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Fish Sanctuaries as an Ecological Approach to Management for Restoring Fish Biodiversity: A Study on Chikadubi Beel Fish Sanctuary, Bangladesh

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The fish biodiversity of open water is reducing as rice culture has been intensified due to other environmental threats. The establishment of a fish sanctuary is a way to conserve fish for future generation. A study was conducted to know the impact of the sanctuary on fish biodiversity for six months from August to December 2020. Various Participatory rural appraisal (PRA) tools were used such as Questionnaire interviews, focus group discussion (FGD), Catch monitoring and

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cross-check interviews were carried out. Data were collected from 50 fishermen using a semi-structured questionnaire interview, Group discussion, and gathering secondary information from different sources. According to the findings, 78 fish species were recorded in the study area where 60 fish species were recorded to be found before establishment of the sanctuary. Baseline production of the sanctuary was 0.58 MT/ha in 2015 which increased to 1.12 MT/ha in 2020 after establishment of the sanctuary. The highest total number of fish species were caught in August (68.45%) and lowest (41.55%) in December in the Chikadubi beel. The dominant fish species in Chikadubi beel was Freshwater shark (*Wallago attu*) followed by Spotted snakehead (*Channa punctatus*), Indian river shad (*Gadusia chapra)* and Jatiputi (*Puntius sophore*) whereas the least available fish species was Koitor poa (*Johnius coitor)*. Among the total catch comprises different family such Cyprinidae 58.33%, Channidae 16.60%, Bagridae 14.58%, Siluridae 6.25% & Schilbeidae 8.33 % respectively. The outcomes suggest that careful planning, management and regular practices, along with active community participation, can have positive impact on fish sanctuary.

Keywords: Chikadubi beel; fish sanctuary; biodiversity; management; ecological approach.

1. INTRODUCTION

"Beel is a saucer-shaped depression, which may hold water permanently or dry up during the dry season" Ahmed et al. [1]. "This type of shallow, seasonal water body is common in low-lying floodplain areas throughout Bangladesh" Mazumder *et al.,* (2015). "It is a low-lying depression on a wetland or floodplain, sometimes drying up in the dry season. Sometimes, it contains water for around the whole year" (FRSS, 2020). "Bangladesh is blessed with vast water resources scattered all over the country in form of haor, baor (Oxbow Lake), beels*,* canals, lakes, small and large rivers, and estuaries. A diverse environment is the basis for the diversity of lives both animals and plants. Inland open and closed water bodies are the major sources of fish production in Bangladesh from time immemorial. But due to different environmental and man-made destructive activities, natural fish stocks are declining day by day" Azher et al. [2]. Climate change has a variety of effects on the fishing business. First and foremost, physiochemical conditions are changed by climate change, leading to greater sea levels, stratification, altered dissolved oxygen levels, ocean acidification, and higher water temperatures Mozumder et al. [3]. "A good number of fishes are highly regarded for their taste and nutritive value but these are now critically endangered, endangered and vulnerable" Hasan et al. [4]. Water is being harmed in massive amounts all around the country as a result of human stupidity. As a result of these factors, plant and wildlife diversity has been declining over the planet. Restoration strategies for habitats, animal populations, and natural processes can either be passive (relying on the environment to recover on its own) or active (reliant on human interventions like environmental engineering). Best methods for restoring freshwater ecosystems damaged by aggregate extraction should be identified as a first stage in this process, depending on the intensity and scope of mining, river dynamics, and socio-ecological contexts. Cooke et al. [5]. In fact, it is important to keep in mind that fisheries grounds are typical commons and, as such, are susceptible to overexploitation, deterioration, and depletion if improperly governed. Gatto et al. [6]. "The fish sanctuary is an adaptable strategy to conserve fish in open water bodies for natural propagation. It's a clearly defined protected zone where no fish are disturbed or harvested. So, the establishment of a sanctuary is a way that carries such facilities and creates opportunities for protection, conservation and breeding of open water fish in natural way. Fish assemble in sanctuaries for shelter, live peacefully without being disturbed, and can freely travel to feeding and reproductive areas. Fish sanctuaries have a positive impact in all cases on fish production, biodiversity and socioeconomic condition of fishers" Azher et al. [2]; Hasan et al. [4]; DoF [7]; Hossain et al. [8]. "Fish species face a difficult period during the dry season. Water levels in rivers, canals, and beel decline dramatically, providing fish with fewer escape routes and increasing their vulnerability to extensive and destructive overfishing. As a result, fish stocks, particularly the brood stock, have been reduced to the point where the fisheries can neither longer be sustained. Both production and catch have decreased over time. As a result, protecting enough brood stock to keep the population at sustainable levels is a vital challenge for

sustainability. Among the measure implemented to reduce stress on inland fisheries, fish sanctuaries have been found to be affective for the protection of broods, while other management measures are difficult to implement in the face of current administrative and social contexts" Ali et al. [9]. **"**Additionally, as a component and manner of fisheries management, sanctuaries are extremely straightforward and maintain by user communities. Many government and non-government organizations have made attempt to fish stock expansion by constructing sanctuaries in beels and rivers of Bangladesh. Department of Fisheries (DoF) has established many sanctuaries in open water bodies like rivers, haors, baor (Oxbow Lake) and beels of the country to protect the native species. Other different organizations under their development projects attempted to establish fish sanctuaries in open water bodies in different areas of the country to protect the indigenous fishes" Parvez et al. [10]. "To date, over 432 fish sanctuaries have been established in the inland open waters of the country through different development projects and programs of the DoF and other agencies" [11]. "The most important haors in respect of biodiversity and natural fish production are Shaneer, Hail, Hakaluki, Dekar, Tanguar Kawadigi and Dingaputa in greater Sylhet, & Netrokona district. Dingaputa haor is one of the most important haor among these which include several numbers of beel and Chikadubi beel is one of them beel. The total estimated beel area in Bangladesh accounts to 114161 ha including total fish production 104871 MT and contributes about 2.27% to the country's freshwater fish production" [12]. "Chikadubi beel fish sanctuary is most important in Dingaputa haor. These sanctuaries were established by the assistance of DoF, and are managed by local fishermen. This sanctuary was established for in order to boost fish production, protect endangered indigenous fish and to create awareness among the local fishermen. Several studies have been conducted on the impact of the sanctuary on fish production and variety in the river or beel fish sanctuary" (Sultana *et al*., 2022) Considering this backdrop, an extensive survey was conducted to assess the status of sanctuary on fish production, conservation of fishes and diversity in Chikadubi beel fish sanctuary of Dingaputa haor in Mohanganj upazila.

2. MATERIALS AND METHODS

2.1 Study Area and Period

The present study was conducted at the Chikadubi beel located on Dingapota haor of Mohonganj Upazila in the Netrokona district of Bangladesh between latitude 24°45'N to 24°55'N and longitude 90°55'E to 91°07'E. (Fig. 1) Data were collected from August 2020 to December 2020 from the three sampling sites and one local fish market.

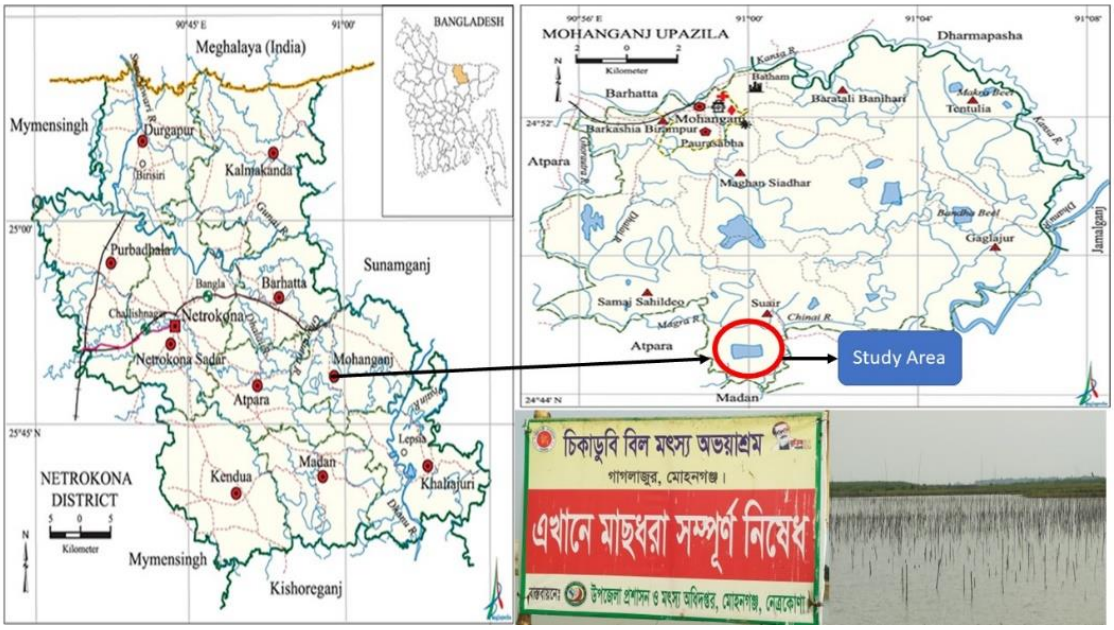

Fig. 1. Map showing the geographical location of the study area

2.2 Description of the Study Site

The fish sanctuary was established in 2015. The sanctuary area is about 2 hectors. Water depth increases up to 15-35 ft during monsoon month and goes down to 10 ft in the dry season. The bottom is not regular and every year, it takes new shapes due to siltation during monsoon. About five hundred bamboo poles, branches of ten tamarind trees, 25 sheora trees were purchased from the local area and placed in the sanctuary to create a habitat and shelter for the aquatic organisms. Some of the branches were donated by local communities. Plastic pipes and cement pipes were used in the fish sanctuary to protect against poaching.

2.3 Data Collection Method

Secondary information was collected from Upazilla Fisheries Office regarding the fisheries, fish sanctuary and on the basis of this information a preliminary survey was conducted in the study area. Primary data were collected also from target groups through questionnaire interviews, PRA such as focus group discussion (FGD) and cross-check interviews with key information. Participatory Rapid Appraisal (PRA) is a group of methods to collect information from target groups. The advantages of PRA over other methods are that the information collected is likely to be more accurate. It is a bottom-up approach. It is generally used for collecting more accurate information with wider participation. A questionnaire was created in accordance with the study's objectives to collect data from the fishermen and target groups. Before creating the questionnaire, a draft was created and then pre-tested in the study area while keeping the study's objectives in mind. During this pre-testing, special attention was made to incorporating any new information not included in the draft timetable. The questionnaire was then finished after required alterations and modifications were made based on the feedback received from the fisherman. The final questionnaire was then prepared in a logical order so that the target group may respond in order. Question was related to species availability before and after the establishment of fish sanctuary, critically endangered and endangered fish species abundance, species wise catch composition abundance of Chikadubi beel fish diversity and socio-economic condition of fishermen were included in the questionnaire. After completion of data collection through questionnaire interviews and FGDs, it was necessary to check the information for justification of the collected data. If there were any items contradictory, then information's were collected from key informant. Cross-check interviews were conducted with key person such as Senior Upazila Fisheries Officer (SUFO), Upazila Chairman. The interviews of the respondents were conducted in their offices during office hour.

2.4 Data Processing, Analysis and Presentation

Graphs and Tables were represented by Microsoft Excel. The Microsoft Excel was used to plots graphs for dissemination of the results. Data with the locally used units and percentages were calculated for further analysis.

3. RESULTS

3.1 Frequency Distribution of Species under Different Families

Frequency of fish species under different families recorded was calculated during the study period. Total 23 families of fish were identified the beels. Among all the families Cyprinidae was the largest family which contributed 41% (32 species). The second highest families were Bagridae which contributed 9% (7 species). The lowest dominant families were Badidae, Anabantidae, Nandidae, Claridae, Heteropneustadae, Notopteridae, Badiidae, Hemiramphidae, Belonidae, Sisoridae, and Aplocheilidae.

4. DISCUSSION

4.1 Impact of a Fish Sanctuary on Fish Biodiversity in Chikadubi Beel

Bangladesh having vast and diversified water resources and of associated 4.71 million aquatic ha is unique in term of valuable wetland ecosystem 260 indigenous fresh biodiversity ranking third in Asia with approximately water species DoF, (2021). But during the study period a total of 78 fish species were recorded in the catches of different gears used by the fishermen in Chikadubi beel. So, its fish diversity is very little in comparison with the total fish diversity of Bangladesh.

During the month of August, the most fish species were recorded (67). The rainy season in Bangladesh usually begins in June or July, and this is the peak breeding season for most fish

species. The fish sanctuary and the beel in my study site have a close biological relationship. The seasonal connectedness of the fish sanctuary with the beel may be linked to the reduction in biodiversity over time. Because the beel is connected to the fish sanctuary during the rainy season, species diversity is normally great; however, during the dry season, the beel is separated from the fish sanctuary, and species diversity in any of them is lower. In the winter season, the water level of the beel decreases and fishing intensifies in small area. The gradual decrease of fish species may be related to this.

According to Siddique et al. [13], “the number of fish species (71) where 62 species were native and 9 were exotic under 26 families of 11 orders in the Halti Beel sanctuary of Piprul Union established by Noldanga Upazila Fisheries Office Noldanga, Natore”. The present study of the impact of fish sanctuary on fish biodiversity in chikadubi beel result was closely related with the study of Halti beel fish sanctuary as per result a total of 78 fish species under 21 families were recorded in the catches of different gears used by the fishermen in Chikadubi beel.

Accoding to Islam et al. [14] “sanctuary status on diversity and production of fish and shellfish in sunamganj dekar haor of Bangladesh result found that total of 64 species including fish (57), freshwater prawns (2), crabs (1) and mollusks (4) were recorded Of 57 fish species, 52 were indigenous and rest 5 exotic, which belonged to 9orders and 24 families in chikadubi beel it is found that total of 78 species including freshwater prawns (3), crabs (1) and mollusks (3) which is closely related with the study”.

Accoding to Khan et al. [15] “impact of sanctuary the result showed that total 45 fish species under 17 families were recorded in the study area where there were 38 species before establishment of the sanctuary in kolavanga beel where the impact of fish sanctuary on fish biodiversity in chikadub i beel found that total 78 fish species under 21 families were recorded in the catches of different gears used by the fishermen in Chikadubi beel this beel is situated in dingaputa haor & this beel contain water all the year round that is why the variation in species number” .

According to MACH [16], “the number of fish species found during the baseline period was 71. Combining all six "impact years" defined by MACH (2001-2006), a total of 85 species have been recorded in Hail haor”. The present study of the impact of fish sanctuary on fish biodiversity in chikadubi beel found that total 78 fish species under 21 families were recorded in the catches of different gears used by the fishermen in Chikadubi beel which is closely related with the study of MACH [16].

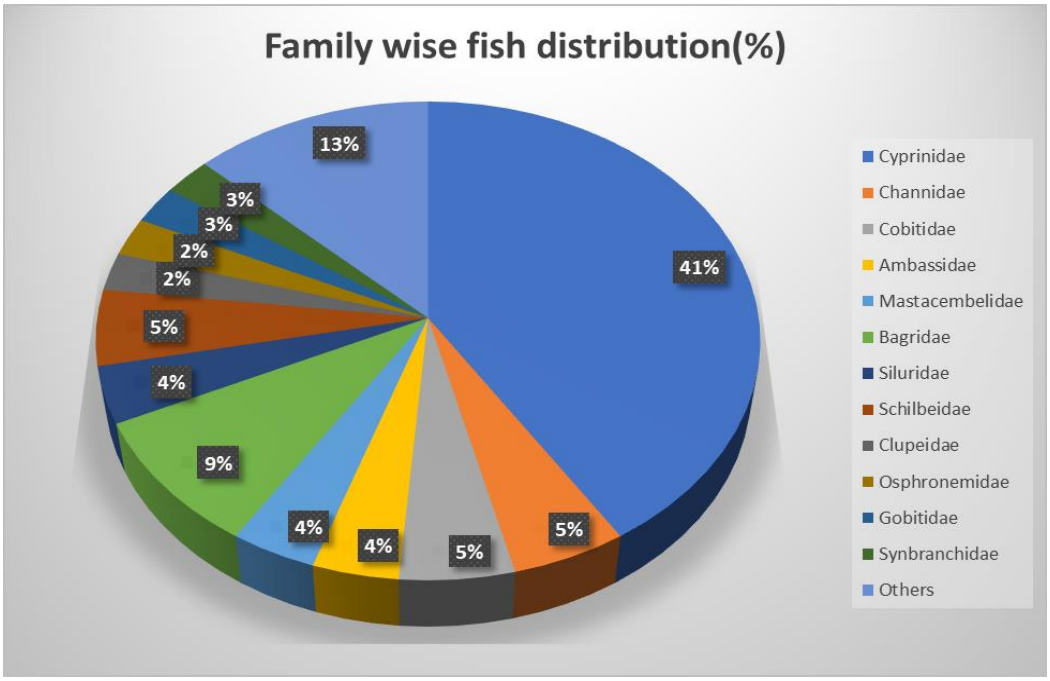

Fig. 2. Frequency distribution of fish species under different families

Table 1. Fish species found in Chikadubi beel after fish sanctuary establishment

Sl. No.	Family name	Local Name	Common Name	Scientific Name	IUCN Status	
					BD	Global
1	Cyprinidae	Mrigal	Indian major carp	*Cirrhinus cirrhosus*	NT	VU
2		Rui	Indian major carp	*Labeo rohita*	LC	LC
3		Catla	Indian major carp	*Labeo catla*	LC	NE
4		Kalibaus	Black Rohu	*Labeo calbasu*	LC	LC
5		Goinna	Goniya	*Labeo gonius*	NT	LC
6		Carpio	Common carp	*Cyprinus carpio*	NE	DD
7		Silver carp	Silver carp	*Hypopllthalmichthys molitrix*	LC	LC
8		Grass carp	Chainese carp	*Ctenopharyngodon Idella*	LC	LC
9		Mola	Mola	*Amblypharyngodon mola*	LC	LC
10	Cyprinidae	Chela	Silver hatchet Chela	*Chela cachius*	VU	LC
11		Chep Chela	Bengal danio	*Danio dangila*	VU	LC
12		Borali	Barred baril	*Barilius barila*	EN	LC
13		Borali	River-Carp baril	*Barilius gatensis*	EN	LC
14		Hiraluborali	Hamiltons barila	*Barilius bendelisis*	EN	LC
15		Elang	Bengala Barb	*Megarasbora elonga*	EN	LC
16		Sarpunti	Olive barb	*Systomus sarana*	NT	LC
17		Darkina	Flying Barb	*Esomus danricus*	LC	LC
18		Lachu	Lachu	*Labeo dyocheilus*	DD	LC
19		Bogabata	Bogalabeo	*Labeo boga*	CR	LC
20		Angrarui	Angralabeo	*Labeo angra*	LC	LC
21		Kala bata	Gangeticlatia	*Crassocheilus latius*	EN	LC
22		Dhela	Dhela	*Osteobrama cotio*	NT	LC
23		Punti	Glass barb	*Pethia guganio*	LC	LC
24		Jatiputi	Jatiputi	*Puntius sophore*	LC	LC
25		Kanchonputi	Rosy barb	*Puntius conchonius*	LC	LC
26		Rayekbata	Reba carp	*Cirrhinus reba*	NT	LC
27		Narkeli chela	Large razorbely minnow	*Salmostoma bacaila*	LC	LC
28		Nandinarui	Nandi labeo	*Labeo nandina*	CR	NT
29		Terio	Terio puti	*Puntius terio*	LC	LC
30		Puntio	Puntio barb	*Puntius puntio*	DD	NE
31		Lamba chela	Barb	*Salmostoma bacaila*	LC	LC
32		Titputi	Fire fin barb	*Puntius ticto*	VU	LC
33		Cheng	Asiatic snakehead	*Channa orientalis*	LC	LC
34		Shol	Snakehead murrel	*Channa striatus*	LC	LC
35		Gojar	Giant snakehead	*Channa marulius*	EN	LC

Sl. No.	Family name	Local Name	Common Name	Scientific Name	IUCN Status	
					BD	Global
36		Taki	Spotted snakehead	*Channa punctatus*	LC	LC
37	Cobitidae	Botya loach	loach	*Botia dayi*	EN	NE
38		Gutum	Guntea loach	*Iæpidocephalus guntea*	LC	LC
39		Bethi	Y loach	*Botia lohachata*	EN	NE
40		Rani	Bengal loach	*Botia dario*	EN	LC
41	Ambassidae	Glassy perchlet	Glassy perchlet	*Pseudambassis lala*	NY	LC
42		Lal chanda	Glassy perchlet	*Pseudoambasis ranga*	LC	LC
43		Nama chanda	Elongated glass perch	*Chanda nama*	LC	LC
44	Badidae	Perch	Blue perch	*Badis badis*	NT	LC
45	Anabantidae	Koi	Climibing earch	*Anabas testudineus*	LC	DD
46	Osphronemidae	Khalisha	Climibing pearch	*Colisa fasciatus*	LC	LC
47		Koi bandi	Paradise fish	*Pseudosphronaenus cupanus*	LC	LC
48	Nandidae	Veda	Mottled nundus	*Nandus nandus*	NT	LC
49	Gobitidae	Chiring	Gobi	*Apocryptes bato*	LC	LC
50	Mastacembelidae	Tara baim	One striped spiny eel	*Macrognathus aculeatus*	NT	NE
51		Guchi baim	Striped spiny eel	*Mastacembelus pancalus*	LC	LC
52		Boro baim	Tire-track spiny eel	*Mastacembelus armatus*	EN	NE
53	Synbranchidae	Kuchia	Mud eels	*Monopterus cuchia*	VU	NT
54		Baus	Bengal eel	*Ophisternon bengalense*	VU	LC
55	Bagridae	Tengra	Striped dwarf catfish	*Mystus vittatus*	LC	LC
56		Bujuri tengra	Long bled catfish	*Mystus tengra*	LC	LC
57		Batashi	Batashi	*Batasio batasio*	NT	LC
58		Gulsha	Long whiskered catfish	*Mystus cavasius*	NT	LC
59		Rita	Rita	*Rita rita*	EN	LC
60		Air	Long whiskered catfish	*Sperata aor*	VU	LC
61		Guji Air	Long whiskered catfish	*Sperata seenghala*	VU	LC
62	Claridae	Magur	walking catfish	*Clarius batrachus*	LC	LC
63	Siluridae	Boal	Fresh water shark	*Wallago atto*	VU	NT
64		Boali pabda	Butter catfish	*Ompok bimaculatus*	EN	NT
65		Pabda	Pabo catfish	*Ompok pabo*	CR	NT
66	Heteropneustidae	Shing	Stinging catfish	*Heterepneustes fossilis*	LC	LC

Sl. No.	Family name	Local Name	Common Name	Scientific Name	IUCN Status	
					BD	Global
67	Schilbeidae	Silon	Silond catfish	*Silonia silondia*	LC	LC
68		Kajuli	Khoila	*Aila coila*	LC	NT
69		Ghaora	Garu bacha	*Clupisoma garua*	EN	NE
70		Bacha	River Catfish	*Eutropiichthys vacha*	LC	LC
71	Clupeidae	Chapila	Indian river shad	*Gadusia chapra*	VU	LC
72	Clupeidae	Kachki	Shad	*Corica soborna*	LC	LC
73	Notopteridae	Foli	Feather back	*Notopterus notopterus*	VU	LC
74	Hemiramphidae	Ek tuta	Wrestling Halfbeak	*Hyporhamphus limbatus*	LC	NE
75	Belondiae	Kakila	Fresh water gar fish	*Xenentodon cancila*	LC	NE
76	Sisoridae	Gang tengra	Gang tengra	*Gagata gagata*	LC	LC
77	Gobiidae	Bailla	Bar-eyed goby	*Glossogobious giuris*	LC	LC
78	Aplocheilidae	Kanpona	Rice fish	*Aplocheilus panchax*	LC	LC

VU = Vulnerable, EN = Endangered, NT = Near threatened, LC = Least concern, DD = Data deficient, NE = Not evaluated, CR= Critically Endangered, BD=Bangladesh, GB=Global

Table 2. Fish species revived and their status after fish sanctuary establishment

Sl. No.	Family name	Local Name	Common Name	Scientific Name	Conservational status	
					BD	Global
1	Bagridae	Air	Long whiskered catfish	*Sperata aor*	VU	LC
2	Bagridae	Rita	Rita	*Rita rita*	EN	LC
3	Nandidae	Veda	Mud perch	*Nandus nandus*	NT	LC
4	Siluridae	Pabda	Pabda catfish	*Ompok pabda*	EN	NT
5	Channidae	Gozar	Giant snakehead	*Channa marulius*	EN	LC
6	Channidae	Shol	Striprd snakehead	*Channa striatus*	LC	LC
7	Cyprinidae	Gonia	Kuria labeo	*Labeo gonius*	NT	LC
8	Cobitidae	Rani	Bengal loach	*Botia dario*	EN	LC
9	Mastacembelidae	Tara baim	One striped spiny eel	*Macrognathus aculeatus*	NT	NE
10	Mastacembelidae	Sal baim	Tire track spiny eel	*Mastacembelus armatus*	EN	NE
11	Notopteridae	Chital	Humped featherback	*Notopterus chitala*	EN	NT
12	Notopteridae	Foli	Grey feather back	*Notopterus notopterus*	VU	LC
13	Cyprinidae	Angus	Angra labeo	*Labeo angra*	LC	LC
14	Cyprinidae	Lachu	Kalabans	*Labeo dyocheilus*	DD	LC
15	Schilbeidae	Vacha	Vacha	*Eutropiichthys vacha*	LC	LC
16	Gobiidae	Chiring	Goby	*Apocryptes bato*	LC	LC
17	Anabantidae	Koi	Climibing earch	*Anabas testudineus*	LC	DD
18	Cyprinidae	Jatiputi	Jatiputi	*Puntius sophore*	LC	LC

VU = Vulnerable, EN = Endangered, NT = Near threatened, LC = Least concern, DD = Data deficient, NE = Not evaluated, CR= Critically Endangered, BD=Bangladesh, GB=Global

Table 3. A checklist of non-conventional fisheries resources in the chikadubi beel

Phylum		Local name	Common name	Scientific name	Seasonal availability and breeding season
	Amphibia	Cola bang	Bull Frog	*Rana tigrina*	Available throughout the year, breeding season June- July
Chordata		Shona bang	Frog	*Rana hexadactyla*	Available throughout the year, breeding season June-July
	Reptilia	Kachim	Tortoise	*Trionyx gangeticus*	Available throughout the year, breeding season April-September
		Kasim	Tortoise	*Chitra indica*	Available throughout the year, breeding season April-September
Arthropoda		Golda chingri	Fresh water prawn	*Macrobrachium rosenbergii*	Available throughout the year, breeding season December-February
	Crustacea	Gura chingri	Fresh water prawn	*M. lamarrei*	Available throughout the year, breeding season April-June
		Bele chingi	Fresh water prawn	*M. dayanam*	Available throughout the year, breeding season December-February
		Shamuch	Snail	*Pila globosa*	Available throughout the year, breeding season April-June
Mollusca		Jhinuk	Mussel	*Unio* sp.	Available throughout the year, breeding season April-June
		Kakra	Crab	*Cancer* sp.	Available throughout the year, breeding season April- June

Accoding to Haque et al. [17] “during the study period, diversity in both native and exotic fish species (71) were increased where 62 species were native and 9 were exotic under 26 families of 11 orders”. So, the present study of the impact of fish sanctuary on fish biodiversity in chikadubi beel was closely related with the study of Baikka beel fish sanctuary. Relatively lower diversity with 33 and 26 fish species were recorded from Rajdhala beel and Padmai beel located at Netrokona district Rahman et al. [18]; Salda beel Saha and Hossain. [19].

Aziz et al. [20] reported a total 34 fish species inside the Matshyarani fish sanctuary. On the other hand, Taiyebi et al. [21] reported 35 fish species, Hasan et al. [22] reported 31 fish species and Khoshru et al. [23] reported 24 fish fishes inside of the sanctuary. According to present study a total of 78 fish species under 21 families were recorded in the catches of different gears used by the fishermen in Chikadubi beel as this sanctuary is located in dingaputa haor and this comprise a vast area of water body for this reason there is a difference between present and previous research.

In the present study, different numbers of fish species of different common groups were found in chikadubi beel. The number of fish species of different common groups named carps, catfishes, snakeheads, perches, eels, barbs and minnows, clupeids and miscellaneous species were 28, 16, 4, 6,5, 7, 2 and 10, respectively. Hossain et al. [24] reported 7 species of carps, 12 species of catfishes, 4 species of

snakeheads, 5 species of perches, 3 species of eels, 8 species of minnows, 3 species of clupeids and 7 species of miscellaneous groups from 49 species of fish fauna estimated from the Kolimar haor.

The high abundant of carp in chikadubi beel indicated that the fish sanctuary was especially helpful and acted as the friendly ecosystem for the carp fishes along with haor water body. From both the biodiversity and production point of view the high abundant of SIS showed a very good sign. The abundance of the most common types of fish fishes indicated that the fish sanctuary ecosystem was suitable for the fin fishes. The presence of different types of freshwater eels and loaches ensured that the ingredients used in sanctuary were helpful to congregate such type of bottom dwellers. The sanctuary in spite of large in size, was also suitable and provided sufficient space for big predators like Boal *Wallago attu*. Similar result was reported by Aziz et al. [20]; Khoshru et al. [23]; Hasan et al. [22]; Taiyebi et al. [21] inside the Matshyarani fish sanctuary. The Most abundant fish species in the Chikadubi beel for the establishment of fish sanctuary were Boal, Koi, Tengra, Baim, Chikra etc. Haque et al. [25] observed "43 species with the highest availability of a loach - *Psilorhynchus sucatio* and a catfish, tengra -*Mystus vittatus* in

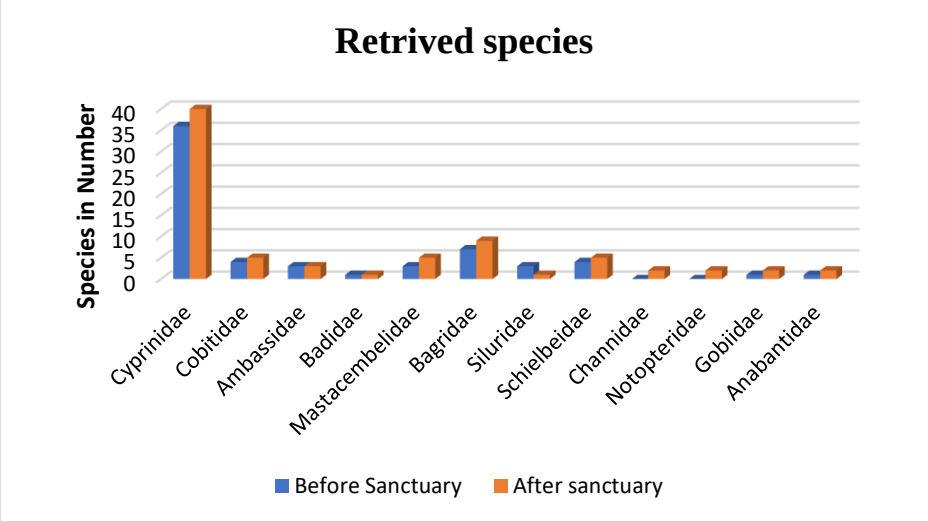

Fig. 3. Retrived fish species after establishment of sanctuary

Table 4. List of available aquatic weeds in chikadubi beel of dingaputa haor

Type of weed	Scientific name	Common name	Local name
	Ipomea carnea	Gloriad la manana	Dhol kolmi
	Enhydra fluctuans	Water cress	Helencha
Emergent weeds	*Polygonum glabrum*	Polygonum	Bishkatali
	Ipomea aquatica	Water spinach	Kolmi
	Hydrorayza aristata	Asian water weed	Dol
	Alternanthera philoxerodies	Alligatorweed	Malancha
	Ludwigia adscendens	Water primrose	Keshore dam
	Commerlina bengalensis	Dayflower	Kanai bashi
	Noimphea nauchali	Red water lilly	Lal shapla
	Nymphaea daubenyana	White water lilly	Sada shapla
Floating weeds	*Eichhornia crassipes*	Water hyacinth	Kachuripana
	Pistia stratiotes	Water lettuce	Topapana
	Lemna minor	Duck weed	Khudipana
	Azolla pinnata	Mosquito fern	Kutipana
Submergible weeds	*Hydrilla verticilata*	Water thyme	Hydrilla
	Cartophyllum demersum	Coontail	Kata jhanji

Table 5. Impact of chikadubi beel fish sanctuary on baseline production

Fiscal year	2015-2016	2016-2017	2017-2018	2019-2020	2020-21
Baseline production (MT/Ha)	0.58	0.73	1.02	0.94	1.12

*** Source: Department of fisheries, Upazila fisheries Office, Mohongonj, Netrokona.*

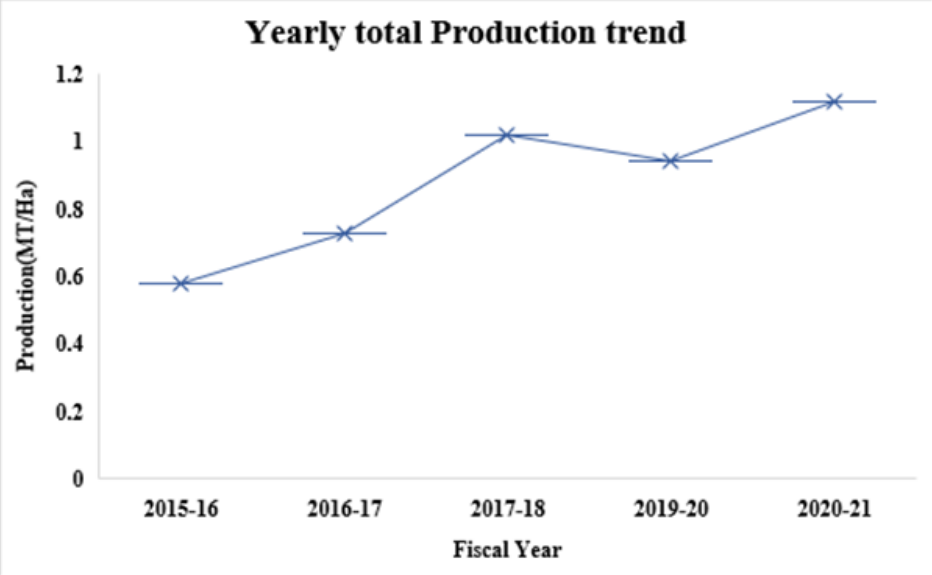

Fig. 4. Fish production trend in last 5 year

three sanctuaries established under CBFM-2 project in the three rivers - Updakhali, the Kalihar and the Kangsha in Netrokona district using bamboo and tree branches as sanctuary materials CBFM [26]."

In the present study, top 10 species Boal (6%), Taki (5.6%), Shol (5.3%), Kani pabda (5%), Common carp (4.8%), Gonia (4.5%), Koi (4%), Tit puti (3.7%), Tengra (3.2%), and Gulsha (3%) contributed 45.10% of the total catch by weight after fish sanctuary establishment in Chikadubi beel. Haque et al. [17], reported top 10 species (Boal, Taki, Shol, Foli, Common carp, Grass carp, Gonia, Koi, Jat puti and Meni) contributed 58.7% of the total catch by weight after the sanctuary establishment in 'Baikka Beel'.

We hoped that the findings of this study would be beneficial to a variety of stakeholders, including the fishing community, local managers, legislators, and Beel management authorities. Furthermore, we wish to encourage the national and international communities to organize thorough surveys to evaluate the significance of beel before it undergoes irreparable damage [27].

5. CONCLUSION

The fish sanctuary was established in Chikadubi beel in 2015, and continued till present experiment was carried out to observe the impact of the fish fish biodiversity and production of fish. It is found that total fish production was in increasing trend except in 2019-20 fiscal year that might be due natural calamities and mass disease outbreak in that haor area. According to the results, fish sanctuaries have an effect on fish species' abundance as well as fishes' qualitative and quantitative diversity.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ahmed KKU, Ahamed SU, Hasan KR, Mustafa MG. Option for formulating community-based fish sanctuary and its management in beel ecosystem in Brahmanbaria. 2007;10.
2. Azher SA, Khanom F, Dewan S. Impacts of fish sanctuaries on the production and

diversity of plankton in beels of haor region in Bangladesh. Bangladesh J. Fish. Res. 2006;10 (2):139-150.

3. Mozumder MM, Schneider P, Islam MM, Deb D, Hasan M, Monzer MA, Nur AA. Climate change adaptation strategies for small-scale Hilsa fishers in the coastal area of Bangladesh: social, economic, and ecological perspectives. Frontiers in Marine Science. 2023;10.
4. Hasan M, Lucky N, Hossain M. Natural food abundance and sis biodiversity of matshaya rani fish sanctuary. Journal of Environmental science and natural resources. 2012;5(1):319-328.
5. Cooke SJ, Piczak M, Nyboer EA, Michalski F, Bennett A, Koning AA, Hughes KA, Chen Y, Wu J, Cowx IG, Koehnken L. Managing exploitation of freshwater species and aggregates to protect and restore freshwater biodiversity. Environmental Reviews; 2023 (ja).
6. Gatto A, Sadik-Zada ER, Özbek S, Kieu H, Huynh NT. Deep-sea fisheries as resilient bioeconomic systems for food and nutrition security and sustainable development. Resources, Conservation and Recycling. 2023;197:106907
7. DoF (Department of Fisheries). National fish week compendium. Ministry of Fisheries and Livestock, Bangladesh. 2019;51-53.
8. Hossain MM, Moon TM, Rahman MH, Islam MA. Establishment of sanctuary in Belua River for fish exploitation and its impacts on fisheries biodiversity in the coastal region of Bangladesh. European Journal of Advanced Research in Biological and Life Science. 2017;5(2):33-44.
9. Ali ML, Hossain MAR, Ahmed M. Impact of sanctuary on fish production and biodiversity in Bangladesh. Bangladesh Fisheries Research Forum: Dhaka; 2009.
10. Parvez I, Sujan HS, Alam MS, Akter MN, Roy K, and Haque MR. Fish biodiversity and conservation status of the Dhepa river sanctuary in protection and restoration of threatened fishes of the northwest Bangladesh Journal of Biodiversity and Environmental Sciences. 2017;(10): 183-190.
11. DoF (Department of Fisheries). Fishery statistical yearbook of Bangladesh, 2018-2019. Fisheries recourses survey system, department of fisheries, Bangladesh, Dhaka. 2020;40-42.
12. DoF (Department of Fisheries). Fishery statistical yearbook of Bangladesh, 2020-2021. Fisheries recourses survey system, department of fisheries, Bangladesh, Dhaka. 2022;143-144.
13. Siddique MAB, Hussain MA, Alam MM, Haque MA, Flowra FA. Fish sanctuary as a sustainable management tool for recovering fish biodiversity, production and livelihood: A case study on Halti Beel tank sanctuary, Bangladesh Archives of Agriculture and Environmental Science. 2020;5(4):567-575
14. Islam MS, Hossain A. Sanctuary status on diversity and production of fish and shellfish in Sunamganj Dekar Haor of Bangladesh. Journal of the Asiatic Society of Bangladesh, Science. 2019;45(2):175–186.
15. Khan AA, Mohsin S, Mrityunjoy P, Debasish. Impact of fish sanctuary on fish biodiversity and livelihoods of fishermen in Kolavanga Beel of Bangladesh. 2018; 10:46-54.
DOI: 10.5829/idosi.wjfms.2018.46.54
16. MACH (Management of Aquatic Ecosystems through Community Husbandry). Fish catch and consumption survey report. Winrock International: Dhaka. 2003;3:176.
17. Haque MMU. Impacts of Baikka beel sanctuary on protection and restoration of fish diversity and enhancement of local livelihoods. Connecting communities and conservation: Co-management initiatives by IPAC in wetlands and forests of Bangladesh. USAID/ Bangladesh. 2013; 177-191.
18. Rahman MM. Comparison of benthic fauna of two beels of Netrakona district under different management condition. M.S. dissertation submitted to the Department of Aquaculture, Bangladesh Agricultural University, Mymensingh; 2000.
19. Saha BK, Hossain MA. Saldu beel fishery of Tangail. Bangladesh Journal of Zoology. 2002;30(2):187-194.
20. Aziz MT. Impact of a fish sanctuary on fish diversity in the old Brahmputra River, MS Thesis, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh; 2014.
21. Taiyebi KA. Effect of a fish sanctuary, matshyarani on the water quality parameters, Natural food abundance and fish biodiversity in the river old Brahmaputra. MS Thesis, Department of

Fisheries Biology and Genetics, Bangladesh Agricultural University, Mymensingh; 2009.
22. Hasan ANG. Hydrographic status, natural food abundance and sis biodiversity in matshyarani fish sanctuary. MS Thesis, Department of fisheries biology and genetics, Bangladesh Agricultural University, Mymensingh; 2008.
23. Khosru MS. Impact of matshyarani sanctuary on fish diversity and socioeconomic status of fishers. MS Thesis, Department of fisheries biology and genetics, bangladesh agricultural university, Mymensingh. 2007;78.
24. Hossain T. Study on biodiversity of fish fauna and socioeconomic condition of the fishermen in the Kolimar haor, Itna, Kishorgonj. M.S. Thesis, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh; 2007.
25. Haque M, Ahmed M, Mustafa G. Preferences of fishes to different types of Katha materials used in sanctuaries in three rivers of Netrokona, Bangladesh. Bangladesh Journal of Fisheries (Special Issue). 2007;30:147-156.
26. CBFM-2. Community Based Fisheries Management Project. Annual report January-December-2004, World Fish Center, Dhaka, Bangladesh; 2004-2005.
27. Hossain MAR. An overview of fisheries sector of Bangladesh. Research in Agriculture Livestock and Fisheries. 2014; 1(1):109–126.

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