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ECOLOGY OF THE SHAPLA BEEL, BRAHMANBARIA, BANGLADESH

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Abstract: The Shapla beel, an open beel having an area of 128 ha, is located in the Brahmanbaria district of northeastern region of Bangladesh. The study was carried out to document the water quality, icthyo- and planktonic diversity of beel ecosystem. Dissolved oxygen (DO) content ranged between 5.0 and 9.7 mg/L, pH fluctuated in the alkaline range (7.1-8.6) and free CO_2 fluctuated between 1.6 and 18.9 mg/l. Total hardness and total alkalinity of the beel water fluctuated between 9.0 and 25.0 and 11.2 and 32.0 mg/l, respectively. A wide variation (11.8–42.2 x 10^3 cells/l) occured in the standing crop of total plankton; the contribution of phytoplankton to total plankton was high (93.37%). Phytoplankton diversity in the beel is represented by three groups in the order of dominance as follows: Chlorophyceae > Myxophyceae > Bacillariophyceae. A total of 51 fish species belonging to 36 genera, 20 families and one species of prawn occurred in the beel. A total of 13 fishing gear types was recorded from the beel. Fishing gears, like seine nets (*moshari berjal, ghono berjal*) and gill net (*current jal*) were identified as destructive to local fisheries. *Kua* fishing involved dewatering practice. A total of 11 species of aquatic weeds, belonging to 11 genera and 10 families, was identified from the beel. The eggs of *Macrobrachium lamarrei* were observed along with *Najas najas* vegetation during April-September.

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Key words: Ecology, Shapla bee, Brahmanbaria, Bangladesh.

INTRODUCTION

The inland freshwater fisheries resources of Bangladesh have been among the most productive fisheries in the world, with only China and India reporting more inland fish production than Bangladesh. The major fisheries of Bangladesh

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take place in rivers and estuaries, *beels* (natural depression) and *baors* (dead rivers), flood lands (seasonal floodplains) and a man-made lake (Kaptai lake). The floodplain dependent fishery has been notable for the diversity of its fish and prawn species and the primary source of protein for all Bangali people (Rahman 1989). Inland open water capture fishery as a whole is in decline over the decades due to multiple causes. This capture fishery is made up of three inter-related general areas (riverine, *beel/baor* and floodplains), the decline in one area is an indicator of problems in all areas (DoF 2002). To mitigate the prevailing situation there is a need for the search of new interventions, policies, and management options and future programs should be designed to prevent the further decline and possible collapse of the existing fishery.

Beel is a saucer-shaped depression, which may hold water permanently or dry up during the dry period. A total area of *beels* in Bangladesh has been estimated to be 114,161 ha, occupying 27.0% of the total inland freshwater area. The number of *beels* in the Northeast region has been reported to be between 3,440 (covering 58,500 ha with a mean size of 7 ha) and 6,149 (covering 63,500 ha with a mean size of 10 ha) (Bernacsek *et al.* 1992). About 58% of the *beels* in the Northeast region are permanent and the reminder is seasonal.

The WorldFish Center of Bangladesh has been implementing a project (CBFM-2) in 115 open water bodies of Bangladesh in collaboration with the Department of Fisheries (DoF) and a number of Non-Government Organizations (NGOs) to promote sustainable use of openwater fisheries resources by community management. Among 115 *beels*, the *beel* Shapla (N24°08.487′; E091°11.152′) located in northeast region (Brahmanbaria district) was selected to carry out the present study. The Shapla *beel* lies in Gokarna, union of Nasirnagar upazila of Brahmanbaria district, about 30 km Northeast of the district town. This *beel* is leased out to *Beel* Management Committee (BMC- a community based local forum headed by a Chairman) for consecutive five years. The *beel* is managed by BMC with the cooperation from WorldFish Center (WFC), DoF and PROSHIKA.

OBJECTIVES

The specific objectives of the study were -

- to document some ecological selling of the beel
- to help devise sustainable management options for partially dried *beel* ecosystem

MATERIAL AND METHODS

The study was carried out in three selected sites of the beel from July 2003 to June 2004. The research was based on both primary and secondary data, comprehensive literature review and extracts of local knowledge and information. Data collection was limited with a visiting schedule, *viz.* July, September, November, January and June. Mean value of each parameter was calculated from three studied sites. Collection of primary data was made by field observation and different experimentations, *viz.* experimental fishing in Titas river and within the *beel* ecosystem, survey of fish markets adjacent to *beel*, survey of *katha* and *kua* fishing, monitoring of water quality, recording of water level and fishers' perception as well. Secondary data were collected from fishers, lease holders, *Beel* Management Committee (BMC), local administration, Water Development Board (WDB), Department of Fisheries (DoF), Bangladesh Fisheries Research Institute (BFRI), Meteorological Department and related NGOs.

Hydrological, meteorological, physico-chemical and biological characteristics of *beel* ecosystem have been monitored to some limited extent. A bamboo made meter scale was used to measure water depth and secchidisc was used to measure water transparency. Temperature of air and water was measured with a centigrade thermometer. Free CO_2 content was determined by phenolphthalein indicator method (Welch 1948). Total alkalinity was estimated by using phenolphthalein and methyl orange indicator method (Welch 1948). Total hardness was determined by EDTA titrimetric method (APHA 1995). HACH test kit (Model-FF-2, USA) was used to measure water pH, dissolved oxygen (DO), ammonia and nitrite only.

For planktonic study duplicate samples, each of 50 L water, were collected from the euphotic zone of the *beel* and passed through bolting silk plankton net of 55µ. The filtrates were immediately preserved in Lugol's solution. Qualitative and quantitative analyses of both phyto-and zooplankton were done following drop count method (APHA 1995). Microscopic identification was performed up to genera. Each sample was stirred smoothly just before microscopic analysis. One ml of agitated sample was poured in a Sedgwick-Rafter (S-R) counting cell. A binocular microscope was used to identify and enumerate each sample. Qualitative studies were done according to Presscott (1962) and Needham and Needham (1962).

Identification of resident as well as migratory fishes was done through the collection of different species directly from fishers' catch, experimental fishing, fishing through enclosure with *bana* (locally called *pati*), *katha* fishing, *kua* fishing and surveying local fish markets. Monitoring of different types of fishing gear with catch per unit effort (CPUE) survey was done through *in situ* observation. Local knowledge as well as fishers' perception has been considered for conceptual knowledge regarding the identification of resident fishes. Different types of aquatic weed (floating, spreading, emergent, rooted plants with floating leaves) were collected from the *beels* and subsequently identified later on following standard reference books.

RESULTS AND DISCUSSION

Morphometry and hydrodynamics: The river Titas passes through the eastern side of the Shapla *beel*. Mainly this river is used to inundate as well as drain the *beel* Shapla. It is connected with Titas river by a number of canals, locally called *khals*. In dry season, almost all the areas of beel become dried up except the aforesaid canals, where water remains from mid-January to mid-April. Flooding originates from the Meghna river, located to the west of the beel. The average area of Shapla beel is about 128.0 ha. The bottom of the beel is uneven. Surface run-off and increase in river height due to inflow of rain water from the upper stretch, cause inundation of floodplains, often causing resumption of connection between *beels* and parent rivers. The more water gain or exchange of water in *beel* takes place during southwest monsoon when the floodplains are flooded. After recession of flood, water level in the river decreases snapping the beel's connection with the river. The beel gets dried up through evapo-transpiration and seepage. Except deeper portion of beel, the people use most of the area for cultivation by extracting water from the beel. The water loss by various means causes shrinkage of the effective water area and lowering of depth in the beel ecosystem. The nature of beel bed was observed almost hard.

Water quality: The water quality profile of the beel Shapla is given in Table 1. The color of beel water found to be changed periodically. The water level fluctuated between 0.6 and 4.5 m. The highest depth was recorded in July and the lowest in January. The mean water level obtained 3.30±1.09 m. The Secchidisc visibility fluctuated much and ranged from 0.15 m to 0.80 m. The transparency of water was the lowest in January and the highest in September. The mean value of water transparency was 0.65 ± 0.20 m. Air temperature fluctuated remarkably during the study period and ranged from 24 to 33°C. The air temperature was found always higher than surface water temperature. The mean air temperature was 31.50 ± 1.12°C. Surface water temperature ranged between 22 and 30°C. The mean water temperature was recorded 29.38 ± 1.39°C. Water temperature showed an increasing trend in monsoon and post-monsoon season and decreasing in winter which is reported by Mathew (1975). Water temperature is influenced by the air temperature, and it found highly synergistic with the air temperature. Rahman (1992) stated that the transparency of productive water bodies should be 40 cm or less, and water temperature ranging from 26.0 to 31.0°C was found suitable for aquatic life. The range of water temperature of the studied *beel* indicating almost suitable for fish habitat and breeding as well.

Table 1. Meteorological and physico-chemical parameters of *beel* Shapla during July 2003-June 2004.

Parameters	Values					
	Jul	Sep	Nov	Jan	Jun	Mean±SD
Color of water	Clear	Clear	Turbid	Turbid	Brownish green	-
Average depth of beel (m)	4.50	3.85	2.83	0.60	4.0	3.30±1.09
Nature of beel bed	Hard	Hard	Hard	Hard-soft	Hard	-
SD transparency (m)	0.77	0.80	0.71	0.15	0.30	0.65±0.20
Air temperature (°C)	33.0	32.0	31.0	24.0	30.0	31.50±1.12
Water temperature (°C)	30.0	30.0	30.5	22.0	27.0	29.38±1.39
Dissolved oxygen (mg/l)	5.4	8.9	9.7	5.0	5.3	7.33±2.00
Free CO_2 (mg/l)	1.6	2.9	8.7	9.6	18.9	8.02±6.83
pH	8.0	7.5	8.5	7.1	8.6	8.15±0.44
Total hardness (mg/l)	21.6	20.0	24.0	25.0	9.0	18.65±5.75
Total alkalinity (mg/l)	27.0	27.0	31.5	32.0	11.2	24.05±7.60
Ammonia (mg/l)	0.0	0.0	0.2	0.01	0.08	0.07±0.08
Nitrite (mg/l)	0.0	0.0	0.0	0.0	0.4	0.10±0.17

Dissolved oxygen concentration (DO) varied between 5.0 and 9.7 mg/l, and higher concentration was found in post-monsoon period. The average oxygen concentration was recorded 7.33±2.00 mg/l. Banerjea (1967) reported that the water bodies having a range from 5 to 7 mg/l DO is productive, while values having below this range are unproductive ones.

The values of free CO_2 were observed high at the advent of *beel* inundation; it showed wide fluctuation (1.6-18.9 mg/l) during the study period. The average value was recorded 8.02 ± 6.83 mg/l. The high values (5-65 mg/l) of free CO_2 were also reported from the Surma-Kushiyara project area (FAP-16, 1992). Free CO_2 content more than 20 mg/l in water may be harmful to fish and even lower concentration may be equally harmful when dissolved oxygen contents are less than 3 mg/l (Lagler 1972). Ruttner (1953) reported that very low values even 0 mg/l of free CO_2, the photosynthetic activities of phytoplankton occurs normally.

The values of pH were found in the alkaline range from 7.1 to 8.6. Ruttner (1953) quoted that a eutrophic lake normally maintains alkaline pH. The highest and lowest values were found in June and January, respectively. The mean value of pH was 8.14 ± 0.44. It exhibited a narrow range of fluctuation throughout the investigation period. According to Swingle (1967) pH value of 6.5 to 9.0 is suitable for fish culture and more than 9.0 is unsuitable because free CO_2 is not available in this situation.

Total hardness varied between 9.0 and 25.0 mg/l. The highest and the lowest values were observed in January and June, respectively. The mean value was 18.65 ± 5.75 mg/l. Total alkalinity varied between 11.2 and 32.0 mg/l. The highest and lowest values were recorded in January and June, respectively. The mean value was recorded 24.05 ± 7.60 mg/l. The lower concentration of hardness and alkalinity indicated the beel water to be less nutrient enriched. Almost similar values of total hardness and total alkalinity were reported by FAP-16 (1992) from the northeastern areas of Bangladesh. Banerjee (1967) reported that 60 to 70% of average highly productive ponds have total alkalinity ranging from 20 to 200 mg/l. Lake water registering hardness as calcium carbonate below 24 mg/l is generally regarded as soft (Clegg 1974). From the above discussion it may be concluded that the *beel* waters were found as soft-medium hard type and moderately productive.

Ammonia varied between 0.01 and 0.08 mg/l, it was recorded zero in the months of July and September. The mean value was 0.07±0.08 mg/l. Nitrite concentration ranged from traces to 0.4 mg/l. Low values of nitrite contents take place due to rapid absorption of such nutrients by the infestation of macrophyte communities in the *beel* ecosystem.

Planktonic organisms: Abundance of total plankton in Shapla *beel* is presented in Table 2. It is evident from the table that a wide variation (11.8-42.2 × 10^3 cells/l) existed in the standing crop of total plankton in different months. The highest concentration of total plankton count was recorded in July and the lowest count was obtained in November with a mean of 25.7 × 10^3 cells/l. The contribution of phytoplankton ranged between 87.33 and 97.65% with a mean of

Table 2. Monthwise plankton abundance of the *beel* Shapla during July 2003-June 2004.

Month	Phytoplankton (x10^3 cells/l)	Zooplankton (x10^3 cells/l)	Total Plankton (x10^3 cells/l)	Phytoplankton (%)	Zooplankton (%)
July	41.5	1.0	42.2	97.65	2.35
September	23.0	1.4	24.4	94.26	5.74
November	10.3	1.5	11.8	87.33	12.67
January	17.0	1.1	24.4	94.26	5.74
Mean	22.95	1.25	25.7	93.37	6.63

93.37%, while the contribution of zooplankton ranged from 2.35 to 12.67% with a mean of 6.63% to the total planktonic organisms. Low production of zooplankton in a lotic ecosystem is not uncommon. Ehshan *et al.* (1996)

recorded high phytoplankton as 30-66×10^3 cells/l and low zooplankton count as 0.5-0.7×10^3 cells/l from Chanda *beel*.

During the present investigation 23 genera of phytoplankton belonging to 15 families and 10 genera of zooplankton belonging to seven families were recorded from Shapla *beel* (Table 3). The phytoplankton population was composed of algal flora belonging to the groups Chlorophyceae, Myxophyceae and Bacillariophyceae. Among the planktonic algae Chlorophyceae contributed the bulk and the predominant genera were *Protococcus*, *Mougeotia*, *Microspora*, *Mesotenium*, *Closterium*, *Eremesphaera, Chlorococcum*, *Ophiocytium, Penium, Spirogyra*, *Zygnema, Trochiscia* and *Kirchneriella***.** Myxophyceae included various species belonging to genera *Mycrocystis, Anabaena, Merismopedia*, *Polycystis*, *Anacystis* and *Nostoc*. Bascillariophyceae was represented by various species belonging to genera *Melosira, Navicula*, *Diatoma* and *Synedra.* Several authors (Ehshan *et al.* 1997, Hossain *et al.* 1998, Ehshan *et al*. (1996) reported the dominance of Myxophyceae and Chlorophyceae groups from different *beel* ecosystems of Bangladesh. Phytoplankton diversity in the *beels* of upper Assam zone represented by four groups in the following order: Chlorophyceae > Bacillariophyceae > Myxophyceae > Dinophyceae (Sugunan and Bhattacharjya 2000).

Table 3. Composition of plankton in the *beel* Shapla during July 2003-June 2004.

Plankton	Group	Genera
Phytoplankton	Chlorophyceae	*Protococcus, Mougeotia, Microspora, Mesotenium, Closterium, Eremesphaera, Chlorococcum, Ophiocytium, Penium. Spirogyra, Zygnema, Trochiscia, Kirchneriella*
	Myxophyceae	*Mycrocystis, Anabaena, Merismopedia, Polycystis, Anacystis, Nostoc*
	Bacillariophyceae	*Melosira, Navicula, Diatoma, Synedra*
Zooplankton	Rotifers	*Polyarthra, Keratella, Filinia,Trichocerca*
	Cladocera	*Daphnia, Bosmina*
	Copepoda	*Cyclops, Nauplius, Diaptomus*
	Ostracoda	*Oicomonas*

Among zooplankton the represented genera were *Polyarthra, Keratella, Filinia, Trichocerca, Daphnia, Bosmina, Cyclops, Nauplius, Diaptomus* and *Oicomonas* belonged to four groups, Rotifera, Cladocera, Copepoda and Ostracoda. Rotifera was the most dominant group followed by Copepoda, Cladocera and Ostracoda. Almost similar observations were made by Ehshan *et al.* (1996) and Patra and Azadi (1987). Similar observation was also made by Sugunan and Bhattacharjya (2000) from some beels in Assam.

Ichthyo-diversity and fishing methods: Fish genetic resources in northeastern regions are unique being a mixture of migratory, resident and exotic fish species.

A total of 51 fish species belonging to 35 genera, 20 families and one species of prawn was collected and identified from Shaka beel. Out of them 38 resident

Table 4. Fish species recorded from the Shapla beel during July 2003-June 2004.

Groups	Family	Scientific names	Fishing methods involved
Carps	Cyprinidae	*Labeo rohita*, *Cirrhinus mrigala*, *C. reba*, *L. boga*, *L. calbasu*, *L. gonius*	Enclosure with *pati*[1], FAD, Gill net, Seine net
Minnows	Cyprinidae	*Rohtee cotio*, *Esomus danricus*, *Salmostoma phulo*, *S. bacaila*, *S. cachius*, *Amblypharyngodon mola*	Drag net, Seine net, cast net, FAD
Barbs	Cyprinidae	*Puntius sarana*, *P. ticto*, *P. sophore*	Gill net, Push net, Cast net, FAD
Chinese carp	Cyprinidae	*Cyprinus carpio*	FAD, Seine net
Air-breathing catfish	Clariidae	*Clarias batrachus*	FAD*
Fresh water shark	Siluridae	*Wallago attu*	FAD, Seine net, Long line
Butter catfish	Siluridae	*Ompok pabda*	Seine net
Stinging catfish	Heteropneustidae	*Heteropneustes fossilis*	FAD
Catfish	Schilbeidae	*Ailia coila*, *Aorichthys aor*, *M. vittatus*, *M. tengra*	Seine net, Push net, FAD
Feather back	Notopteridae	*Notopterus notopterus*	Seine net
Sardines	Clupeidae	*Gudusia chapra*, *Corica soborna*	Gill net, SM** seine net
Freshwater spiny eels	Mastacembelidae	*Macrognathus aculeatus*, *Mastacembelus armatus*	Gill net, Seine net, Drag net, Cast net, FAD
Spiny eel	Mastacembelidae	*M. pancalus*	Gill net, Seine net, Drag net, Cast net, FAD
Climbing perch/Gouramies	Anabantidae	*Colisa sota*, *C. fasciatus*, *C. lalius*, *Anabas testudineus*	Gill net, Push net, FAD
Gobies/Mud skipper	Gobiidae	*Glossogobius giuris*	Push net, Seine net, Gill net, FAD
Mud perch	Nandidae	*Nandus nandus*	Gill net, Push net, FAD
Perch	Pristolepidae	*Badis badis*	Seine net, Push net
Glass perch	Centropomidae	*Chanda nama*, *C. ranga*	Push net, SM Seine net, FAD
Loaches	Cobitidae	*Botia dario*, *Lepidocephalus guntea*	Seine net
Snake-heads	Channidae	*Channa striatus*, *C. marulius*, *C. orientalis*, *C. punctatus*	Cast net, FAD, Hand line
Needlefish	Belonidae	*Xenentodon cancila*	Seine net, FAD
Half-beak	Hemirhamphidae	*Hyporhamphus gimardi*	Seine net
Puffer fish	Tetradontidae	*Tetraodon cutcutia*, *Chelonodon fluviatilis*	Seine net, FAD
Mud eel	Synbranchidae	*Monopterus cuchia*	Gill net, Seine net, Drag net, Cast net
Small prawn	Palaemonidae	*Macrobrachium lamarrei*	Push net, SM Seine net, FAD

[1] Fence made by bamboo splits and rope. *Fish aggregating device (FAD)-Fishing using Brush Park and from Kua (dewatering). **SM- Small meshed

fish species belonging to 27 genera, 17 families and one species of prawn were identified. Of the 51 fish species recorded, 16 species belong to the family Cyprinidae, followed by Siluridae, Anabantidae and Channidae, each having four species. Haroon *et al.* (2002) identified a total of 92 species of fish and prawn from Sylhet-Mymensingh basin. They found the dominance of barbs, catfishes and major carps in the Sylhet sub-basin and catfishes, major carps and prawns in the Mymensingh sub-basin.

In Shapla *beel*, 13 types of fishing methods were generally found in operation. Those included enclosure for fish trapping, fish aggregating device (FAD), like *katha* (brush park) and *kua* fishing, and other traditional fishing gears, *viz.* seine nets (purse seine net, *moshari berjal*, *ghono berjal*), gill nets (*chapila jal*, current *jal*, *koi jal*), cast net (*jhaki jal*), push net (*felun jal*), drag net (*moi jal*) and long line (*chara borshi*) were also observed. Fishing gears of different meshes (2.5-40 mm) were found to operate in the *beel* ecosystem. Catch per unit effort (CPUE) of different gears varied between 1.5 and 14.0 kg/day. Sugunan and Bhattacharjya (2000) found a wide variety of fishing methods (passive gear, active gear, FAD, falling gear, dewatering) employed in the beels of Assam, which are very similar to the present findings. Haroon *et al.* (2002) reported 18 types of fishing gears from the Sylhet sub-basin and 13 types from Mymensingh sub-basin. They also recorded many kinds and sizes of bamboo made fishing traps.

Table 5. Aquatic weeds recorded from the *beel* Shapla during July 2003- June 2004.

Family	Local name	Scientific name	Type
Pontederiaceae	Kachuripana	*Eichhornia crassipes*	Floating
Lemnaceae	Edurkanipana	*Wolffia arrhiza*	Floating
Gramineae	Arail	*Leersia hexandra*	Spreading
Gramineae	Dal	*Hydroryza aristota*	Emergent
Nymphaceae	Shapla	*Nymphaea nouchali*	Rooted plants with floating leaves
Najadaceae	Najas	*Najas najas*	Submerged
Compositaceae	Helencha	*Enhydra flucktuans*	Spreading
Marsiliaceae	Shusnishak	*Marsilea quadrifolia*	Emergent
Convolvulaceae	Kalmilata	*Ipomoea aquatica*	Spreading
Commelinaceae	Kanaibashi	*Commelina bengalensis*	Spreading
Nymphaceae	Padma	*Nelumbo nucifera*	Rooted plants with floating leaves

Macrophytes: A total of 11 species belonging to 11 genera and 10 families of aquatic weeds was identified from the Shapla beel (Table 5). Five types of macrophytes, *viz.* floating, emergent, spreading, submerged and rooted plants with floating leaves were identified. The eggs of *Macrobrachium lamarrei* were observed along with *Najas najas* vegetation during April-September. FAP-16 (1992) reported less abundant macrophytes from Surma-Kushiyara floodplains.

Sugunan and Bhattacharjya (2000) found a rich growth of marginal and submerged vegetation in the floodplain wetlands of Brahmaputra basin. Rahman *et al.* (1997) could not find any floating aquatic vegetation from the spawning locations of Halda, the Jumuna and the Brahmaputra river and there were no significant relationship existed between the aquatic vegetation and spawning of major carps.

The abundance and succession of biotic communities occupying in the *beels* are influenced mainly by the unique water renewal pattern of the ecosystem. Fluctuation of water level in the *beel* ecosystem is an important parameter for fish spawning. The shallower areas of the *beels* were found suitable for the spawning of some resident fishes (*viz.*, *Glossogobius giuris, Heteropneustes fossilis, Channa* spp, *Xenentodon cancila, Puntius* spp*, Mystus* spp, *Matacembelus* spp., *Macrobrachium lamarrei* etc.). Ali (1997) reported that most of the smaller sized fishes breed into shallower water areas, mainly in *beel*/floodplain.

CONCLUSION

In floodplain wetlands, water quality is influenced to a great extent by inflow of water from the connecting rivers, local catchment areas and by the metabolic processes of plants and animals living within the water body and the aquatic vegetation in particular. The turbidity in *beel* water was mainly due to silt and organic debris carried by the run-off waters. The weed-choked *beels* have the lowest turbidity. The basin and aquatic soil can influence the pH value. The variations in the concentrations of DO and free CO_2 were mainly due to the rate of photosynthetic activity by aquatic vegetation and variation in the organic matter contents in the basin soil. An evaluation of hydrology and physico-chemical properties of water indicates that in spite of the low values of hardness and alkalinity the Shapla beel was found conducive to enhanced fisheries, capture fisheries and biological production as well.

The land owners excavate ditches in the *beel* along the canals that connect the *beel* to the main river stream and, have a tendency to encroach *khas lands* while excavating ditches. As such, most of the connecting canals of the *beel* become blocked by the raised dyke of *kuas* and siltation. So, it is an essential task to excavate the connecting canals from the mouth of the river to the tail end of the *beel* for easy access of incoming water with fish. For the sake of sustainability complete harvesting by dewatering is a harmful fishing method for any water body. Likewise *kua* fishery is not favorable for sustaining yields, because all fish including brood stock and juveniles are harvested at a time. The dry season represents the most critical season for all species of fish and the greatest impact occurs at this period; mortality rate is high, populations are at their lowest levels, fishery habitat is limited, predation is at peak and growth is slowed. It is suggested that during dry season a certain amount of fish can be conserved in the deeper pools of *beel* with the installation of brush park for next year's successful breeding and recruitment to the population. In addition, conducting awareness program for the fishers can reduce indiscriminate killing of juveniles.

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