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Biodiversity and Management Status of Charia Beel in Northern Bangladesh

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Abstract

Purpose: *The aim is to study the condition of aquatic species in the Charia beel. A good management technique is developed for protecting biodiversity and productions of the beel in order to ensure food security.*
Subjects and Methods*: Primary data was developed by a semi-structured questionnaires and primary data was collected by field observation which comprised of selected area of the beel basin, survey of different fishing methods, conducted a series of Focus Group Discussions (FGDs), applying Local Ecological Knowledge (LEK) and Key Informant Interview (KII). Secondary data were collected from the Department of Fisheries (DoF), comprehensive literature review and internet sites. The code of IUCN was followed to categorize the status of the beel and to compare the trend among different years Shannon index was followed.*
Results: *A total number of 91 species (83 wild fishes, four prawns, one crab, one snail, and four species of turtles) belonging to 65 genera were identified from the Charia beel. About 10 types of operative fishing gear and craft were found in the river. The increasing rate of using current jal (20.50-30.50%) and Kapuri jal (14.60-18.00%) were identified as detrimental gear used to kill the different species during four years. A common increasing trend of using current jaal, Kapuri jaal (seine net) and FAD (Fish aggregating device) were identified as detrimental gear killing different species between 2016 and 2019. The fish productivity decreased dramatically from 184.52± 55.04 to 141.65± 57.66 mt within four years and the total production percentage (%) also sharply decreased from 8.88% mt to 23.23% over the same period.*
Conclusion: *Commercially important 06 aquatic species namely Sarpunti (Puntius sarana), Napit (Badis badis), Gajar (Channa marulius) and Turtles (Kachuga tecta,Morenia petersi and Lissemys punctata) were regional extinct, 18 commercially important aquatic species were at the edge of extinction (critically endangered, CR), 35 species endangered (EN), 23 species vulnerable status (VU), five species were identified as lower risk (LR) and only four species of the river were not threatened (NT) in position between 2016 and 2019 in the this beel.*

1. Introduction

River ecosystems encompass ecological, social and economic processes that interconnect organisms including humans and helpful in maintaining biodiversity. Biodiversity has different levels and values (Verma, 2016; Chakraborty et al. 2021). Biodiversity helps in maintaining the ecological balance. There is a necessity of ecological balance for widespread biodiversity (Ashok, 2017a) and the ecological balance is an indispensable need for human survival (Verma, 2018; Chakraborty et al. 2021). Biodiversity conservation and environmental ethics both are required for the sustainable development and survival of plants and animals because biodiversity is the foundation of human life (Ashok, 2019; Verma and Prakash, 2020).

The study of biodiversity has become a major concern to the fishing biologists against the backdrop of rapid decline in the natural population of fish and aquatic biota across all the continents of the world. Biodiversity encompasses genetic species, assemblage, ecosystem and land cape levels of a biological organization with structural, compositional and functional components (Noss, 1983; Crains and Lackey, 1992). Genetic diversity acts as a buffer for biodiversity (Ashok, 2017b). Though loss of aquatic species has been occurring rapidly, the aquatic organisms have received comparatively little attention from conservation biologists (Allendorf, 1988). A rich diversity of fish species is critical to the ecology and sustainable productivity of the flood plains (Praksh and Verma, 2019; Prakash et al., 2020). The resource of aquatic fauna in Bangladesh are under severe threat due to over-exploitation and environmental degradation, which includes human interventions through the 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 the extinction of a considerable amount of aquatic biota in the same stretches of the open water system (Disaster, 1990).

In Bangladesh, the beels are important fishing grounds. Once, these beels (wetland) had abundant of native wild fish species, prawns, snail, crabs, and turtles. Due to over-exploitation and various ecological changes of the beel (wetland), 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 channel (khal), and consequently, a beel becomes very extensive water body in the monsoon and dries up mostly in the post-monsoon period (Chakraborty et al., 2021, 2019; Chakraborty and Mirza, 2010).

During the monsoon, the beels get inundated and become part of seasonal floodplain 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 phytoplankton and macrophytes thus partly contributing to the process of eutrophication. The basin of the beel supports a large variety of wetland biodiversity and works as a natural reservoir as it plays a key role in basin water resources by regulating water flows of the different river systems. In the past century or so, when the human population 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 the population increased, boro cultivation expanded on these marginal lands leading to a large area being drained. Thus, the existence of these wetlands of the beels is now threatened (Chakraborty, 2009).

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

2. Material and Methods

Location and area of the beel

The Charia beel comprised an average area of 1050 ha. The beel is surrounded by Kamaria village in the east, Kodomtoli village in the west and North and Haripur village in the South, under Fhatepur union, Sadar Upazilla, in Mymensingh district (Fig. 1).

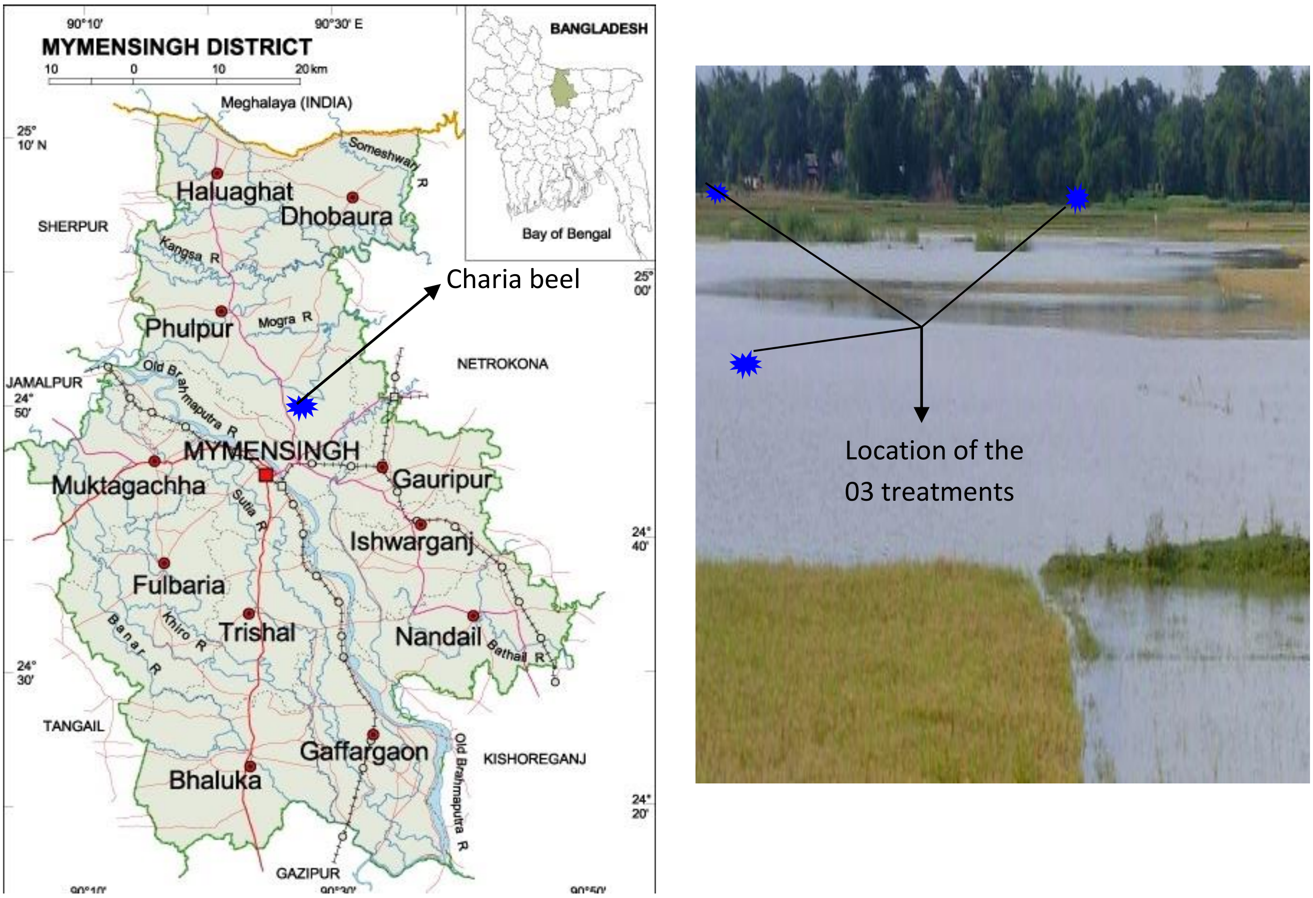

Fig. 1. Map of Bangladesh and Netrokona district showing the location of Charia beel with three treatments.

Experimental procedure

Detail survey on the flora and fauna of the Charia beel was conducted during 2016-2019 with particular emphasis on soil and water quality, biological productivity and biotic communities and status of fishery exploitation. The research was operationalized through a collection of both primary and secondary data. Collection of primary data was developed by a semi-structured questionnaires and primary data was collected by field observation which comprised of selected area of the beel basin, survey of different fishing methods, conducted a series of Focus Group Discussions (FGDs), applying Local Ecological Knowledge (LEK), Key Informant Interview (KII) a survey of fish market adjacent to waterbody, depot holders and monitoring feeding and breeding ground, monitoring of hydrological, meteorological, physico-chemical and biological characteristics of beel and fishers' perception as well. Secondary data were collected from the Department of Fisheries (DoF), comprehensive literature review and internet sites.

Morphometry and hydrodynamics of experimental eel

Generally, the main sources of water input into the Charia 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 Meghaloya's hilly range, India. This beel is connected with the Brahmaputra River by a cannel (khal). In the dry season, almost 50% of beel areas was dried up, and khata and kua fishing area where water remains during January to mid-April. Flooding of the recorded beel was originated from the inflow of water from the Brahmaputra River causing resumption of connection between beel, and canal and river. The accumulation or exchange of water took place during southwest monsoon when floodplains were flooded. The early flood phase (April to early June) occurred in the early monsoon when the water level in the basin was relatively low. The water level in the beel rose and fell in accordance with the water level in adjacent floodplains and adjacent river. Floodwater in flood plains started receding in the post-monsoon season (October to December). The deep flood phase (June to September) begins when the water level in the Brahmaputra River registers a rapid rise, causing deep flooding in the area of the surveyed beel. Floodwater in floodplains of the Charia beel started receding in the post-monsoon season (October to December). After the recession of flood, the water level in the beel decreased snapping the beel connection with the river. When the surface area of the beel shrank, fishes and other aquatic organisms move with water flow into deep water area of the beel. The beel gets almost dried up through evapo-transpiration and seepage. Except the deeper portion of the beel, most of the margin was 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 Chariabeel.

Study of Physico-Chemical Parameters

Physico-chemical parameters were followed by 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 the titrimetric method (Clesceri *et al.*,1989).

Fishing Method

Detail survey on the fishing method of the Charia beel was conducted with particular emphasis on the number of different gears and traps. Fishers' used boat for transport of nets and related materials and used ber jal (seine net), komor jal (seine net, used for Khata fishing), thela jal (Push net), bua jal (small lift net), lift net, cast net, current jal (Gill net), various type of fish traps, hook and lines; and fishing by dewatering FAD (Fish aggregating device) 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 (vair, dugair, ghuni, pholo, etc) hook and lines (barsi, fulkuichi, jhupi,, aikra, etc.) to catch fishes. They also operated kata fishing by sein net (Ber jal and Komor jal) in winter and springseasons.

Data Collection

An organized sampling program was run for a long time to get a true picture of the catch and catch composition of surveyed 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 current study, being a rapid survey, gives only a broad picture of a stock of fishes, prawn, crabs, snail and turtles' that was recorded through fish landing centers and different market survey, collection of different species directly from fishers' catch,fishing through the enclosure with bana fence (made by bamboo), khata fishing and interaction with fishers' in the beels. Resident fish species was recorded through fishing in the deep pool areas (man-made kuas) where water remains during dry season (January to mid-April). The number of six codes (CR, E, EN, VU, LR and NO) of IUCN was followed to categorize the status of the beel and to compare the trend among different years Shannon index was followed by Shannon (1948).

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

S = numbers of species encountered

$\sum$ = sum from species 1 to species S

Note: The power to which the base e (e=2.718281828.......) must be raised to obtain a number is called the natural logarithm (ln) of the number.

Analysis of experimental data

The data were analyzed through one-way ANOVA using MSTAT followed by Duncan's Multiple Range Test 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.

3. Results and Discussion

Physical characteristics of Charia beel

The soil texture of Charia beelbed varied from clay to sandy sand. In the deeper bed, the 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

Table 1. Physical features (sediment) of the surveyed Charia beel.

Name of the beel	Location	Soil texture of the bed of beel (%)		
		Clay	Loam sand	Sandy
Charia beel	Deeper bed	72.2±3.08^{a}	28.3±2.11^{b}	1.5±0.15^{c}
	Wet land bed	20.2±2.28^{b}	81.5±4.85^{a}	2.3±0.45^{c}

Figures with different superscripts in the same row differed significantly (P >0.05).

sand (Table 1). The highest percentage (72.2±3.08%) of clay was recorded in the deeper bed of Charia beel respectively. On the other hand, the highest percentage (81.5±4.85%) of loam sand in the wet land bed of the recoded beel was identified. 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.

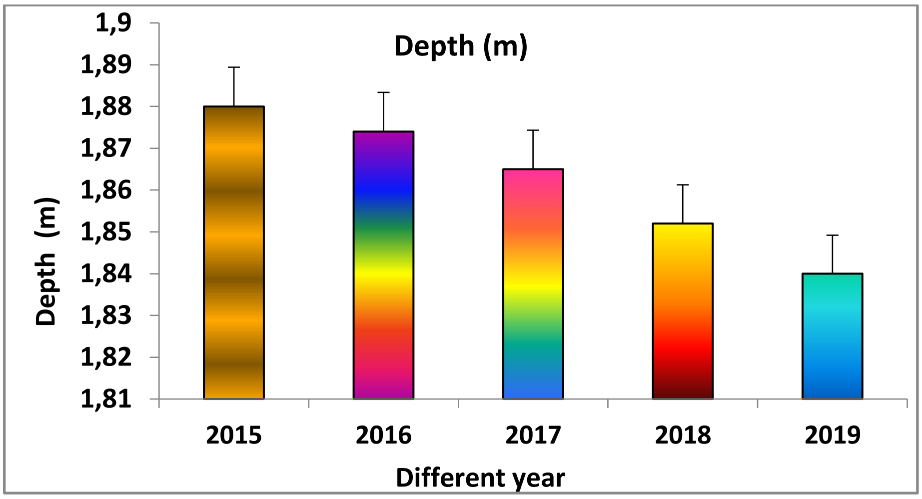

Figure 2: Water depth of the experimental Charia beel between the years 2016-2019.

The water depth of the Charia beel varied from 1.88 to 1.84m during the year 2016-2019, respectively. The highest depth of the surveyed beel was recorded in the year 2016 and the lowest depth was found in 2019. There was a tendency to decrease the depth of the beel bed shallow to shallower between 2016 and 2019 (Fig. 2) due to siltation and sedimentation.

Physico-chemical parameters

The results of the physico-chemical parameters of the Charia beel is furnished in Table 2 which included temperature, transparency, pH, dissolved oxygen and alkalinity of water were found to be more and less in a normal range. is evident from Table 2 that the mean water temperature of the aquatic environment of the beel was not statistically significant (P > 0.05). Mean Secchi disk transparency differed significantly (P < 0.05), during the years 2016 to 2019. Higher values occurred during post-monsoon and summer months due to reduced flow and relatively stable conditions of the water. pH of the experimental beel did not differ significantly (P > 0.05).

Table 2. Physico-chemical parameters of recorded Charia beel.

Parameters	Study years			
	2016	2017	2018	2019
Temperature (^{o}C)	25.24 ± 8.08 (14.44 - 32.77)	26.11 ± 6.51 (14.55 - 32.82)	25.62 ± 7.47 (14.05 - 32.85)	24.86 ± 7.12 (15.20 - 32.95)
Transparency (cm)	42.55 ± 7.14^{d} (32.55 - 51.55)	35.18 ± 6.22^{b} (29.02 - 47.06)	38.35 ± 6.18^{c} (27.18 - 42.28)	30.17 ± 7.44^{a} (32.30 - 50.22)
pH	7.45 ± 2.14 (6.55 - 8.85)	7.61 ± 2.42 (6.50 - 8.86)	7.48 ± 2.11 (6.50 - 8.78)	7.55 ± 2.12 (6.45 - 8.66)
Dissolve oxygen ($mg.L^{-1}$)	5.14 ± 1.51 (4.15 - 8.22)	5.27 ± 1.28 (4.04 - 7.55)	4.98 ± 1.22 (4.38 - 7.65)	5.05 ± 1.25 (4.44 - 7.75)
Alkalinity ($mg.L^{-1}$)	111.12 ± 10.04^{d} (101.24 - 136.33)	121.33 ± 10.22^{b} (108.24 - 146.42)	126.55 ± 9.44^{a} (111.27 - 156.24)	116.52 ± 9.57^{c} (106.18 - 138.14)

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

It 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 ($P > 0.05$). But total alkalinity of the experimental beel differed significantly ($P < 0.05$).

Macrophytes

A total number of 14 species belonging 14 genera and 12 families of aquatic weeds were identified from the surveyed beel (Table 3). The Macrophytes consisted of 11 families in the concerned four beels viz.,Lemnaceae, Pontederiaceae, Gramineae, Marsiliaceae, Najadaceae, Compositaceae, Commelinaceae, Convolvulaceae, Nymphaceae, Menyanthaceae and Myrtaesae. A total number of 14 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 and different fish species 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. However, due to changing ecosystem health, using pressure of human consumption and cattle food, the percentage (%) of the population of aquatic weeds was reduced day by day.

Table 3: The percentage of Aquatic weeds of Charia beel decreasing between 2016 and 2019.

SL. No.	Type	Local & Scientific name	Decreased percentage (%) of aquatic weeds between 2016 and 2019		
			2016-2017	2017-2018	2018-2019
1.	Floating	Edurkanipana(Wolffia arrhiza) and Kachuripana(Eichhornia crassipes)	12.22	15.51	18.88
2.	Emergent	Dal(Hudroryza aristota) and Shusnishak(Marsilea quadrifolia)	12.44	16.32	19.11
3.	Submerged	Najas(Najas najas)	10.25	13.12	15.22

4.	Spreading	Helencha(Enhydra flucktuans), Arail(Leersiahexandra) Kanaibashi(Commelina bengalensis) and Kalmilata(Ipomoea aquatica)	11.44	13.66	16.24
5.	Rooted plants with floating leaves	Shapla(Numphaea nouchali), Padma(Nelumbo nucifera) Amazan lili(Victoria amazonica)and Chandmala (Nymphoides cristata)	10.82	12.73	14.05
6.	Rooted plants	Hizal(Barringotonia acutangula)	11.18	14.15	20.41

Uses of fishing Craft and gears

About 10 types of fishing methods were identified in the Charia beel.In 2016, the percentage of catch statistics of beel showed the use of Ber jal, Bua jal, Cast net, Current jal, Dharma jal, Fish trap, FAD,

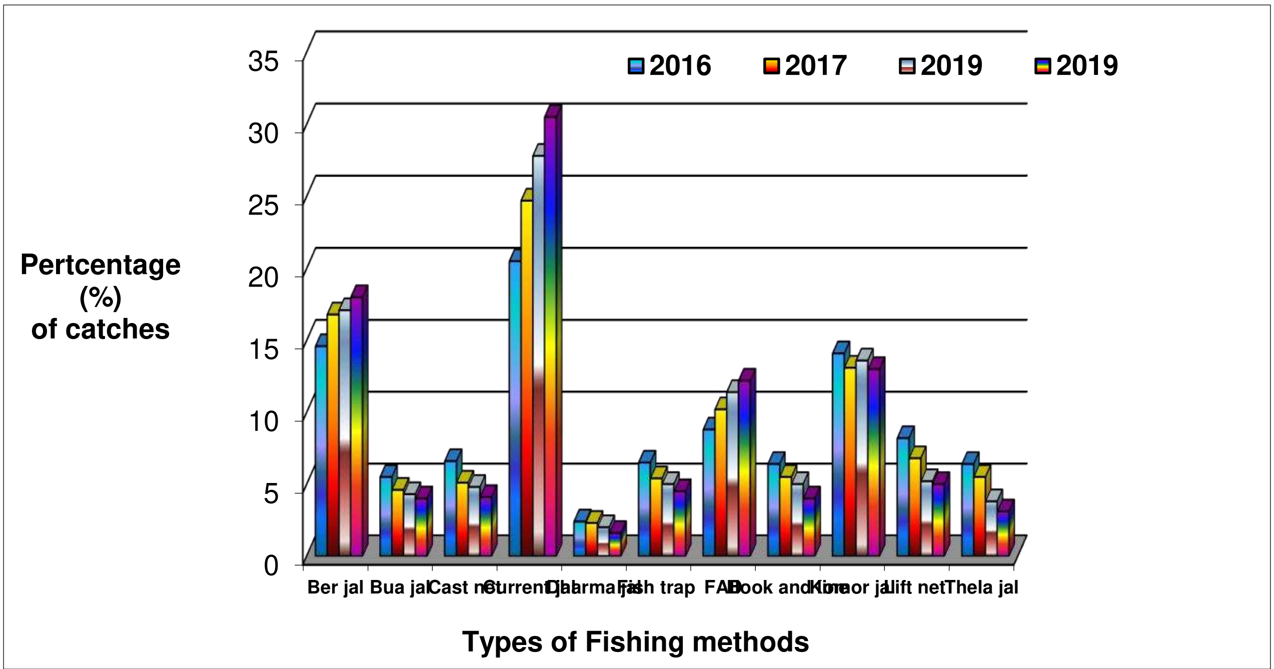

Figure 3. Percent of catch composition by different types of fishing methodsbetween 2016 and 2019 in Charia beel.

Hook and line, Komor jal, Lift net and Thela jal were 14.60, 5.50, 6.60, 20.50, 2.40, 6.50,8.80, 6.40, 14.1, 8.40 and 6.40% in 2016, respectively. The number of using illegal current jal, ber jal (kaperi jal) and FAD were increased in 2017 and 2018. In 2019, illegal using of current jal, ber jal (kaperi jal) and FAD were increased 30.50, 18.00 and 12.2%, and using Bua jal, Cast net, Dharma jal, Fish trap, Hook and line, Komor jal, Lift net and Thela jal were decreased at the level of 4.00, 4.10, 1.60, 4.50, 4.00, 13.00, 5.00 and 3.1%, respectively (Fig. 3). There was a significant difference ($P < 0.05$) in percentages of fish catches among different fishing gears in different years. A significant decreasing trend in fish catches was observed with Bua jal, Cast net, Dharma jal, Fish trap, Hook and line, Komor jal, Lift net and Thela jal during the reporting period. A significant decline in the abundances of fish population could be accounted for due to indiscriminate use of illegal fishing gears (Fig. 3).

Catch and catch composition of the beel

The status of the available position of fauna is furnished in Table 7. The present study indicated the presence of 93 aquatic fauna (83 species of wild fishes, four species of prawn, one species of crabs, one species of snail and four species of turtles) belonging to 65 genera in Charia beel. The annual total catch of the Charia beel was estimated to be 184.52± 55.04; 168.12± 56.22, 152.29± 56.95 and 141.65± 57.66 mt in the year 2016, 2017, 2018 and 2019, respectively consisting of 10 groups (Fig. 4) viz., major carp, minor carp, small fish, Knife fish, snake head, cat fish, small cat fish, spiny eels, prawn, crabs, snail and turtle. Increasing fishing pressure resulting in a gradual reduction in the catches of different groups of fish and other aquatic lives was demonstrated (Table 5).

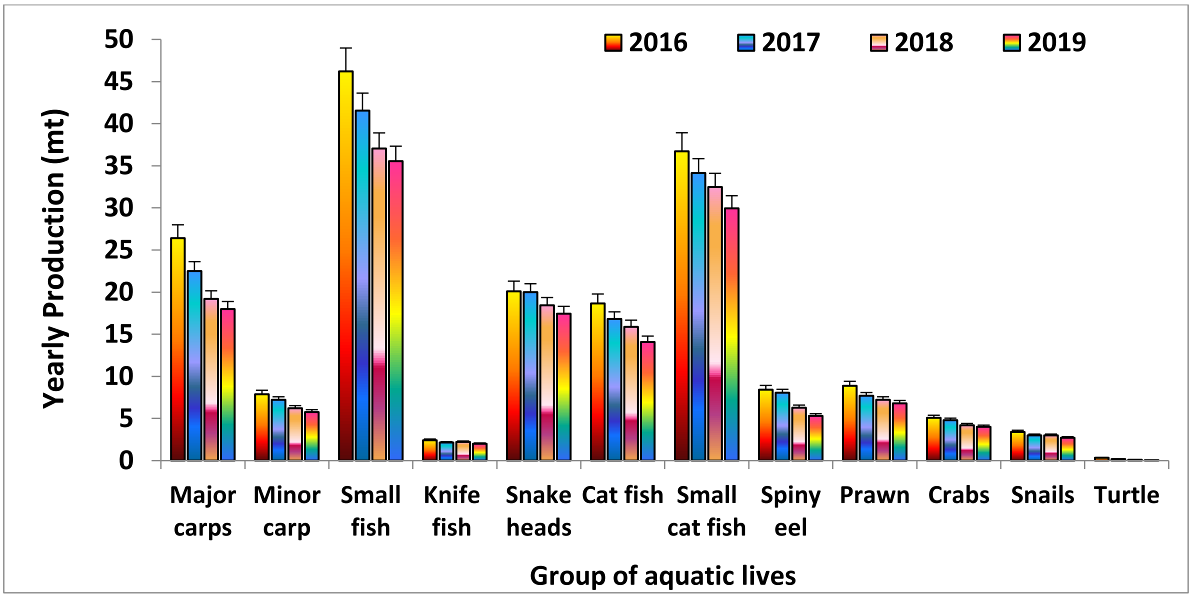

Figure 4: Decreasing production of aquatic fauna in Charia beel between 2016 and 2018, and increasing production in 2019.

The total production of the beel was decreased from 184.52± 55.04 mt to 141.65± 57.66 between 2016 and 2019. The percentage of the total production of the beel was declined from 8.88% mt to 23.23% between 2016 and 2019. Decreasing production percentage of different groups of aquatic fauna between 2016 and 2019 in Charia beel was shown in (Fig. 4).

Small fish was the dominant group in the Charia beel between 2016 (46.21± 7.06 mt) and 2019 (35.55± 6.26 mt) and small cat fish was recorded to be the second-highest production 36.72±7.30 mt and 29.95±6.11 mt in the same period. The catches of all the groups of fishes, crabs, snails and turtles were higher in 2016 but gradually declined between 2017 and 2019 (Fig. 4).

The status of the 91 aquatic wild lives of the Charia beel was ranked as different status. Important Six (7.0 %) species such as Sarpunti (*Puntius sarana*), Napit (*Badis badis*), Gajar (*Channa marulius*) and

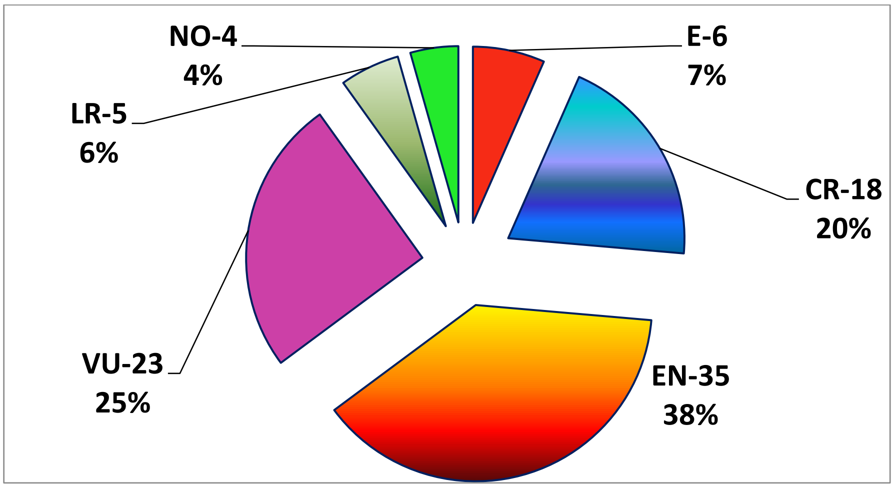

Figure 5. Status of different species of aquatic fauna in the Charia beel during 2016-2019.

Turtles (*Kachugatecta,Morenia petersi* and *Lissemys punctata*) were rarely found in the year 2016 but these species were regional extinct (E) between 2017 and 2019. Eighteen (20.0%) commercial importance species was facing as an extremely higher risk of extinction (Critically endangered, CR) day-by-day. Thirty-five (38.0%) major commercial importance aquatic wild species of the beel was facing as very high risk of extinction (Endangered, EN), twenty three (25.0%) species was facing as high risk of extinction (Vulnerable status, VU), five (5.0%) species were identified as Lower Risk (LR) and only four (4.0%) species was Not threatened (NO) position, respectively (Fig. 5 and Table 6).

Table 6: Status and distribution of aquatic lives of Charia beel.

SL No	Local name	English name	Scientific name	Status			
				2016	2017	2018	2019
1	Puda/Saralpunti	Olive barb	*Puntius sarana*	EN	CR	E	E
2	Napit koi	Dwarf Chameleon fish	*Badis badis*	EN	CR	CR	E
3	Gajar	Giant snake head	*Channa marulius*	EN	CR	E	E
4	Common Roof Turtile	Common Roof Turtile	*Kachuga tecta*	CR	CR	E	E
5	Bengal Eyed Turtile	Bengal Eyed Turtile	*Morenia petersi*	CR	CR	E	E
6	Reptile	Spotted Flapshell	*Lissemys punctata*	CR	CR	CR	E
7	Bhagna	Labeo	*Cirrhinus reba*	EN	EN	EN	CR
8	Along	Bengal barb	*Bengala elanga*	EN	EN	E	CR
9	Laubuca	Indian Glass-barb	*Chela laubuca*	EN	EN	EN	CR
10	Bhagna	Reba carp	*Cirrhinus reba*	EN	EN	EN	CR
11	Dhela	Cotio	*Rohtee cotio*	EN	CR	CR	CR
12	Batasi	IndianPotasi	*Pseudeutropius atherinoides*	VU	EN	EN	CR
13	Chola punti	Chola barb	*Puntius chola*	VU	EN	EN	CR

14	Chola punti	Short leg Prawn	*Machrobrachium mirabile*	VU	EN	EN	CR
15	Baghair	Gangetic Goonch	*Bagarius yarrellii*	VU	EN	CR	CR
16	Gulsa	Gangetic Mystus	*Mystus cavasius*	VU	EN	EN	CR
17	Gang tengra	Gangetic Gagta	*Gagata gagata*	VU	CR	CR	CR
18	Modhu pabda	Pabdha cat fish	*Ompok pabda*	VU	CR	CR	CR
19	Pabda	Pabo catfish	*Ompok pabo*	VU	EN	CR	CR
20	Ghura chela	Gora Chela	*Securicola gora*	VU	EN	EN	CR
21	Bhol	Indian trout	*Raiamas bola*	VU	EN	EN	CR
22	Korsula	Corsula Mullet	*Rhinomugil corsula*	EN	EN	CR	CR
23	Bata	Bata Labeo	*Labeo bata*	VU	CR	E	CR
24	Reptile	Narrow-headed Softsheel	*Chiitra indica*	EN	EN	CR	CR
25	Khoksa	Vagra Baril	*Barilius vagra*	LR	VU	VU	EN
26	Calbaus	Black Rohu	*Labeo calbasu*	VU	VU	EN	EN
27	Ghonia	Kuria Labeo	*Labeo gonius*	VU	EN	EN	EN
28	Kalo bata	Gangetic Latia	*Crossocheilus latius*	VU	EN	EN	EN
29	Jili punti	Golden Barb	*Puntius gelius*	VU	VU	VU	EN
30	Kachki	Ganga River-sprat	*Corica soborna*	VU	VU	VU	EN
31	Mola	Mola Carplet	*Amblypharyngodon mola*	VU	VU	VU	EN
32	Phutani punti	Dwarf Barb	*Puntius phutunio*	LR	VU	VU	EN
33	Jat punti	SpotfinSwamp Barb	*Puntius Sophore*	VU	VU	EN	EN
34	Fulchela	Fine Scaled Razzer Belly Minnow	*Salmostoma phulo*	VU	VU	VU	EN
35	Khalisha	Stripled Gourami	*Colisa fasciata*	VU	VU	EN	EN
36	Lal khailsha	Dwarf Gourami	*Colisa lalia*	LR	VU	EN	EN
37	Chuna Khalisha	Sunset Gourami	*Colisa sota*	VU	VU	EN	EN
38	Kanpona	Esuarine Ricefish	*Oryzias melastigma*	VU	VU	EN	EN
39	Mini	Mottled Nandas	*Nundas nandus*	EN	EN	EN	EN
40	Rani/Botya	Necktie Loach	*Botia Dario*	VU	VU	EN	EN
41	Kakila	Fresh Water Garfish	*Xenentodon cancila*	VU	VU	EN	EN
42	Potka	Ocellated Pufferfish	*Tetrodon cutcutia*	VU	VU	EN	EN
43	Chitol	Humped Featherback	*Notopterus chitala*	EN	EN	EN	EN
44	Shol	Striped snake headed	*Channa striatus*	VU	VU	VU	EN
45	Koi	Climbing Perch	*Anabas testudineus*	VU	VU	EN	EN
46	Neftani	Indian Paradise fish	*Ctenops nobiilis*	EN	EN	EN	EN
47	Ayre	Long Whiskered Catfish	*Aorichthys aor*	EN	EN	EN	EN
48	Guzia	GiantRiver Catfish	*Aorichthys seenghala*	EN	EN	EN	EN
49	Rita	Rita	*Rita rita*	EN	EN	EN	EN
50	Kani papda	Indian butter cat	*Ompok bimaculatus*	EN	EN	EN	EN

		fish					
51	Kajuli	Jamuna Ailia	*Ailia coila*	VU	EN	EN	EN
52	Bacha	Batchwa Bacha	*Eutropiichthys vacha*	VU	EN	EN	EN
53	Gharua	Garua Bacha	*Clupisoma garua*	VU	EN	EN	EN
54	Magur	Magur	*Clarius batrachus*	VU	VU	EN	EN
55	Baim	Tire-track Spinyeel	*Mastacembalus armatus*	VU	EN	EN	EN
56	Kuicha	GangeticMudeel	*Monopterus cuchia*	VU	EN	EN	EN
57	Tara Baim	One-stripe Spinyeel	*Macrognathus aral*	VU	VU	EN	EN
58	Galda isa	Giant fresh water prawn	*Machrobrachium rosenbergii*	VU	EN	EN	EN
59	Snail	-	*Lamellidens marginalis*	VU	VU	VU	EN
60	Catla	Catla	*Catla catla*	LR	LR	VU	VU
61	Rui	Rohu	*Labeo rohita*	LR	LR	VU	VU
62	Mrigal	Mrigal	*Cirrhinus cirrhosus*	LR	LR	VU	VU
63	Taka punti	Rosy Barb	*Puntius conchonius*	LR	LR	VU	VU
64	Tit punti	Ticto Barb	*Puntius ticto*	LR	LR	LR	VU
65	Teri punti	Onespot Barb	*Puntius terio*	LR	LR	VU	VU
66	Darkina	Flying Barb	*Esomus danricus*	LR	LR	VU	VU
67	Chapila	Indian River Shad	*Gadusia chapra*	LR	LR	VU	VU
68	Nama chanda	Elongate Glasds-perchlet	*Chanda nama*	LR	LR	VU	VU
69	Kata chanda	Himalayan Glassy Perchlet	*Pseudambasis bacuculis*	LR	LR	VU	VU
70	Kachki	Ganga River-sprat	*Corica soborna*	LR	LR	VU	VU
71	Ranga chanda	Indian Glassy Fish	*Pseudambasis ranga*	LR	LR	VU	VU
72	Gachua	Asiatic snakehead	*Channa gachua*	VU	VU	VU	VU
73	Taki	Spotted snake head	*Channa punctatus*	LR	LR	VU	VU
74	Boal	Fresh Water Shark	*Wallago attu*	LR	VU	VU	VU
75	Tengra	Striped Dwarf Catfish	*Mystus vitttus*	LR	VU	VU	VU
76	Anju	Zebra fish	*Brachydanio rerio*	LR	VU	VU	VU
77	Singi	Stinging Catfish	*Heteropneustes fossilis*	LR	LR	VU	VU
78	Guchi baim	Striped Spinyeel	*Macrognathus pancalus*	LR	VU	VU	VU
79	Foli	Grey Featherback	*Notopterus notopterus*	LR	VU	VU	VU
80	Gutum	Guntea Loach	*Lepidocephalus gontea*	LR	LR	LR	VU
81	Gura chingri	BirmaRiver Prawn	*Machrobrachium birmanicum*	LR	LR	LR	VU
82	Kakra	-	*Stylla serrata*	LR	LR	LR	VU
83	Common carp	Scale carp	*Cyprinus carpio*	NO	NO	NO	LR
84	Silver carp	Silver carp	*Hypophthalmicichthys molitrix*	NO	NO	LR	LR
85	Bujuri	Tengra Mystus	*Mystus tengra*	NO	LR	LR	LR
86	Grass carp	Grass carp	*Ctenopharyngodon idellus*	NO	NO	LR	LR
87	Nona tengra	Long-whiskered	*Mystus gulio*	LR	LR	LR	LR

		Catfish					
88	Gkatakia chingri	DimuaRiver Prawn	*Machrobrachium villosimanus*	NO	NO	NO	NO
89	Bala	Tank Goby	Glossogobus giuris	NO	NO	NO	NO
90	Thai sarpunti	Silver Barb	Puntius gonionotus	NO	NO	NO	NO
91	Shotka chingri	MonsoonRiver Prawn	Machrobrachium malcolmsnii	NO	NO	NO	NO

(Status code: E- Extinct, CR- Critically Endangered, EN- Endangered, VU- Vulnerable, LR- Lower risk, NO- Not threatened) Shannon index was followed to compare the trend among different years by Shannon index method and six codes of IUCN followed to categorize the status of 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 the 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 jackal, flying fox) were identified.

Discussion

The physico-chemical factors were found to be more or less in the normal range in the Charia beel which is agreed by APHA (1998). Water temperature of the beel showed an increasing trend in monsoon and post-monsoon season and a decreasing trend in winter which is supported by Mathew (1975). Transparency was consistently higher in the deeper portion of the beel, possibly due to the 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 $mg.L^{-1}$) and pH(6.45 - 8.86) as noted in the beel agrees well with the findings of Boyd, C. E. (1982). An alkalinity level of the beel was medium to high (Clesceri *et al.,* 1989).

A total number of 14 species of marginal and submerged vegetation was observed in the floodplain and beel, which are comparable with the finding of Sugunan and Bhattacharjea (2000) in the case of the floodplain of the Brahmaputra basin. The swamp forests, mainly represented by hijal tree (*Barringtonia acutangula*) have been reduced to a few small patches in the surveyed area.

The fishing effort with various types of fishing methods such as seine net (especially kaperi jal), gill net (current jal) and FAD was increased between the year 2016 and 2018 but the use of current jal was increased dramatically during the same period. As a result, the 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 Bhattacharjia (2000) found a wide variety of fishing methods employed in the beels of Assam, India which are very similar to the present study. Cast net

(Jaki jal) was used the whole year in the beel. It is a very popular fishing method and used all over Bangladesh (Ahmad, 1962).

The catch statistics indicate that the fishing pressure of the beel was increased rapidly in the year 2016 to 2019. As a result, a decreasing trend in production percentage of the beel was pronounced within four years 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 a different group of aquatic lives was sharply decreased within four years which are very similar to the study of Chakraborty et al, (2021; 2019; 2010); Chakraborty (2009; 2010); Chakraborty and Mirza (2007). Shannon index (Shannon, 1948) was used to identify the present status of the Charia beel. But six indicators of IUCN (2000) were used for ranking of aquatic fauna of the beel. Commercial important Fish species Local sarpunti (*Puntius sarana*), Napit (*Badis badis*), Gajar (*Channa marulius*) and Reptiles (*Kachuga tecta*,*Morenia petersi* and *Lissemys punctata*) were rarely found in the year of 2016 in the Charia beel. However, these species were regionally extinct between 2017 and 2019. Eighteen commercially important aquatic species were facing as an extremely higher risk of extinction (CR) day-by-day. About 35 commercial importances aquatic wild species of the beel was facing an extremely high risk of extinction (EN), 23 aquatic wild species were Vulnerable status, five 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 on the verge of extinction which is in agreement with the findings of Prakash et al, (2020) and Sarker(1993).

During winter season, turtles(*Morenia petersi, Kachuga tecta Lissemys punctata* and *Chiitra indica*) were caught in the beel and its floodplain. Khan (1982) reported that *Kachuga tecta* are mainly distributed between the stretches of the Ganges River and the Brahmaputra River. Bengal Eyed turtle, *Morenia petersi* was found in the beel and its floodplain. Das (1991) mentioned that the occurrence Bengal Eyed turtle, *Morenia petersi* was in Assam of India. Turtles of the surveyed beel and its floodplain were 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 poses a threat to all species of turtles as well. The population of bivalve, *Lamellidens marginalis* was found in the beel and floodplain, had also decreased which is consistent with the observation ofAli (1991).

The study indicated that the aquatic lives of the beel were subjected to over fishing resulting in gradual decline in the aquatic population. In addition, aquatic ecosystem health is changing due to global effect, 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 were 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 et al.(2021).

Indiscriminate destructive fishing practices was 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; Chakraborty et al.2021). Intervention to control floods, adoption of new agricultural technologies and construction of road networks were altered the ecology of beel significantly which supported the views of Khan (1993) and Ali (1991). The stock of the wildlife brood fishes in their breeding ground was also suffered significant damages resulting in a reduction of biodiversity as noted by Nishat (1993), Zaman (1993) and Chakraborty et al. (2010).

The local beel management committee developed a working frame work on sharing benefits, developing rules and regulations for beel resource management. Fortnightly meetings 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 the overall management of beel nursery and beel resource (Chakraborty *et al*., 2021).

4. Conclusion and Suggestion

For better management to save the stock of aquatic species in this beel, regular stocking of fingerlings with a team of local management committee is needed to develop a working frame-work. 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, ensured 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 floodplains area of the beel; can save and change the ecosystem and the production level of the beel; and can ensure food security of the people of Bangladesh.

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Conflict of Interest

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