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Research Article

DRAMATIC INCREASE OF GANGES RIVER SPRAT (*Corica soborna*) AND INDIAN RIVER SHAD (*Gudusia chapra*): IMPACT ON THE AQUATIC BIODIVERSITY OF KAPTAI LAKE, BANGLADESH

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ABSTRACT

Kaptai Lake is the largest artificial reservoir in South-East Asia and very rich in inland open water capture fisheries of Bangladesh. A study was conducted in three different communities viz. Natun Jele Para (mostly Hindus and entirely depends on fishing at lake), Adar Pahar (mostly Muslim and involved in various occupation) and Mitingachori (mostly ethnic group called Chakma, not entirely dependent on the lake fishery) to understand the historic changes of lake fish biodiversity. PRA tools, well-being ranking of the community people, were used to collect data. It was obtained mixed livelihood profiles in three communities but almost similar views on about the biodiversity changes of fishes in lake. About 44 fish species were recorded and ranked in terms of their availability within the last few decades. Indigenous and coastal fish species were available before the embankment (1960). Then some exotic carp species like Chinese carp, Big Head Carp etc. were dominated in the catch composition but gradually some Small Indigenous Species (SIS) was remaining in the top of the fish catch chart. Now, both Ganges River Sprat (*Corica soborna*) and Indian River Shad (*Gudusia chapra*) comprises about 60% of the total catch with an equal share of each. In 2013-14, total fish production was 8,813 MT (metric ton) where the overall productions of Indian Major Carps (IMC's) fish like *Labeo rohita*, *Gibelion catla*, *Cirrhinus cirrhosus* were only 38.44 MT. On the other hand *C. soborna* and *G. chapra* production were 2,581.53 MT and 2,640.45 MT respectively. Recent landing data of Bangladesh Fisheries Development Corporation (BFDC) were reviewed and it also supports the dramatic increase trend of SIS. The indiscriminate fishing, sedimentation in the lake, water pollution, changing the rainfall hinder the breeding performances of IMC's, and use of Keski Net damage other ichthyoplankton especially IMC's fries.

Keywords: Ganges River Sprat (*C. soborna*), Indian River Shad (*G. chapra*), Kaptai Lake, Biodiversity, SIS, Bangladesh.

INTRODUCTION

Bangladesh is an agro-based riverine country with a huge delta of water resources. Fish and fisheries are indispensable part in the livelihood of the fisheries of this country since time immemorial. More than 4 million people of the country directly or indirectly depended on fisheries, 60% of the national animal protein was supplied from fish, 2.01% export earnings came from fish and fish products, contribution to GDP (Gross Development Product) was 3.69% and contribution to agriculture was 22.60% (DoF, 2015). SIS (Small indigenous species) contributed 27% of the total fish production (DoF, 2011). In terms of overall production, it ranked third in inland fish production of the world (Islam, 2006). The production of inland capture fisheries of the country during 2013-14 was 29,52,730 MT and the production of Kaptai lake was 8,179 MT (DoF, 2015) The country has a globally important wetland ecosystem and associated aquatic biodiversity ranked third in Asia, with approximately 260 indigenous fresh water species (DoF, 2015) with 143 small indigenous species (Rahman, 2005).

The Kaptai reservoir was created as a result of damming the river Karnafuli near Kaptai town in the Chittagong Hill Tracts (Latitude 22029"N and Longitude 92017"E). The H shaped reservoir has two arms, joined by a narrow gorge near Shubalong, a part of the old Karnaphuli river sources. Kassalong; the right arm of the reservoir is fed by two inflowing streams, the Mayni and Kassalang in the northern side and laterally by the Karnaphuli river. The left arm, Rangamati-Kaptai is fed by two streams, the Chengi in the north and Rainkhyang in the south. The lake is confined within the hill district Rangamati and embraces the Sub-districts of Rangamati Sadar, Kaptai, Nannerchar, Langadu, Baghaichhari, Barkal, Juraichhari and Belaichhari. Kaptai Lake was built to serve electricity production, but now have enormous contribution on food fish product, local transport facilities and local livelihoods. Total surface area of Kaptai

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Lake is 68,800 ha and average water depth is about 9 meters with maximum depth of 32 meters (Galib, 2009). The lake continues to serve as a good and important source for fish production as commercial exploitation of fish since 1965 (Galib, 2009). Initially the indigenous major carps (*L. rohita, G. catla, C. cirrhosus, L. calbasu* and *T. tor*) dominated the catch with about 81% in 1965/66, however the catch of these fish had declined continuously to 5% while the production of SIS (e.g., *Corica soborna*, *Gudusia chapra* etc.) had increased to almost 90 percent of the total catch during present years (Alamgir and Ahmed, 2008).

The Ganges River Sprat, *Corica soborna* Hamilton, 1822, locally known as Keski/Kachki and The Indian River Shad, *Gudusia chapra* Hamilton, 1822 locally known Chapila (Figure 1) are the commercially important clupeid that contributes to subsistence and artisanal fisheries in inland waters in Bangladesh (Ahmed *et al*., 2007) (Figure 1).

A total 49 indigenous fish species and 5 exotic fishes in this lake were recorded by Aquatic Research Group (ARG) (1986). On the other hand 71 fish species including 5 exotic fishes and 2 species of prawn were found by Halder *et al.,* (1991). Again a total of 74 freshwater fish species and 2 prawn species were documented by Chakma (2007) in the Kaptai Lake.

For effective management of this lake, having importance as one of the main source of freshwater fish production of the country, the study was done to full fill the necessity to know the exact scenario of the lake with the following specific objectives:

1) To understand the trend of fish biodiversity changes in Kaptai Lake and

2) To identify the overall impact of SIS on the aquatic fauna of the lake.

MATERIALS AND METHODS

For the study, three locations named Natun Jele Para, Adar Pahar and Mitingachori were selected on the basis of differences of fishing activities (Figure 2). Data were collected by using PRA (Participatory Rural Appraisal) tools about species diversity, seasonal abundance, and production of fish and baseline information of the lake. The data were also collected through the interview with fishermen, associated persons and crosscheck interviews with the key informants.

Figure 1: Images of (a) Keski (*C. soborna*) and (b) Chapila (*G. chapra*) fish found in Kaptai Lake.

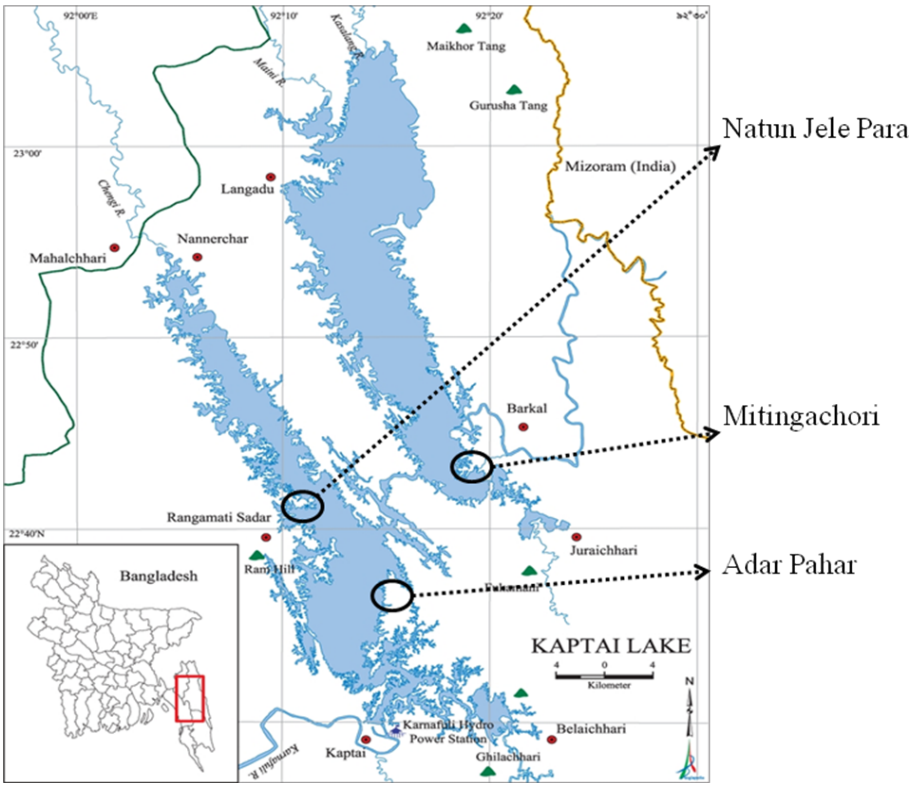

Figure 2: Map of Bangladesh and the study areas of Kaptai Lake (Source: https://maps.google.com)

After that the collected data were cross checked with the landing data from Bangladesh Fisheries Development Corporation (BFDC) fish landing centre, Rangamati. Collected data were accumulated and analysed by Microsoft Office Excel 2007 Worksheet and then presented in textual, tabular and graphical forms to understand. (Figure 2).

RESULTS AND DISCUSSION

Table 1: Abundance of fish species in Kaptai Lake in different periods based on primary data.

Sl. no.	Local name	Common/ English name	*Scientific name*	Availability of fish			
				Before *1965	After 1965	2000	2012-13
1	Rohu	Indian Major Carp (IMC)	*Labeo rohita*	++	+++	+++	++
2	Catla	Indian Major Carp (IMC)	*Gibelion catla*	++	+++	+++	++
3	Mrigal	Indian Major Carp (IMC)	*Cirrhinus cirrhosus*	++	+++	+++	++
4	Kalibaush	Orange fin labeo	*Labeo calbasu*	++	+++	+	-
5	Bata	Bata	*Labeo bata*	-	-	+	++
6	Gonia	Kuria labeo	*Labeo gonius*	++	+++	+	+
7	Silvercarp	Silver carp	*Hypophthalmichthys molitrix*	-	+	+	+
8	Grasscarp	Grasscarp	*Ctenopharyngodon idella*	-	+	+	+
9	Bighead carp	Bighead carp	*Hypophthalmichthys nobilis*	-	+	+	+
10	Carpio	Common carp	*Cyprinus carpio*	-	+	+	+
11	Punti	Puntio barb	*Puntius puntio*	+	++	+	+
12	Shor punti	Olive barb	*Puntius sarana*	++	+	+	+
13	Ayre	Long-whiskered catfish	*Sperata aor*	+	++	+	+
14	Pabda	Pabo catfish	*Ompok pabda*	+	++	+	+
15	Tengra	Assamese batasio	*Batasio tengana*	+	++	+	+
16	Shing	Stinging catfish	*Heteropneustes fossilis*	+	++	+	+
17	Magur	Walking catfish	*Clarias batrachus*	+	+	++	+
18	Pangas	Yellowtail catfish	*Pangasius pangasius*	+	+	-	--
19	Boal	Freshwater Shark	*Wallago attu*	+	++	++	+
20	Bacha	River catfish	*Eutropiichthys vacha*	+	+	+	+
21	Chapila	Indian river shad	*Gudusia chapra*	-	+	+	+++
22	Keski	Ganges river sprat	*Corica soborna*	+	++	++	+++
23	Chanda	Elongated glass perchlet	*Chanda nama*	+	+	+	+
24	Kakila	Freshwater garfish	*Xenentodon cancila*	+	+	+	+
25	Batasi	Indian potasi	*Netropius atherinoides*	+	+	+	+
26	Chela	Large razorbelly Minnow	*Salmostoma bacaila*	+	+	+	+
27	Faissa	Gangetic hairfin anchovy	*Setipinna phasa*	+	++	-	--
28	Shol	Snakehead murrel	*Channa striata*	+	+	++	+
29	Taki	Spotted snakehead	*Channa punctata*	+	+	+	+
30	Gozar	Great snakehead	*Channa marilius*	+	+	+	+
31	Mohashol	Tor barb	*Tor tor*	+	+	+	-
32	Koi	Climbing perch	*Anabas testudineus*	++	++	+	+
33	Kajuli	Gangetic ailia	*Ailia coila*	+	+	+	+
34	Baim	Zig-zag eel	*Mastacembellus armatus*	+	+	+	+
35	Foli	Bronze featherback	*Notopterus notopterus*	+	+	+	+
36	Chitol	Clown knifefish	*Chitala chitala*	+	++	+	+
37	Katamoilla	Indian carplet	*Amblypharyngodon microlepis*	-	-	+	++
38	Guramoilla	Mola carplet	*Amblypharyngodon mola*	-	-	+	+
39	Kucho chingri	Yellow shrimp	*Metapenaeus brevicornis*	+	+	+	+
40	Tilapia	Nile tilapia	*Oreocromis niloticus*	-	-	+	+
41	Banshpata	Sind danio	*Devario devario*	+	+	+	+
42	Poa	Pama croaker	*Otolithoides pama*	+	+	-	--
43	Bailla	Scribbled goby	*Awaous guamensis*	+	+	+	--
44	Ilish	Hilsa shad	*Tenualosa ilisha*	++	+	--	--

[+ least abundance, ++ moderate abundance, +++ high abundance, - very few/rare, and -- not found; * time of embankment; The scientific and English name of the fish (Froese and Pauly, 2014]

The availability of the fish species before and after the embankment was recorded in (Table 1) where data were collected by three focus group discussions (FGD) in three study sites and questionnaire method from the adjacent people, fishermen and *aratdars* (Fish wholesaler) (Table 1).

43 species under 19 families and 10 orders were found during the study period. Among them Cyprinidae family of order Cypriniformes were most abundant. 17 species under the family of Cyprinidae and 10 species under the order of Siluriformes were listed. Kostori *et al.,* (2011) found a total of 82 SIS belonging to 10 orders, 22 families and 46 genera in Chalan Beel. Again, Mohsin *et al.,* (2013) found a total of 69 species belonging to 10 orders, 25 families and 47 genera of fish species during July 2009 to June 2010 in Padma River. The most dominant fish order was Cypriniformes contributing 25 species in 15 genera. Cyprinidae was the most dominant family contributing 22 species in 13 genera. Seven alien species were also found in their study. Shukla and Singh (2013) found a total of 18 fish species belonging to 6 orders, 11 families and 17 genera in Aami River of Gorakhpur, India. Among them order Cypriniformes was the most abundant followed by Beloniformes, Symbranchiformes and Perciformes. On the other hand, Mastacembelida, Centropomidae, Amphipnoidae, Ophiocephalaidae, Clupeidae, Sisoridae, Clariidae, Bagridae and Saccobrachidae families were also abundant. Again, Nath *et al.,* (2010) recorded a total of 47 fish species belonged to 19 families and 31 genera from the Borulia Haor, Nikli, Kishoregonj. Among them 7 species of carps, 12 species of catfishes, 4 species of snakeheads, 3 species of eels, 8 species of minnows, 2 species of clupeids and 7 miscellaneous species were found..

In Kaptai Lake there were some rare species which were very incidentally or occasionally available, such as *Labeo gonia* (Gonia), *Otolithoides pama* (Poa), *Setipinna phasa* (Faissa), *Salmostoma bacaila* (Chela), *Tor tor* (Mohashol) etc. Based on the result of the catch composition of the 44 species recorded, the most abundant species were *Gudusia chapra* (Keski), *Corica soborna* (Chapila), *Sperata aor*, *Labeo bata*, *Labeo calbasu*, *Gibelion catla*, *Wallago attu*, *Amblypharyngodon mola* and *Notopterus notopterus* while *C. soborna* and *G. chapra* population yield were the highest in increasing rate during last five years.. Ahmed *et al.,* (2001) stated that, trends in the yield rate of the major fish category for three decades reveal a sharp decline in the catch of IMCs in Kaptai Lake. In contrast, small clupeid-like keski fish have the highest yield rate. Fishing gears can play a crucial role in this fishery agreeing with the present findings. It was not expected that all the species would be found available during the study. But the non-availability and less availability of some species indicate the alarming decline of biodiversity of fishes in the surveyed area and in the country as a whole. Fish habitat destruction by roads, embankments, aquaculture, drainage and flood control, and natural siltation along with over-fishing, have been commonly cited as causes of the deterioration of the country's resources (Ali, 1997). Again Ahmed (1997) observed that seasonal fluctuation in the fish species is a common phenomenon in Bangladesh. There are also some species which are found throughout the year. Abundance of fish also varies from season to season depending on demand and production. In this study it was found that the abundance of C. soborna (Keski) and G. Chapra (Chapila) fluctuated with the water level fluctuation of the lake. Hossain (1996) studied various aspects of SIS in Bangladesh and found that the demand of the fishes remain relatively constant throughout the year but observed a great variation in the production scale from October to December agreeing with these findings.

While studying the history of the abundance of fish found in the lake it was found that along with IMCs other fish like carp, catfish were gradually increased after the establishment of embankment. But in recent years the abundance of SIS are increased dramatically in comparison with other fish species (Figure 3).

According to the annual fish landing report of BFDC Fish Landing Centre, Rangamati, in the year of 2007-08 total production from Kaptai Lake was 6,327 MT and in the year of 2010-11 the production was 8,973 MT. However, in 2011-12 the production was 8,420 MT and in 2012-13 the production was 8,813 MT. It was found that the production of large fish species is decreasing gradually and on the other hand the small fish species like keski and chapila are increasing. There was sharp increment of these small fish population yield among the total amount of fish landed in BFDC fish landing centre during last few years, which is recorded in (Table 2).

The table shows that *C. soborna* and *G. chapra* production is dramatically increased in Kaptai Lake than other fish species. In 2007-08, the production of these two species were almost equal to the others fish species. However, in the next year the production of these fishes has slightly decreased and the following years have seen very dramatic increase of these two species. (BFDC, 2014) The total percentage of

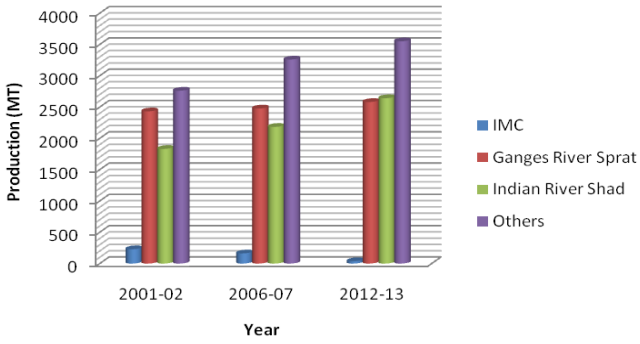

Figure 3: Fish production in Kaptai Lake in recent years.

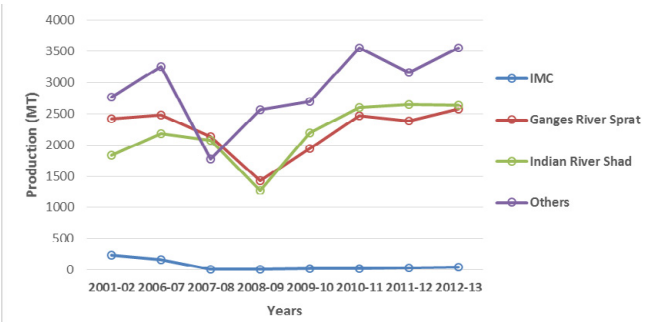

Figure 4: Production of IMC fish, Ganges River Sprat and Indian River Shad in Kaptai Lake during 2001-2013.

Table 2: The change in the production of Ganges River Sprat, Indian River Shad and other fish species over last few years.

SL.	Fish	2001-02 (MT)	2006-07 (MT)	2012-13 (MT)
1	IMC's	230	163	38
2	Ganges River Sprat	2423	2478	2582
3	Indian River Shad	1832	2184	2642
	SIS (Ganges River Sprat and Indian River Shad) in total	4255	4662	5224
4	Others	2762	3260	3551
5	Total Fish Production	7247	8085	8813

[IMC= Indian Major Carp *i.e. Labeo rohita, Gibelion catla, Cirrhinus cirrhosus*; Fish production of Kaptai Lake [31-33].

Keski and Chapila production in 2012-13 was 59% where the remaining fish production was only 41%. Figure 4 shows that how frequently these two fish population is increasing year after year. The yield of carp steadily declined from 19 kg/ha during the 1970s to only 5 kg/ha in the 1990s, and in 2001 they contributes only 5.1% of total landings. On the same time, the yield of clupeids is 32 kg/ha, among them three pelagic species, *C. soborna, G. chapra* and *G. onialosa manminna* accounted for 63.4% of the total catch in 2001 (Ahmed *et al.,* 2006) (Figure 4).

According to Rahman *et al.,* (2014) the physicochemical parameters of Kaptai Lake water still in suitable condition for survival of aquatic flora and fauna including fish production. But in comparison to SIS, larger fish like IMCs and other carp fish have low production because of overfishing due to increase of number of fishermen as well as indiscriminate using of Keski Net (a surrounding large net prepared with mosquito net operated from land vicinity to netting place mainly used for fishing keski and other small indigenous fish species) in the lake. Some fishermen have started using keski net for harvesting keski fish during the year of 2000. During the fishing operation with Keski net on an average 40 kg keski fish were captured per 100 kg fish. The other 60 kg fish was the mixture of carp and other fish, and their fry or fingerlings. Eventually the using of this type of net damage the other ichthyoplankton while harvesting of keski fish species The abundance of SIS showed inverse relationship with the abundance of IMC, other carp species, catfishes, snakehead and other fish. Before the introduction of keski net the abundance of IMC fish species were satisfactory, but now (2013-14) the abundance of these fish species is very low.

The Kaptai reservoir has undergone major changes in its catch composition since impoundment. Production records show a declining trend in the productivity of high-value fish. A host of managerial, socioeconomic and environmental factors are responsible for the underutilization of the reservoir's potential to provide high-value freshwater fish. These include deterioration of the natural breeding ground, environmental damage, poor implementation of regulations, inefficient fish farming technology and poor management practices. These constraints are discussed and possibilities for future improvements are suggested by Ahmed *et al.,* (2006).

In this lake both keski and chapila increased due to their high recruitment ability. In turn dramatic increase of that two fish populations have reduced the growth of IMCs. According to Hossain *et al.,* (1997) *G. chapra* reduces the net production at 47.49% in carp's polyculture. Mondal and Kaviraj (2010) stated that chapila exhibited an early maturity under environmental conditions of floodplain lakes. That's why chapila and keski population increased dramatically in Kaptai Lake.

At the start of commercial exploitation of fishes from Kaptai Lake, Indian major carps i.e. *L. rohita, G. catla, C. cirrhosus* were the dominant fish species contributing more than 60% of the total production (Galib, 2009). During 1965-66 the Indian major carps contributed 81% of total fish captured, after that this percentage has declined to about 5% of total fish capture during the last decade of the century. On the other hand the production of small forage fish has increased to 90% of total catch (Alamgir, 2004). However, the production of major carp species in Kaptai Lake has decreased in a very significant scale and in the year 2004-2005, Chapila and Keski contributed more than 50% of the Lake production (FRSS, 2006). Basically, the landing of major carps began to decrease drastically from 1985 (ARG, 1986). BFDC, Rangamati experts mentioned some reasons behind the dramatic increase of that two fish population in Kaptai Lake, like decreasing rate of larger fish, fluctuation of water depth, rainfall variation, over fishing of larger fish species etc., but the most important reason behind the increasing rate of keski and chapila population is the fishing ban seasons in Kaptai Lake every year (BFDC, 2012). High survival rate of keski and chapila population is another important reason. During the study period 43% of the fishermen reported that decreasing of larger fish may increase the production of that two fish population, while 28% mentioned the reason is the existing fishing ban period. The average fish yield (FY) from Sono Beel in North-Eastern India has been estimated to be 96.8 kg/ha. Species such as Puntius chola contributed to the bulk of the lake fish registering an annual relative yield of 24.60% (Kar *et al.,* 2006). On the other hand, in 2011-12 the average fish yield (FY) from Kaptai Lake has been estimated to be 105.63 kg/ha where keski and chapila species contributed an annual production of 28% and 32% respectively.

Though the price of these two fish species are lower than the larger fishes, due to their high abundance capturing of these small fishes are profitable. According to BFDC (2014) and the local fish retailer and customer the price of each kg of keski fish was 150-200 BDT (Bangladeshi Taka) and chapila fish is 100-120 BDT and average price of other fishes were 180 to 200 BDT during the peak season. But harvesting and selling of the huge amount of these two fish species local fishermen and fish retailers have a handsome income.

Due to high abundance of small fish species like Ganges River Sprat and Indian River Shad fishermen involve with fishing of these fishes getting good condition. On the other hand the condition of fishermen involve with larger fish catching getting worse day by day. SIS catchers have chances to fulfill their family nutritional requirements by consuming enough small fishes after selling enough fish to the local market (BFDC, 2012).

With decreasing of the larger fish abundance in Kaptai Lake the dependent fishermen loose the earning source. Studying last three years it was found that the average monthly income of IMC catcher fishermen decreasing year after year. On the other hand SIS catchers as well as the fishermen who catch both IMC and SIS have increased average monthly income during last three years. Thilsted (2012a) stated that in poor countries small fishes are common source of food and everyday it provides some extra nutrition to carbohydrate rich diets of many population groups who suffer from under-nutrition, including micronutrient deficiencies. He also stated that during the peak fish production season small fish made up to 50 to 80 percent of total fish intake in rural Bangladesh and Combodia. Again, Thilsted (2012b) mentioned that for the livelihoods, nutrition and income of rural poor in low-income countries with water resources small fish species are very important. In this study it was found that people of the adjacent area of Kaptai Lake are highly dependent on the resources of the water body. Their socio-economic condition fluctuates with the fluctuation of the fisheries production of the lake. About 62% people of the adjacent area believe that they can fulfill their nutritional requirement by consuming small fish species largely as they can eat more small fish than larger fish frequently. Due to high abundance of keski and chapila fish 59% people informed that their socio economic condition has turned into good from bad which is a very good outcome of this study.

CONCLUSION

Although *Corica soborna* and *Gudusia chapra* fish populations in Kaptai Lake are increasing day by day, larger fishes like IMCs (*Labeo rohita, Gibelion catla, Cirrhinus cirrhosus*, etc.) are decreasing gradually.. The overall economic return from the catch is reduced to 60% by calculating the standing crops and assumes that the IMCs volume has been replaced by SIS. Indiscriminate fishing as well as using of different fishing gears is believed to be the main contributor of declining IMCs in the Kaptai Lake. Siltation, poor water quality, water crisis during the winter season and regular huge migratory population pressure are also responsible for the declination of larger fishes. Use of Keski net for small fish netting should be restricted to certain period of the year i.e. post spawning season. Establishment of sanctuary at carp breeding ground, strict enforcement of the banning the period during breeding season of IMC's with an alternative livelihood options for the fishermen throughout the period could provide conservation success like Hilsa conservation program performed other parts of the country. Although, there has been found that larger amount of small indigenous fish catch can enhance poor fishermen and marginal population nutritional security and also having positive impact on the socio-economic improvement of the adjacent poor people of this water body. But for the sustainable management of Kaptai Lake, species composition should be such where ecological balance is maintained effectively. A further detail study is needed to understand the causes and effects of these biodiversity changes that took place in the last few years.

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