to increase hilsa production

by implementing regulation on *jatka* catch and restriction on brood hilsa catch from the breeding season of 2003-2004. In the year 2005-06, about 11% of the country's total fish production came from hilsa ^[14]. Average hilsa production was about 215 thousand MT worth US \$380 million that contributed 1.0% to the GDP ^[26, 27] and hilsa production is increasing day by day that became 387 MT in 2015 (Fig. 6).

**Fig 6:** Total hilsa catch in Bangladesh from 1991-2015 ^[24]

The government has mobilized its resources to create awareness and introduced enforcement involving fisheries officers, police, navy and coastguard. As most of the fishers depend only on fishing for their livelihood, it is difficult for

fisher to comply with the ban regulations as fishing ban stop their only income source that put adverse impact to their livelihood. Considering the fact the government of Bangladesh has taken initiative how to conserve hilsa by

supporting the livelihood of fishers as well ^[28]. Amount of compensation is not up to the mark. Compensation package should be based on the preference of the fishers.

7. Conclusion

Illegal fishing gear should be banned by implementing existing policy to retain the status of hilsa. To reduce overfishing, excessive fishing pressure and illegal fishing, improvement of the livelihood status of fishing communities and *jatka* (juvenile of hilsa) conservation is necessary. Fishing pressure could be reduced by providing alternative income generating facility. The government has taken initiatives to compensate the earning loss of fishers by providing rice but the amount is not satisfactory as the fishers live below the poverty line and struggle to survive with income, food security, nutrition, health, and sanitation. It is not possible by the government only to take this responsibility; different development and research organization, social and cultural organization should come forward to co-operate the government in this purpose.

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