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Conservation status of fin fish and shell fish in Haria *beel* in Bangladesh and prospect for utilizing the *beel* for conservation and production of fish

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ABSTRACT

Present status of aquatic biodiversity and the prospect for raising fish fingerlings in the Haria beel in Bangladesh has been presented. A total number of 84 aquatic species (71 wild fish, five prawn, one crab, four snail and three fresh water turtle) were identified in the beel during 2007 - 2010. About ten types of fishing methods were identified to be used by the fishers' of the surveyed beel. Increasing pressure of illegal current jal (gill net), Kapuri jal (sein net) and FAD (Fish aggregating device) were detected as detrimental gear and killing method almost all type of species. Over a period of 3 years, total production of fish and allied species in the Haria beel was found to decrease from 178.60±5.50 to 115.98±4.12 t indicating 35.06% decline between 2007 and 2009. Due to increasing fishing pressure and global affect, commercially important 7 species were extinct, 15 species were critically endangered, 27 species were endangered, 27 species were vulnerable status, 4 species were in lower risk and 04 species were not threatened position from biodiversity view point. But in 2010, strict enforcement of fish Act-1950 in the beel resulted in reduces rate of use of gill net, sein net and FAD. Initiation of new technology for production of carp fingerlings in the Haria beel through community based co-management policy and enforcement of Fish Regulation Act-1950, helped to augment productivity of the recorded beel from115.98±4.12 to 184.32±3.49 t exhibiting 103.20% biomass enhancement. Two species bata (Labeo bata) and along (Rasbora elanga) were found to have reappeared in the beel and surrounding floodplains.

Note: Beel = Seasonally flooded large water bodies and are used as crop land during dry season.
Khal = A narrow channel connected between beel and river.

***Keywords**: Aquatic lives, *beel*, biodiversity, carp nursery, endangered, illegal fishing*

The study of biodiversity has become a major concern to the fishery biologists against the backdrop of rapid decline in the natural population of fish and other aquatic biota across the continents around the Globe. Biodiversity encompasses genetic, species, assemblage, ecosystem and lands-cape levels of biological organization with structural, compositional and functional components (Noss, 1990; Crains and Lackey, 1992). Though loss of aquatic species has been occurring rapidly, the aquatic organisms have received comparatively little attention from conservation biologists (Allendrof, 1988). A rich diversity of fish species is critical to the ecology and sustainable productivity of the floodplains. The aquatic lives in Bangladesh are under severe threat due to over-exploitation and environmental degradation, which includes human interventions through construction of flood control embankments, drainage structures and sluice gates, conversion of inundated land to cropland, thereby reducing water area and indiscriminate use of pesticides. Pollution from domestic, industrial and agrochemicals wastes and run off have resulted in extinction of a considerable amount of aquatic biota in same stretches of the open water system (Disaster, 1990).

In Bangladesh, the *beel* is important fishing ground. Once, this *beel* (wetland) had abundant of native wild fish species, prawn, snail, crabs and turtles. Due to over-exploitation and various ecological changes of the *beel* (wetland), some important fish species and turtles have disappeared. The feeding and breeding grounds of aquatic lives in and around the rivers and wetlands have been reducing drastically from various human and naturally created problems. Indiscriminate destructive fishing practices, soil erosion, siltation, construction of flood control and drainage structures and agro-chemicals have caused havoc to the aquatic biodiversity in Bangladesh (Hussain and Hossain, 1999). The *beel* receives surface runoff water by rivers and canals (khal), and consequently, a *beel* becomes very extensive water body in the monsoon and dries up mostly in the post-monsoon period (Chakraborty and Mirza, 2010).

During monsoon the *beel* get inundated and become part of seasonal flood plain resources with abundant aquatic vegetation. However, through gradual sedimentation, the basin becomes shallower leading to the formation of reeds and sedges. This resulted in providing enough food and shelter for fish and other aquatic fauna, and added fertilizer to the crop land of the *beel* which promoted rich growth of macrophytes, thus, partly contributing to the process of eutrophication.

The basin of the *beel* supports a large variety of wetland biodiversity and works as natural reservoir as it plays a key role in basin water resources by regulating water flows of the different river system. In the past century or so, when human population

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pressure of Bangladesh was less, most of the rim-lands of the *beel* remained as cultivable wasteland which was mainly used for extensive grazing in the dry season. As population increased, boro cultivation expanded on these marginal lands leading to a large area being drained. Thus, the existence of these wetland of the *beel* is now threatened (Chakraborty, 2010).

Owing to massive loss in aquatic biodiversity, a well planned and systematic study is required to assess the present status of biodiversity in the *beel* of Bangladesh with a view to take an appropriate action to preserve and manage the aquatic fauna. The present study focuses on the abundance, species combination, catch statistics and related aspects of Haria *beel*. Based on present physiographic conditions of the *beel*, cost-effective fish fingerlings production technique is developed through co-management community approach which leads to enhanced biological productivity of the recorded *beel*.

MATERIALS AND METHODS

Location and area of the *beel*

The Haria *Beel* comprised an average area of 540.5ha with an average depth 2.47±0.04 m. The *beel* is surrounded by Haria and Bhraduba villages under Bhaluka Upazilla in the district of Mymensingh provide latitude-longitude.

Experimental procedure

Detail survey on flora and fauna of the Haria *beel* was conducted during 2007-2010 with particular emphasis on soil and water quality, biological productivity and biotic communities and status of fishery exploitation. The research was operationalzed through collection of both primary and secondary data, comprehensive literature review and extracts of local knowledge and information. Collection of primary data was made by field observation and different experimentations which comprised of experimental fishing in the *beel*, survey of different fishing methods, survey of fish markets adjacent to *beel*, monitoring of hydrological, meteorological, physico-chemical and biological characteristics of *beel* and fishers' perception as well. Secondary data were collected from Department of Fisheries (DoF) and from the local fishers.

Formation of committee and awareness meeting

Local management committee was formed with the community people living in the surrounding area of Haria *Beel* consisting of 80 members from stakeholders through participatory discussion. The members of the management committee formulated required rules and regulations for sharing benefits from *beel* resources. Regular meeting was arranged fortnightly by the implementing team during the period of 2010 where all stakeholders' representative along with Upazilla Fisheries Officer, Department of Fisheries (DoF) were present and discussed the improvement of the management activities of the *beel* during investigating period.

Morphometry and hydrodynamics of experimental *beel*

The main sources of water input into the Haria *beel* ecosystem was *viz*., overspill from the river channel, surface flow and regeneration. Water flows were determined by both rainfall and flooded water from the Khiru River. In the dry season, almost 72% areas of the *beel* dried up except the canals, and khata and kua fishing area where water remains during January to mid-April. Except deeper portion of the *beel*, most of the marginal area where brought under rice cultivation by extracting water from the *beel*. The water lost by various means caused shrinkage of the effective water area and lowering of depth in the *beel* which affected the status of the aquatic biodiversity of the Haria *beel*.

Study of physico-chemical parameters

Physico-chemical parameters were determined following the standard method of APHA (1998). A bamboo made meter scale was used to measure water depth. Water temperature was measured using a Celsius thermometer and transparency was recorded by using a Secchi disc of 20 cm diameter. Dissolved oxygen and pH were calculated directly using a digital electronic oxygen meter (YSI Model 58) and an electronic pH meter (Jenway Model 3020). Alkalinity was recorded by titrimetric method (Clesceri *et al*., 1989).

Fishing method

Detail survey on fishing method of the Haria *beel* was conducted with particular emphasis on number of different gears and traps. Fishers' used boat for transport of nets and related materials and used seine net, bua jal (small lift net), cast net, gill net, dharma jal, various type of fish traps, fishing by dewatering FAD (Fish aggregating device), hook and line, komor jal (scien net used in kata fishing), lift net and thela jal (push net); and according to season and availability of different species of fish. During monsoon and post monsoon, fisher's used lift net, current jal, cast net, traps (*dugair, ghuni, pholo, vair* etc) hook and lines (*aikra, barsi, fulkuichi, jhupi*, etc.) to catch fishes. They also operated kata fishing by sein net (komor jal) in winter season.

Data collection

An organized sampling program was run for a long time to get a true picture of the catch and catch composition of Haria *beel*. The experimental *beel* were sampled during winter (mid November to mid February), pre monsoon (mid February to April), monsoon (May to August) and post monsoon (September to mid November) for assessment of aquatic lives' abundance and availability. The study gives a broad picture of a stock of fishes, prawn, crabs, snail and turtles that was recorded through different market survey and fish landing centers, collection of different species directly from fishers' catch, fishing through enclosure with *bana fence* (made by bamboo), khata fishing and interaction with fishers' in the *beel*. Resident fish species was recorded through fishing in the deep pool areas (man-made kuas) where water remains during dry season (December to mid April). The number of six codes (CR. E, EN, VU, LR and NO) of IUCN (2000) was followed to categorize the status of the *beel* and Shannon index was followed by Shannon (1948) to compare the trend among different years.

Shannon diversity index

$$H = \sum_{i=1}^{s} - (P_i * \ln P_i)$$

Where:

H = the Shannon diversity index

P_i = fraction of the entire population made up of species i

S = numbers of species encountered

Nursery development

Nursery preparation and stocking

In 2010, on the basis of status and physical condition of *beel*, nursery ground for native carp (*Catla*, *Rui and Mrigal*) were constructed in different location of the Haria *beel*. The experiment was planned with three treatments (locations) designated as, T_1, T_2 and T_3. The area and average depth of each earthen nursery ponds was 0.50 ha and 0.71 m, respectively. The nursery ponds were limed (250 kg ha^{-1}). Then the ponds were filled up with water up to 0.71 m depth. Cow dung (2500 kg ha^{-1}) was added in the water. Five days after manuring both Urea and Triple supper Phosphate (TSP) were applied to the ponds at the rate of 24.7 kg.ha^{-1} each to stimulate the primary productivity of the ponds. Dipterex (0.5 ppm) was applied to the ponds to control predatory zooplankton and harmful insects 24 hrs before stocking the spawn. The ponds were stocked at the rate of 2.5 kg ha^{-1} with 4 days old hatchlings of catla (*Catla catla*), rui (*Labeo rohita*) and mrigal (*Cirrhinus cirrhosus*)having an initial length of 1.01 cm and weight of 0.012 g, respectively.

Supplementary feeding

Supplementary feed consisting of a mixture of mustard oilcake, rice bran, wheat bran and fish meal in 30:25:25:20 proportions was supplied at the rate of 10-12% of their total biomass twice daily commencing from the first day of stocking. The rate of feeding was 20 kg per million hatchling per day for the first week, 24 kg for the 2-3 weeks, 28 kg for the 4-5 weeks, 32 kg for the 6-7 weeks and 36 kg for the 8-9 weeks. Proximate composition of the feeds was analyzed according to AOAC International (1995) method, nitrogen free extract (NFE) by subtraction (Castell and Tiews, 1980). Proximate composition (% dry matter) of the supplementary feeds (crude protein, crude lipid, crude fiber, ash and nitrogen-free extract) of experimental feeds was 32.84%, 7.80%, 11.18%, 17.81% and 30.37%, respectively.

Water quality parameters and plankton monitoring in nursery ponds

Physico-chemical parameters and quantitative and qualitative estimates of plankton in the nursery ponds were monitored every 10 days interval between 9.00 and 10.00 am. The plankton sample was collected fortnightly from the euphotic zone using 0.55 blotting silk plankton net and later analyzed numerically with the help of Sedgewick-Rafter counting cell (SR-cell) under a compound microscope according to Clesceri *et al.* (1989). Calculation of the abundance of plankton was done by Rahman (1992) and Stirling (1985).

Estimation of growth, survival, production and feed utilization

Fifty individuals from each pond were sampled at 10 days interval to adjust daily ration until they attained the fingerlings stage. Growth in terms of length and weight, average daily gain (ADG), specific growth rate (SGR) and food conversion rate (FCR) was estimated. SGR and FCR calculated according to Brown (1957); Castell (1980) Gangadhara *et al.* (1997), respectively. Survival rate of fish as well as fish production (kg.ha^{-1}) were also determined as per conventional method. After 60 days, the fingerlings counted and weighed. The fish fingerlings were allowed to move out from the nursery ground to the open water area *beel* on commencement of early monsoon flood.

Analysis of experimental data

The data were analyzed through one way ANOVA followed by Duncan's Multiple Range Test using MSTAT to find out whether any significant difference existed among treatment means (Duncan, 1955; Zar, 1984). Standard deviation in each parameter was calculated and expressed as mean ±S.D.

RESULTS AND DISCUSSION

Physical characteristics of Haria *beel*

Soil texture of Haria *beel* bed varied from clay to sandy sand. In the deeper bed, structure of soil texture of the bed appeared to have predominantly clay and in the wet land bed the soil was found to be sandy to loam sand (Table 1). Highest percentage (70.3 ± 3.08%) of clay was recorded in the deeper bed of Haria *beel* respectively. The soil structure of the deeper bed appeared to have predominantly clay and in the surrounding area of the wet land was loamy to clay.

Table 1: Physical features (sediment) of the surveyed Haria *beel*

Location	Soil texture of the bed of *beel* (%)		
	Clay	Loam sand	Sandy
Deeper bed	70.3 ± 3.08[a]	28.1 ± 2.11[b]	1.6 ± 0.15[c]
Wet land bed	19.1 ± 2.28[b]	78.6± 4.85[a]	2.3 ± 0.45[c]

Water depth of the Haria *beel* varied from 2.48 to2.46 m during the year 2007 to 2010, respectively. The physico-chemical parameters like temperature, transparency, pH, dissolve oxygen and alkalinity of water were found to be more and less in a normal range (Table 2). It is evident from table- 2 that the mean water temperatures of the aquatic environment of the *beel* were not statistically significant. Mean Secchi disk transparency differed significantly, during period under study. pH of the experimental *beel* did not differ significantly. A significant rise in pH during pre-monsoon; followed by a drop in winter was noted in the experimental *beel*. The mean dissolved oxygen (DO) of the experimental *beel* did not differ significantly. But total alkalinity of the experimental *beel* differed significantly.

Table 2: Recorded physico-chemical parameters of Haria *beel*

Parameters	Years			
	2007	2008	2009	2010
Temperature (^oC)	25.64 ± 7.11	25.81 ± 6.01	25.52 ± 7.34	25.77 ± 7.2
	(14.44 - 33.02)	(14.55 - 32.72)	(14.05 - 32.84)	(15.20 - 32.88)
Transparency (cm)	35.22 ± 6.62[b]	42.05 ± 7.14[d]	38.45 ± 6.2[c]	30.28 ± 7.2[a]
	(28.82 - 48.16)	(30.15 - 50.50)	(27.08 - 49.28)	(30.33 - 47.22)
pH	7.42 ± 2.04	7.64 ± 2.12	7.08 ± 2.44	7.22 ± 2.38
	(6.15 - 8.05)	(6.50 - 8.22)	(6.02 - 8.70)	(6.05 - 8.44)
Dissolve oxygen (mg l^{-1})	5.24 ± 1.41	5.07 ± 1.28	4.88 ± 1.22	5.11 ± 1.25
	(4.15- 8.02)	(4.14 - 7.88)	(4.08 - 7.66)	(4.24 - 7.84)
Alkalinity (mg l^{-1})	110.02 ± 10.04[d]	122.13 ± 9.02[b]	128.15 ± 9.14[a]	115.22 ± 9.07[c]
	(101.24-135.22)	(110.24 - 140.42)	(108.27 - 146.24)	(106.88 - 128.11)

Note: Figure with different superscripts in the same row differed significantly (P>0.05). Figures in the parentheses indicate the range.

Macrophytes

A total number of 15 species belonging 14 genera and 12 families of aquatic weeds were identified from the surveyed *beel* (Table 3). The Macrophytes consisted of 12 families in the concerned *beel viz*., lemnaceae, pontederiaceae, gramineae, marsiliaceae, najadaceae, compositaceae, commelinaceae, convolvulaceae, nymphaceae, menyanthaceae and myrtaesae. A total number of 15 species of marginal and submerged aquatic macrophytes were recorded from the *beel*. These macrophytes provide shelter to the periphyton and other aquatic insects, and act as a source of nutrition to the aquatic animals. *Najas najas* was dominant among the identified weeds. The eggs of prawn (*Machrobrachium malcolmsnii and Machrobrachium birmanicum*) and different fish species (*Cyprinus carpio, Colisa fasciata Nundas nandus* were identified into the *N. najas* and water hyacinth (*Eichhornia crassipes*) during summer to winter. Water hyacinth usually covered a layer on the surface of Khua in the deep area.

Table 3: The percentage of aquatic weeds of Haria *beel* decreasing between 2007 and 2010

SL.No.	Type	Name of the weed flora	Decreased percentage (%) of aquatic weeds		
			2006-07	2007-08	2008-09
1.	Floating	*Wolffia arrhiza, Eichhornia crassipes, Lemna minor*	10.33	13.68	16.18
2.	Emergent	*Hudroryza aristota, Marsilea quadrifolia*	10.04	13.11	16.11
3.	Submerged	*Najas najas*	10.05	12.22	15.55
4.	Spreading	*Enhydra flucktuans, Leersia hexandra, Commelina bengalensis, Ipomoea aquatica*	11.04	13.12	16.22
5.	Rooted plants with floating leaves	*Numphaea nouchali, Nelumbo nucifera, Victoria amazonica, Nymphoides cristata, Trapa natans*	9.12	11.23	13.22
6.	Rooted plants	*Barringotonia acutangula*	8.18	11.22	16.44

Uses of fishing craft and gears

About 11 types of fishing methods were identified in the Haria *beel*. In 2007, the percentage of catch statistics of *beel* showed the use of *ber jal, bua jal, cast net, current jal, dharma jal, fish trap, FAD, hook and line, komor jal, lift net* and *thela jal* were 14.60, 5.50, 6.60, 20.5, 2.40, 6.50, 8.80, 6.40, 14.10, 8.20 and 6.40 in 2007, respectively. The percentage (%) of using ber jal (kaperi jal), current jal and FAD were increased in 2008. In 2009, illegal using of ber jal, current jal, and FAD increased 18.10, 31.10 and 12.20%, and using of bua jal, cast net, dharma jal, fish trap, hook and line, lift net and thela jal were decreased 3.80, 4.20, 1.50, 4.40, 4.20, 4.20 and 2.80% respectively (Fig. 2). There was a significant difference in percentages of fish catches among different fishing gears in different years. A trend in fish catches was observed with bua jal, cast net, dharma jal, fish trap, hook and line, lift net and thela jal during the reporting period. Adoption of community based co-management approach in *beel* nursery of Haria *beel* in 2010 resulted to reduce using of ber jal (18.10–14.20)%, current jal (31.10-18.20)% and FAD (12.20–8.40)% which consequently lead to higher productivity of the *beel* (Fig. 1).

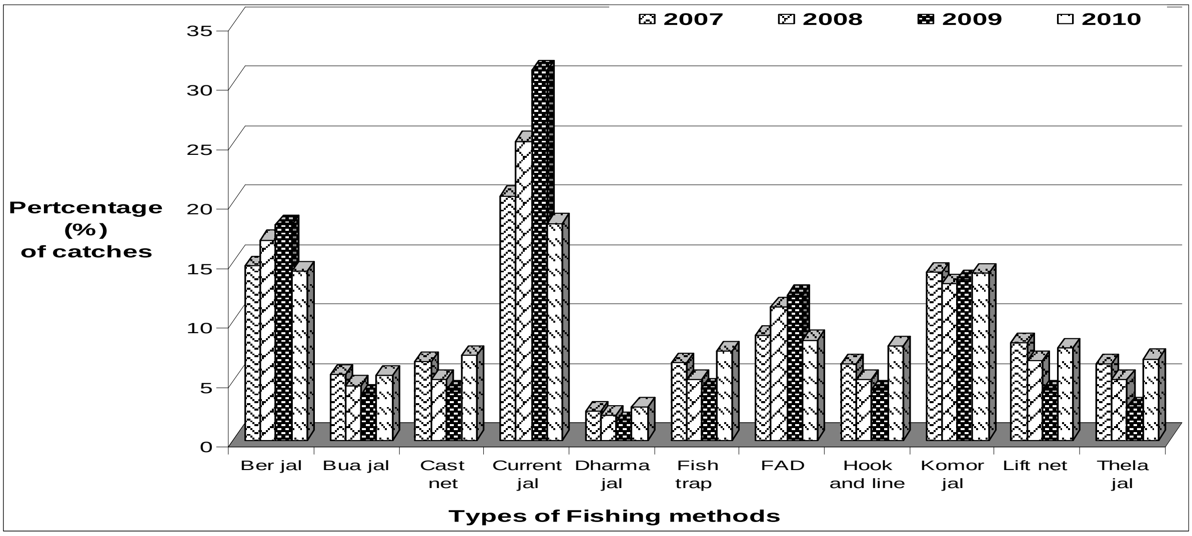

Fig. 1: Percent of catch composition by different types of fishing methods during 2007-10 in Haria *beel*

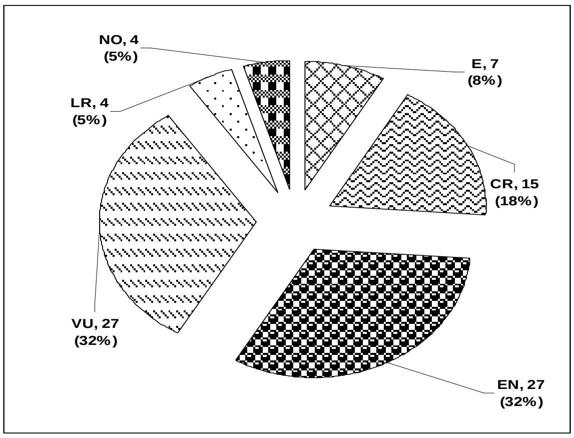

Fig. 2: Conservation status of different aquatic fauna in the Haria *beel* during 2006-09

IUCN codes: E- Extinct, CR- Critically Endangered, EN- Endangered, VU- Vulnerable, LR- Lower risk, NO- Not threatened

Catch and catch composition of the *beel*

The present study indicated the presence of 82 species of wild fishes, four species of prawn, one species of crab, four species of snail and bivalve, and three species of turtles belonging to 62 genera in Haria *beel*. Annual total catch was consisted of 10 groups (Fig. 1) of this *beel* was estimated to be 178.60±5.50; 140.21±4.65, 115.98±4.12 and 184.32±3.49 t in the year 2007, 2008, 2009 and 2010, respectively *viz*., major carp, minor carp, small fish, Knife fish, snake head, cat fish, small cat fish, spiny eels, prawn, crabs, snails and turtles. The total production of the *beel* decreased from 178.60±5.50 to 115.98±4.12 between 2007 and 2009 resulting in percentage decline from 21.50% to 35.06% between 2007 and 2009. But in 2010, the situation improved significantly after adoption of carp nursery practice in the *beel* and community based co-management approach in the *beel* area. Total production increased and recorded to be 184.32±3.49 t (Table 4). Small fish was the dominant group in the Haria *beel* between 2007 (45.55 t) and 2010 (46.21t) and small cat fish was recorded to be second highest production 38.14 t and 36.72 t in the same period. The catches of all the groups of fishes, crabs, snails and turtles were higher in 2007 but gradually declined between 2008 and 2009 (Fig. 2). The production scenario of *beel* totally changed when the *beel* was brought under carp nursery practices and community participation (Table 4).

Table 4: Decreasing and increasing production of different aquatic fauna of Haria *beel*

Groups of aquatic lives	Decreasing production (%)		Increasing production (%)
	2007-08	2008-09	2009-10
Major carp	19.74	40.85	193.77
Minor carp	24.33	42.09	65.54
Small fish	18.66	32.93	51.26
Knife fish	12.94	27.06	16.18
Snake head	14.93	19.80	22.26
Cat fish	23.71	41.01	51.95
Small cat fish	30.57	40.87	62.83
Spiny eel	22.08	18.83	58.57
Prawn	12.55	31.91	38.75
Crabs	17.81	27.09	26.68
Snails	11.76	20.29	25.46
Reptiles	27.08	87.5	16.66

The status of the 84 aquatic wild lives of the Haria *beel* ranked as different status. Important seven (8.0%) species such as Sarpunti (*Puntius sarana*), Cheng (*Channa gachua*), Gajar (*Channa marulius*), Napit (*Badis badis*), Bhagna (*Cirrhinus reba*) and Turtles (*Kachuga tecta* and *Morenia petersi*) were rarely found in the year 2007 but these species were extinct (E) between 2008 and 2010. Fifteen (15.0%) commercially important species was facing an extremely higher risk of extinction (Critically endangered, CR) day-by-day. Twenty seven (27.0%) major commercial importance aquatic wild species of the *beel* was facing an very high risk of extinction (Endangered, EN), twenty seven (27.0%) species was facing an high risk of extinction (Vulnerable status, VU), four (4.0%) species were identified as Lower Risk (LR) and only four (4.0%) species were not threatened (NO) position, respectively (Fig. 2 and Table 5).

A technology as a carp nursery of *beel*, Community based co-management approach and enforcement of Fish Regulation Act-1950 might have helped to upgrade the habitat of the *beel*. As a result, a remarkable increase in production was observed and bata labeo (*Labeo bata*) and Bengal barb (*Rasbora elanga*) was rehabilitated and the total production percentage (%) also increased in 2010 in the *beel*. During investigation periods, fresh water pearl bearing mussels (Bivalve, *Lamellidens marginalis*) were recorded in the experimental *beel*. Shells of bivalve were utilized by rural people for production of lime which was utilized in aquaculture and agriculture land, and consumed with betel leaves and nuts. Wildlife includes, amphibians (*Buffo melanostictus*, *Rana tigerina*, *Rana limnocharis*, *Rana cyanophyctis* and *Salamandra salamondra)* aves (whistling duck, great crested grebe, great cormorant, red crested pochard, water cock, swamphen, great black headed gull, gray-headed fish eagle, curlew, spotted redshank) and mammals (musk shrew, fishing cat, small Indian jackle, flying fox) were identified.

Formation of committee and awareness meeting

About 23 meetings were held with the community people living in the vicinity of Haria *Beel* through participatory discussion in 2010. The members of the management committee and Upazilla Fisheries Officer, Department of Fisheries, discussed about the activities and progress of the *beel* nursery and development of the Haria *beel* during investigating period. The highest number of attendances (79.50±1.06) was recorded in the last meeting. Every awareness meeting and the progress of the management works were remarkable (99.38%) in the study period (Table 6).

***Beel* nursery**

The physico-chemical parameters, which included temperature, transparency, pH, oxygen and alkalinity of water, were found to be in suitable range for warm water fish culture (Boyd, 1979). From the table-7, it is evident that physico-chemical parameters were more or less similar in all treatments. It was also evident from data in table-8 that the phytoplankton consisted of 27 genera in the *beel* under four broad groups' *viz*., *Chlorophyceae, Bacillariophyceae, Cyanophyceae* and *Euglenophyceae*. *Chlorophyceae* was the dominant group followed by *Bacillariophyceae* which differed significantly between 2007 and 2010 (Table 8 and 9). The zooplankton population consisted of 12 genera including nauplii in two groups. *Rotifera* was the dominant group followed by *Crustacea* which differed significantly during 2007 to 2010. The abundance of total phytoplankton and zooplankton differed significantly in the *beel* nursery ponds (Table 8).

Growth and production parameters of fingerlings are shown in table- 10 and fig. 3. The initial length and weight of spawns, stocked in all the nursery ponds of the *beel* were similar. The fish (spawn) in all treatments showed the more or less similar gain in both length and weight, where stocking density of spawn was 2.5 kg ha^{-1}. However, the mean final length and weight of fingerlings in different treatments were not significantly different. The highest weight gain was also more or less similar. Therefore, SGR, FCR and survival rate were more or less similar in all the *beel* nurseries. There was no significant variation in the value of SGR, FCR and survival rate in catla, (*Catla catla*), rui, (*Labeo rohita*) and mrigal (*Cirrhinus cirrhosus*) fry and fingerlings among different treatments.

Table 5: Conservation status and distribution of aquatic lives of Haria *beel*

Sl. No.	Local name	English name	Scientific name	Status			
				2006	2007	2008	2009
1.	Saralpunti	Olive barb	*Puntius sarana*	EN	CR	E	E
2.	Cheng	Snake head	*Channa gachua*	CR	E	E	E
3.	Gajar	Giant snake head	*Channa marulius*	EN	CR	E	E
4.	Napit koi	Dwarf chameleon fish	*Badis badis*	EN	CR	E	E
5.	Bhagna	Labeo	*Cirrhinus reba*	EN	CR	E	E
6.	Common roof turtle	Common roof turtle	*Kachuga tecta*	CR	CR	E	E
7.	Bengal eyed turtle	Bengal eyed turtle	*Morenia petersi*	CR	CR	E	E
8.	Along	Bengal barb	*Bengala elanga*	EN	EN	E	CR
9.	Bata	Bata labeo	*Labeo bata*	VU	CR	E	CR
10.	Dhela	Cotio	*Rohtee cotio*	EN	CR	CR	CR
11.	Batasi	Indian potasi	*Pseudeutropius atherinoides*	VU	EN	EN	CR
12.	Baghair	Gangetic goonch	*Bagarius yarrellii*	CR	CR	CR	CR
13.	Chola punti	Chola barb	*Puntius chola*	VU	EN	EN	CR
14.	Chuto chingri	Short leg prawn	*Machrobrachium mirabile*	VU	EN	EN	CR
15.	Anju	Zebra fish	*Brachydanio rerio*	VU	EN	EN	CR
16.	Gulsa	Gangetic mystus	*Mystus cavasius*	VU	EN	EN	CR
17.	Guizza	Giant river catfish	*Aorichthys seenghala*	VU	EN	EN	CR
18.	Gang tengra	Gangetic Gagta	*Gagata gagata*	VU	CR	CR	CR
19.	Modhu pabda	Pabdha cat fish	*Ompok pabda*	VU	CR	CR	CR
20.	Neftani	Indian paradise fish	*Ctenops nobiilis*	VU	EN	EN	CR
21.	Pabda	Pabo catfish	*Ompok pabo*	VU	EN	CR	CR
22.	Reptile	Spotted flapshell	*Lissemys punctata*	EN	EN	CR	CR
23.	Calbaus	Black rohu	*Labeo calbasu*	VU	VU	EN	EN
24.	Ghonia	Kuria labeo	*Labeo gonius*	VU	EN	EN	EN
25.	Kalo bata	Gangetic latia	*Crossocheilus latius*	VU	EN	EN	EN
26.	Kachki	Ganga river-sprat	*Corica soborna*	VU	VU	VU	EN
27.	Mola	Mola carplet	*Amblypharyngodon mola*	VU	VU	VU	EN
28.	Phutani punti	Dwarf barb	*Puntius phutunio*	LR	VU	VU	EN
29	Jat punti	Spotfin swamp barb	*Puntius Sophore*	VU	VU	EN	EN
30.	Fulchela	Razzer belly minnow	*Salmostoma phulo*	VU	VU	VU	EN
31.	Khalisha	Stripled gourami	*Colisa fasciata*	VU	VU	EN	EN
32.	Lal khailsha	Dwarf gourami	*Colisa lalia*	LR	VU	EN	EN
33.	Chuna khalisha	Sunset gourami	*Colisa sota*	VU	VU	EN	EN
34.	Kanpona	Esuarine ricefish	*Oryzias melastigma*	VU	VU	EN	EN
35.	Mini	Mottled nandas	*Nundas nandus*	EN	EN	EN	EN
36.	Rani/botya	Necktie loach	*Botia Dario*	VU	VU	EN	EN
37.	Kakila	Fresh water garfish	*Xenentodon cancila*	VU	VU	EN	EN
38.	Potka	Ocellated pufferfish	*Tetrodon cutcutia*	VU	VU	EN	EN
39.	Rani	Loach	*Botia dayi*	EN	EN	EN	EN
40.	Chitol	Humped featherback	*Notopterus chitala*	EN	EN	EN	EN
41.	Shol	Striped snake headed	*Channa striatus*	VU	VU	VU	EN
42.	Koi	Climbing perch	*Anabas testudineus*	VU	VU	EN	EN
43.	Ayre	Long whiskered catfish	*Aorichthys aor*	EN	EN	EN	EN
44.	Kani papda	Indian butter cat fish	*Ompok bimaculatus*	EN	EN	EN	EN
45.	Kajuli	Jamuna ailia	*Ailia coila*	VU	EN	EN	EN
46.	Magur	Magur	*Clarius batrachus*	VU	VU	EN	EN
47.	Kuicha	Gangeticmudeel	*Monopterus cuchia*	VU	EN	EN	EN
48.	Tara baim	One-stripe Spinyeel	*Macrognathus aral*	VU	VU	EN	EN
49.	Galda isa	Giant fresh water prawn	*Machrobrachium rosenbergii*	VU	EN	EN	EN

cont..

Table 5: Conservation status and distribution of aquatic lives of Haria *beel*

Sl. No.	Local name	English name	Scientific name	Status			
				2006	2007	2008	2009
50.	Catla	Catla	*Catla catla*	LR	LR	VU	VU
51.	Rui	Rohu	*Labeo rohita*	LR	LR	VU	VU
52.	Mrigal	Mrigal	*Cirrhinus cirrhosus*	LR	LR	VU	VU
53.	Taka punti	Rosy barb	*Puntius conchonius*	LR	LR	VU	VU
54.	Tit punti	Ticto barb	*Puntius ticto*	LR	LR	LR	VU
55.	Teri punti	One spot Barb	*Puntius terio*	LR	LR	VU	VU
56.	Darkina	Flying barb	*Esomus danricus*	LR	LR	VU	VU
57.	Chapila	Indian river shad	*Gadusia chapra*	LR	LR	VU	VU
58.	Nama chanda	Elongate Glasds-perchlet	*Chanda nama*	LR	LR	VU	VU
59.	Kata chanda	Himalayan glassy perchlet	*Pseudambasis bacuculis*	LR	LR	VU	VU
60.	Kachki	Ganga River-sprat	*Corica soborna*	LR	LR	VU	VU
61.	Ranga chanda	Indian glassy fish	*Pseudambasis ranga*	LR	LR	VU	VU
62.	Gachua	Asiatic snakehead	*Channa gachua*	VU	VU	VU	VU
63.	Taki	Spotted snake head	*Channa punctatus*	LR	LR	VU	VU
64.	Boal	Fresh water shark	*Wallago attu*	LR	VU	VU	VU
65.	Tengra	Striped dwarf catfish	*Mystus vitttus*	LR	VU	VU	VU
66.	Singi	Stinging catfish	*Heteropneustes fossilis*	LR	LR	VU	VU
67.	Gutum	Guntea loach	*Lepidocephalus gontea*	LR	LR	LR	VU
68.	Guchi baim	Striped spinyeel	*Macrognathus pancalus*	LR	VU	VU	VU
69.	Shotka chingri	Monsoon river prawn	*Machrobrachium malcolmsnii*	LR	LR	LR	VU
70	Kakra		*Stylla serrata*	LR	LR	LR	VU
71.	Foli	Grey featherback	*Notopterus notopterus*	LR	VU	VU	VU
72.	Gutum	Guntea loach	*Lepidocephalus gontea*	LR	LR	LR	VU
73.	Snail	Apple snail	*Pomacea insularum*	LR	LR	LR	VU
74.	Samuk		*Viviparus viviparus*	LR	LR	LR	VU
75.	Bivalve	Freshwater swan	*Lamellidens marginalis*	VU	VU	VU	VU
76.	Bivalve	Freshwater mussel	*Margaritifera auricularia*	LR	LR	LR	VU
77.	Gura chingri	Birma river prawn	*Machrobrachium birmanicum*	LR	LR	LR	LR
78.	Silver carp	Silver carp	*Hypophthalmicichthys molitrix*	NO	NO	LR	LR
79.	Bujuri	Tengra mystus	*Mystus tengra*	NO	LR	LR	LR
80.	Baila	Tank goby	*Glossogobus* giuris	NO	NO	LR	LR
81.	Common carp	Scale carp	*Cyprinus carpio*	NO	NO	NO	NO
82.	Gkatakia chingri	Dimua river prawn	*Machrobrachium villosimanus*	NO	NO	NO	NO
83.	Thai sarpunti	Silver barb	*Puntius gonionotus*	NO	NO	NO	NO
84	Shotka chingri	Monsoon river prawn	*Machrobrachium malcolmsnii*	NO	NO	NO	NO

Note: IUCN codes: E- Extinct, CR- Critically Endangered, EN- Endangered, VU- Vulnerable, LR- Lower risk, NO- Not threatened

Table 6: Information on activities and progress of committee of Haria *beel*

Sl. No.	Duration	No. of meeting	No. of stake-holder	Discussion	Progress (%)
1.	January- March	6	78.11±2.32	sharing knowledge and benefits from *beel* resources, site selection and preparation of nurseries, group formation, pond dyke improvement	97.64
2.	April-June	6	78.05±2.44	Release of spawns and fingerlings, feeding and monitoring of water quality parameters	97.56
3.	July-Sept.	6	77.32±2.05	Close monitoring of aquatic environment and illegal fishing, developing rules and regulations for *beel*	96.65
4.	Oct. - Dec.	5	79.50±1.06	Fishing and selling, sharing the benefits, sharing knowledge and preparation of *beel* nursery for next year	99.38

Table 7: Physico-chemical characters of carp nursery treatments during the experimental period

Parameters	Treatments		
	T$_1$	**T**$_2$	**T**$_3$
Temperature (^oC)	30.15 ± 0.42 (27.04 - 32.20)	30.06 ± 0.71 (27.50 - 32.15)	29.88 ± 0.65 (28.22 - 32.32)
Transparency (cm)	34.04 ± 2.11^c (30.32 - 37.90)	29.22 ± 0.62^b (26.70 - 29.80)	24.21 ± 0.84^a (20.20 - 27.40)
pH	7.90 ± 0.14 (7.40 - 8.44)	7.92 ± 0.15 (7.33 - 8.38)	7.90 ± 0.82 (7.45 - 8.60)
Dissolve oxygen (mg l^{-1})	4.32 ± 0.32 (3.88 - 4.77)	4.11 ± 0.34 (3.40 - 5.80)	4.44 ± 0.66 (3.73 - 4.66)
Alkalinity (mg l^{-1})	124.55 ± 1.95^c (120.33 - 130.66)	127.66 ± 1.88^b (122.42 - 128.80)	132.46 ± 2.48^a (127.10 - 138.77)

Table 8: Mean variation of phytoplankton (individual ml^{-1}) and zooplankton (organism ml^{-1}) population in the experimental *beel* nursery treatments

Plankton group	Treatments		
	T$_1$	**T**$_2$	**T**$_3$
Chlorophyceae	98.55 ± 5.18^c (92.33 - 106.34)	103.33 ± 6.08^a (94.20 - 110.32)	107.44 ± 8.22^b (98.33 - 114.44)
Bacillariophyceae	82.24 ± 1.34^c (77.33 - 87.67)	90.81 ± 0.54^b (86.00 - 94.62)	96.0 ± 1.12^a (94.66 - 99.14)
Cyanophyceae	52.00 ± 0.77^c (50.00 - 54.50)	56.22 ± 1.28^b (53.33 - 57.40)	61.27 ± 0.84^a (58.11 - 62.33)
Euglenophyceae	4.19 ± 0.31^a (3.88 - 4.34)	3.44 ± 0.38^b (2.77 - 3.89)	2.36 ± 0.30^c (2.00 - 2.77)
Total phytoplankton (×10^4 cells l^{-1})	236.98 ± 41.46^c	253.80 ± 44.69^b	267.03 ± 47.20^a
Rotifera	13.62 ± 1.22^c (9.33 - 15.67)	11.88 ± 1.44^b (9.67 - 13.66)	12.02 ± 0.80^a (11.07 - 15.38)
Crustaceae	6.51 ± 0.38^a (5.04 – 6.02)	5.50 ± 0.62^b (4.52 - 6.77)	5.01 ± 0.34^c (4.42 - 6.58)
Others	2.11 ± 0.11^b (2.01 - 2.55)	2.57 ± 0.08^a (2.02 - 3.08)	1.77 ± 0.02^c (1.22 - 2.70)
Total zooplankton (×10^3 cells l^{-1})	22.24 ±5.81^c	19.95 ± 4.76^b	18.80 ± 5.23^a

Note: Figure with different superscripts in the same row differed significantly (P>0.05). Figures in the parentheses indicate the range.

Table 9: List of phytoplankton and zooplankton recorded from the Haria *beel*

Plankton group	Name of plankton
Phytoplankton Chlorophyceae	*Chlorococcum* sp., *Clasterium* sp., *Eremesphaera* sp., *Gonotozygon* sp., *Kirchneriella* sp., *Mesotenium* sp., *Microspora willeana, Mougeotia viridis, Oocystis borgei, Ophiocytium* sp., *Pediastrum simplex, Penium* sp., *Protococcus* sp.,*Spyrogyra pseudocylindrica, Tetraedron tumidulum, Volvox aureu* and *Zygnema pectinatum.*
Bacillariophyceae	*Diatoma ancips, Fragilaria crotonensis, Melosira* sp., and *Navicula* sp.
Cyanophyceae	*Anabaena* sp., *Chroococcus giganteus, Merismopedia* sp., *Mycrocystis aeruginosa* and *Oscillatoria* sp.
Euglenophyceae	*Euglena viridis.*
Zooplankton Rotifera	*Brachionus calycifiorus, Filinia longiseta, Keratella cochlearis* and *Trichocera* sp.
Crustacea	*Bosmina sp, Cyclops americanus, Daphnia longispina, Diaptomus oregonensis, Lecane* sp., *Moina* sp., *Oicomonas* sp. and *Nauplius*.

Table 10: Growth performance, survival and production of carp fry and fingerlings after 60 days of rearing; mean ± SD with ranges in parentheses

Parameters	Treatments		
	T_1	T_2	T_3
Initial length (cm)	1.01 ± 0.02 (0.94 - 1.05)	1.01 ± 0.02 (0.94 - 1.05)	1.01 ± 0.02 (0.94 - 1.05)
Final length (cm)	10.64 ± 2.11^a (7.44 - 13.88)	10.58 ± 2.07^b (7.48 - 14.11)	10.60 ± 1.88^c (7.28 - 14.02)
Initial weight (g)	0.012 ± 0.001 (0.010 - 0.016)	0.012 ± 0.001 (0.010 - 0.016)	0.012 ± 0.001 (0.010 - 0.016)
Final weight (g)	49.99 ± 3.88^a (45.30 - 53.77)	50.0 ± 3.92^a (45.28 - 53.22)	49.20 ± 4.02^b (44.77 - 53.52)
Net weight gain (g)	49.98 ± 3.58^c (44.58 - 53.22)	49.99 ± 3.61^a (44.11 - 52.52)	48.19 ± 3.34^b (44.18 - 53.25)
Average daily gain(g)	0.83 ± 0.02^c (0.76 - 0.86)	0.83 ± 0.02^a (0.77 - 0.86)	0.80 ± 0.02^b (0.77 - 0.83)
Specific growth rate	13.89 ± 0.42^b (13.35 -14.05)	13.89 ± 0.62^a (12.94 - 14.76)	11.27 ± 0.66^c (12.52 - 13.8 4)
Survival rate (%)	70.55 ± 0.80^b (68.86 - 74.80)	72.70 ± 0.72^a (70.24 - 74.55)	70.08 ± 0.68^c (68.80 - 73.24)
FCR	1.42 ± 0.01^a (1.12 - 1.42)	1.43 ± 0.01^a (1.10 - 1.44)	1.73 ± 0.02^b (1.12 - 1.96)
Production ha^{-1}#	$432,554 \pm 21.22^c$	$432,584 \pm 52.45^a$	$428,249 \pm 44.18^b$

Note: Figure with different superscripts in the same row differed significantly (P>0.05). Figures in the parenthesis indicate the range. # Total number of fingerlings harvested after 60 days.

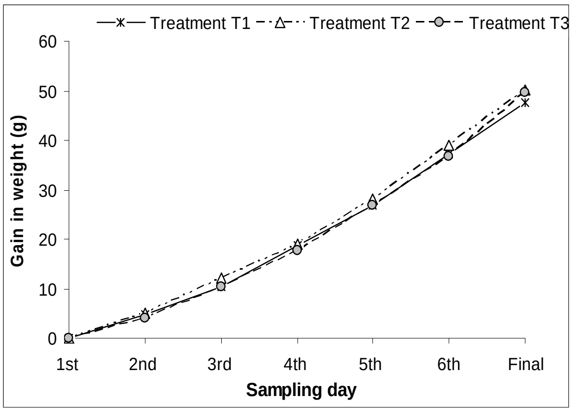

Fig. 3: Gain in weight (g) of carps fry and fingerlings in three treatments at every 10 days interval

The initial length and weight of fish spawn were almost identical. It is evident from the data that the fry attained an average size of 10.64 ± 2.11cm in length and 49.99 ± 3.88 g in weight in treatment T_1, 10.58 ± 2.07 cm in length and 50.0 ± 3.92 g in weight in treatment T_2, and 10.60 ± 1.88 cm in length and 49.20 ± 4.02 g in weight in treatment T_3, where same feed with mustard oil cake (30%), rice bran (25%), wheat bran (25%) and fish meal (20%) were maintained. It is clearly indicated that the growth in weight was exhibited by the fry and fingerlings when they were supplied same quality/amount of feed stuff, showing a direct correlation between feed stuff and growth of fish. The mean production (number.ha^{-1}) of fingerlings was 432554, 432584 and 428249 in treatment T_1, T_2 and T_3, respectively. The production was very much similar in all the treatments and production of fingerlings did not differ significantly among the treatments (Table 10).

The physico-chemical factors were found to be more or less in normal range in the Haria *beel* (APHA, 1998). Water temperature of the *beel* showed increasing trend in monsoon and post monsoon season and decreasing trend in winter which is supported by Mathew (1975). Transparency was consistently higher in deeper portion of the *beel*, possibly due to stagnancy of water. Rahman (1992) stated that the transparency of productive water bodies should be 40 cm or less. The uniformly average value of oxygen range (4.05-7.65 mg l^{-1}) as noted in the *beel* agrees well with the findings of APHA (1998), pH (6.45-8.86) values of the *beel* was more or less similar with the findings of Rahman and Rahman (2003). An alkalinity level of the *beel* was medium to high (Clesceri *et al.*, 1989). The temperature and transparency of the carp nursery was within the acceptable range for *beel* nursery ponds (Haque *et al.*, 1993). The dissolve oxygen was in acceptable range compared to ponds stocked with same density. Similar results were observed by Boyd (1982). Fluctuation of dissolve oxygen concentration might be attributed to photosynthetic activity and variation in the rate of oxygen consumption by fish and other aquatic organisms (Boyd, 1982). pH values agreed well with the findings of Kohinoor *et al.* (1994) and Chakraborty *et al.* (2003). Alkalinity levels indicate medium to higher level of productivity. Higher total alkalinity values might be due to higher amount of lime used during carp nursery preparation (Boyd, 1982; Jhingran, 1991).

The fishing effort with various types of fishing methods such as seine net (kaperi jal), gill net (current jal) and FAD increased between the year 2006 and 2008 but use of current jal increased dramatically during same period. As a result, an average number of fishes and other aquatic lives declined in the surveyed *beel* and its floodplain. Haroon *et al.* (2002) reported eighteen types of fishing gears recorded from the Sylhet sub-basin and thirteen types from Mymensingh sub-basin which are very similar to this study. Sugunan and Bhattacharya (2000) found a wide variety of fishing methods employed in the *beel*s of Assam, India which are very similar to the present study. Cast net (Jaki jal) was used whole year in the *beel*. It is a very popular fishing method and used all over the Bangladesh (Ahmad, 1962).

The catch statistics indicate a decreasing trend in production percentage of the *beel* which was very similar to the report of Moyle and Leidy (1992). According to them, worldwide 20% of all freshwater species are extinct, endangered or vulnerable. The total catch statistics of aquatic lives in the surveyed *beel* indicated that percentage of different group of aquatic lives sharply decreased within three years which are very similar to the study of Chakraborty (2009, 2010), Chakraborty and Mirza (2007). Shannon index (Shannon, 1948) was used to identify the present status of the Bogajan *beel*. But six indicators of IUCN (2000) were used for ranking of aquatic fauna of the *beel*. Commercially important seven (8.0%) species such as Sarpunti (*Puntius sarana*), Cheng (*Channa gachua*), Gajar (*Channa marulius*), Napit (*Badis badis*), Bhagna (*Cirrhinus reba*) and Turtles (*Kachuga tecta* and *Morenia petersi*) were rarely found in the year 2007 in Haia *beel*. However, these species were extinct between 2008 and 2010. Fifteen commercially important aquatic species were facing extremely higher risk of extinction (CR) day-by-day. About 27 important aquatic wild species of the *beel* was facing as extremely high risk of extinction (EN), 27 aquatic wild species were Vulnerable status, four species were identified as Lower Risk and only four species were Not threatened position, respectively. According to IUCN 1998, Bangladesh about 56 freshwater fish species are critically or somewhat endangered. Due to over-exploitation and various ecological changes in natural aquatic ecosystem health such as *beel* and its floodplain, commercially important aquatic lives were in the verge of extinction which is in agreement with the findings of Sarker (1993).

During winter season, turtles (*Morenia petersi, Kachuga tecta* and *Lissemys punctata*) were caught in the *beel* and its floodplain. Khan (1982) reported that *Kachuga tecta* are mainly distributed between the stretches of Ganges River and the Brahmaputra River. Bengal eyed turtle, *M. petersi* was found in the *beel* and its floodplain. Das (1991) mentioned that the occurrence of Bengal eyed turtle, *M. petersi* was in Assam of India. Turtles of the surveyed *beel* and its floodplain declined because of dewaterization of its habitat for irrigation and destruction of its breeding ground and nesting sites. Over exploitation for local consumption and foreign trade indiscriminately posses a threat to all species of turtles as well. The population of bivalve, *Lamellidens marginalis* found in the *beel* and floodplain, had also decreased which is consistent with the observation of Ali (1991).

The study clearly indicated that the aquatic lives of the *beel* were subjected to over fishing resulting in gradual decline in aquatic population. In addition, aquatic ecosystem health is changing due to global affect, construction of flood control barrage, soil erosion, siltation and drainage structures and agro-chemicals. Domestic organic wastes (sewage) directly or indirectly passing through canals or drains to the *beel* polluted the aquatic ecosystem health. The genetic stock structure of aquatic populations was reduced due to pollution and destructive fishing practices (Mazid and Hussain, 1995). Indiscriminate killing of fish occurred due to the use of pesticides in improper doses, use of forbidden chemicals, and aerial spray of chemicals as used in paddy field which is very much similar to the observation of Mazid (2002) and Chakraborty (2010).

Indiscriminate destructive fishing practices caused havoc to the aquatic biodiversity of the *beel*. As a result, the ecosystem health and biological diversity of the *beel* deteriorated at an unprecedented rate (Hussain and Hossain, 1999). Intervention to control floods, adoption of new agricultural technologies and construction of road networks was altered the ecology of *beel* significantly which supported the views of Khan (1993) and Ali (1991). Stock of the wildlife brood fishes in their breeding ground also suffered significant damages resulting in a reduction of biodiversity as noted by Nishat (1993) and Chakraborty (2010).

The phytoplankton consisted of 26 genera, which was more or less similar to the observation of Sugunan and Bhattacharjea (2000). The zooplankton population consisted of 12 genera which were closer to the findings of Ahmed *et al.* (1997) and Sugunan and Bhattacharjea (2000). In the nursery ponds, the phytoplankton abundances were consistently higher than that of zooplankton. Similar results were also recorded in various food fish, and fry and fingerling rearing ponds (Chakraborty *et al*., 2003).

A total number of 15 species of marginal and submerged vegetation was observed in the floodplain and *beel*, which are comparable with the finding of Sugunan and Bhattacharya (2000) in case of floodplain of Bramahputra basin. The swamp forests, mainly represented by hijal tree (*Barringtonia acutangula*) have been reduced to a few small patches in the surveyed area. In this experiment, crude protein levels (32.88% dry weight) in supplementary feeds was very near the dietary protein of 31% for the optimal growth of *Labeo rohita* (De Silva and Gunasekera, 1991). Growth in terms of length, weight, weight gain and SGR of fingerlings of carp fry and fingerlings was more or less similar in the different treatments where the stocking density feed quality was same. De Silva and Davy (1992) stated that digestibility plays an important role in lowering the FCR value by efficient utilization of food. Digestibility, in turn, depends on daily feeding rate, frequency of feeding, and type of food used (Chiu *et al*., 1987). However the FCR value in the present study indicates better food utilization efficiency, despite the values increased with applied stocking densities. Haque, *et al.* (1991); Thripathi *et al.* (1979); Rahman and Rahman (2003) and Chakraborty *et al.* (2006) found higher stocking density of fry and fingerlings of carps as well as competition for food and space reduces survival rate. But there was a same competition for food and space in the experimental nursery ponds due to maintaining same stocking density (2.5 kg ha^{-1}). Saha *et al.* (1988), Rahman and Rahman (2003) and Chakraborty *et al.* (2006) stated that low growth at higher stocking densities could be due to less availability of natural food and some variations in environmental parameters. In this experiment, same stocking density was maintained and same percentage of daily ration was regularly used in different treatments. Finally, it is concluded that the survival, growth, production of carp fingerlings were more or less similar due to the same stocking densities of hatchlings. Stocking density of 2.5 kg $hatchlings.ha^{-1}$ is a standard density of stocking for rearing of carp fingerlings for 60 days in single-stage nursing. Production of requisite quantity of higher quality fish fingerlings within the *beel* premises may be helpful towards the protection of catla, (*Catla catla*), rui (*Labeo rohita*) and mrigal (*Cirrhinus cirrhosus*) from extinction as well as ensuring its conservation and rehabilitation. The local *beel* management committee developed a frame work on sharing of benefits, developing rules and regulations for *beel* resource management. Fortnightly meeting were regularly by the *beel* management committee to monitor and progress of the *beel* nursery practice. Participation of local member of the community and their active involvement played an important role in overall management of *beel* nursery and *beel* resource (Chakraborty *et al*., 2010).

It is very important to apply community based co-management approach to harness aquatic resources and conserve biodiversity of the *beel*. In order to promote biodiversity the deep area of the *beel* must be declared as sanctuaries to protect the aquatic lives in all season, strict enforcement of fish Act-1950, forbidding unplanned digging and sedimentation; avoid unplanned construction of flood control, embankments, drainage system and sluice gates, conversion of inundated land to cropland (reducing water area); and controlling use of pesticides and agrochemicals in the *beel* and flood plain area. The above issue will lead to ensure the food security of the people of Bangladesh.

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