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# Fish biodiversity and their conservation measures in the Mathabhanga river, Chuadanga, Bangladesh

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**Abstract:** The study was concerned to determine the present status of the fish biodiversity in the Mathabhanga river, Chuadanga and its conversation measures based on the questionnaire interview with 40 fishers, focus group discussion with river bank community members and cross check interview with key informants. A field study was conducted for a period of four months from December, 2021 to March, 2022 to assess the fish biodiversity in the Mathabhanga river, investigate the existing fishing practices and also to identify proper management strategies for the conservation of fish biodiversity in the river. The results revealed that three categories of fishers were engaged in the Mathabhanga river namely, professional fishers (45.0%), seasonal fishers (37.5%) and subsistence fishers (17.5%). Shannon-Weaver diversity (H) and Margalef's richness (D) values revealed that diversity and richness of fish species were the highest in March (H = 2.99, D = 4.45), followed by February (H = 2.96, D = 3.69) and January (H = 2.63, D = 3.15), while the lowest values were obtained in December (H = 2.60, D = 2.80). The Pielou's evenness (e) values were found to be slightly varied with the variations of total number of species, being the highest in December (e = 0.94) and the lowest in January (e = 0.91). Different types of fishing gears like seine net, gill net, cast net, hook and line, and traps were found to be operated to catch fish by the fishers during this survey. A total of 26 fish species were identified in the catches of the Mathabhanga river. According to the survey, indiscriminate and overexploitation were found to be responsible for almost 40% loss, and pollution and siltation caused about 25% loss of ecosystem. Around 20% and 15% loss of ecosystem were caused by habitat destruction and changes of river course, respectively. As a

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result, the water quality was deteriorating day by day, and the availability of fish species and other aquatic biodiversity were decreasing gradually. During the survey, almost 16 fish species was found at a risk to be endangered. The specific conservation measures including community based fisheries management, establishment of sanctuary, control of pollution, maintenance of fishing gears and the implementation of fisheries act should need to be made for the sustainable utilization and conversation of fish biodiversity in the Mathabhanga river.

**Keywords:** Fish Biodiversity, Fisheries management, Sustainable utilization, Conversation measures, Mathabhanga river

# 1 Introduction

Bangladesh, with its rich inland waters and river systems, has significant capture fishery and aquaculture potential. It has a vast area of water bodies in the form of rivers, ponds, tanks, canals, haors, beels, reservoir, Ox-bow lakes (baors), Kaptai lake, the Bay of Bengal and seasonally flooded areas. The country is fortunate enough to have a vast aquatic resource (both closed and open water bodies) and these are the principal sources of fish. It has gained 6.28% GDP in fisheries at the last five years (DoF, 2019). Hossain (2014) enlisted at least 293 fish species from 13 orders and 61 families that were found in the rivers, streams, ponds, ditches, beels, haors, baors, lakes and floodplains of Bangladesh in which 25 loach species were recognized under 3 families.

In Bangladesh, The Department of Fisheries (DoF) has been working for the sustainable development and management of the vast fisheries resources in the country as well as contributing significantly for the socio economic development of the people. Fisheries sector contributes 3.52% to the national GDP and more than one-fourth (26.37%) to the total agricultural GDP. Fish and fisheries products contribute 1.39% to the total export earnings. The country's vast fisheries resources are broadly divided into three sub-groups, i.e., inland culture, inland capture and marine capture. Inland culture fishery includes mainly pond/ditch, ox-bow Lake (baor), shrimp/prawn farm, seasonal cultured water-body, pen and cage culture etc., covering an area of about 8.37 lakh ha and produces 25.84 lakh MT accounting for about 57.38% of the total fish production in 2019-20 (DoF, 2020). The aquaculture production of 10.63 lakh MT in 2008-09 has been more than doubled to 25.84 lakh MT in 2019-20, showing consistent growth performance (DoF, 2020).

River Mathabhanga - Churni is a very important river in Bangladesh and also important in India. Especially, it is very important for Chuadanga district of Bangladesh and Nadia district in India. It is the tributaries in Ganges Padma river system, one of the major river system in Bangladesh. It originates in Bangladesh territory by leaving the main channel of the Ganges about 16 km below the divergences. The river has a great economic importance in sociological, environmental and economic aspects. It is the major source of surface water in this region and plays an important role in maintaining agriculture, fish production and livelihood of the fishermen (Biswas and Panigrahi, 2014). Biodiversity and its conservation are regarded as one of the major issues of enabling sustainable use of natural resources. Nevertheless, proper

maintenance of biodiversity in the open water (river) ecosystem is important to fulfill the national demand. The overall goal of this study was to conserve fish biodiversity of Mathabhanga river. The main objectives of the present study were: i) to estimate the availability of fish biodiversity in the Mathabhanga river, ii) to understand the existing fishing practices, iii) to observe the causes of threats to the biodiversity of the Mathabhanga river and iv) to identify proper management strategies for the conservation of fish biodiversity. The findings of the study will, in particular, be applicable to the management of the Mathabhanga river in Chuadanga, Bagladesh.

# 2 Materials and Methods

**2. 1. Study area and periods**

The Mathabhanga river of Chuadanga district was selected for the study area (Figure 1) and the primary areas of questionnaire interview were done around Doulotdiar, Hajrahati and hatkalugong regions in the Mathabhanga river. The study was conducted for four months from December, 2021 to March, 2022.


Figure 1. Partial view of the study area.

**2. 2. Target groups of fishers**

The target groups of fishers were chosen randomly from the study area in the Mathabhanga river of Chuadanga district, especially from Doulotdiar, Hajrahati and hatkalugong area. The total respondents were 40 fishermen and fishing community members for questionnaire interviews.

**2. 3. Data collection methods**

The methodology of the study involved some necessary steps, which are shown in Figure 2.

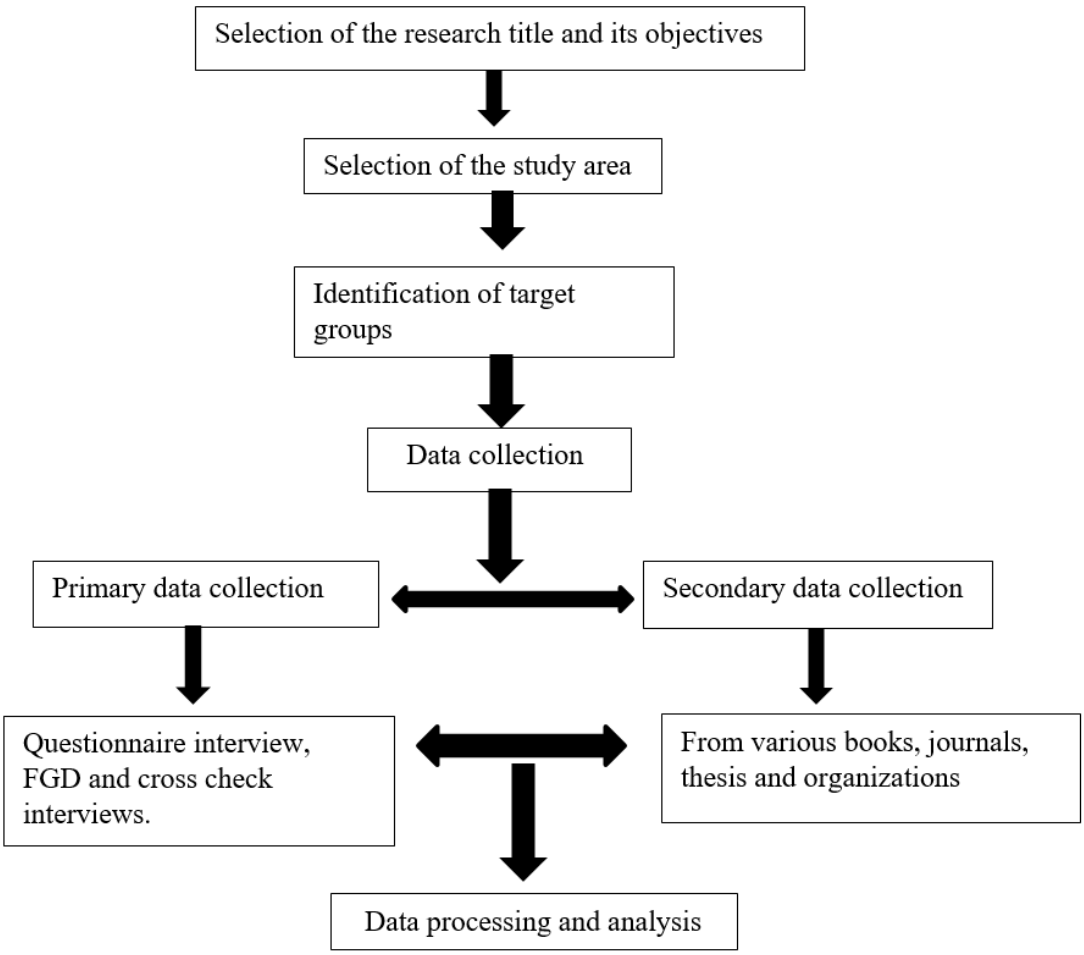


Figure 2. Methodology followed for the study.

**2. 4. Questionnaire interview**

The questionnaire interviews were conducted at the point sites in the selected area and other adjacent places.

**2. 5. Focus group discussion**

Focus group discussion (FGD) was conducted with two or three fishermen in the study area to get overall information about fish diversity.

**2. 6. Evaluation of biodiversity status**

To determine the seasonal diversity of fishes in the study area, month-wise data were collected. In this study, the Shannon-Weaver diversity index (H), Pielou's evenness index (e) and Margalef's richness index (D) were calculated for understanding the status of diversity using the following formulas:

- Shannon-Weaver diversity index, $H = -\Sigma Pi \ln Pi$ (Shannon and Weaver, 1949)

Where, H is the diversity index and Pi is the relative abundance (s/N).

- Margalef's richness index, $D = s-1/InN$ (Margalef, 1968)

Where, s is the number of individuals for each species, N is the total number of individuals and D is the richness index.

- Evenness index, e = H/InS (Pielou, 1966)

  Where, S is the total number of species, e is the similarity or evenness index, ln is the natural logarithm and H is the diversity index.

### 2. 7. Data processing and analysis

After collecting data from the survey, these were verified to eliminate errors and inconsistencies. Data were processed and analyzed by using Microsoft Excel Software.

## 3 Results and Discussions

### 3. 1. Results

#### 3. 1. 1. Fishers profile

On the basis of questionnaire survey with 40 fishermen, three categories of fishers were found in the Mathabhanga river (Figure 3), which are as follows:

1) Professional fishers (45.0%), who were depended on fishing all the year for their livelihood.

2) Seasonal fishers (37.5%), who harvested fish only during a part of the year as earning source.

3) Subsistence fishers (17.5%), who were mostly related with fishing for their own consumption.

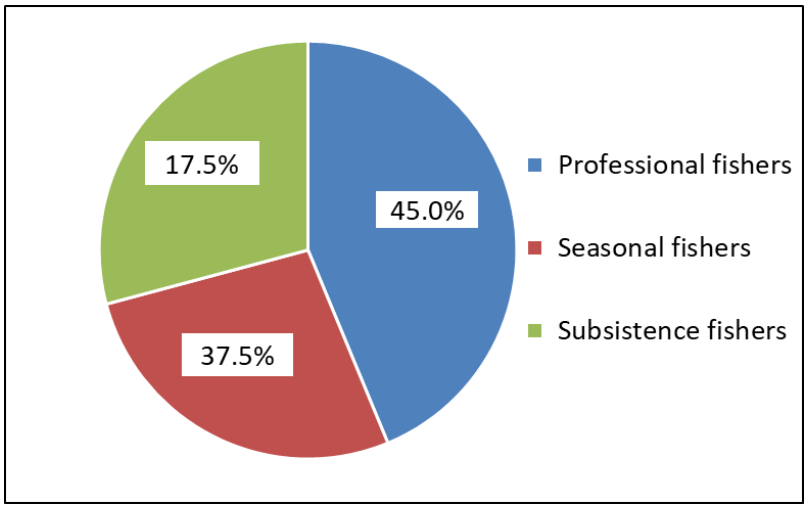


Figure 3. Three categories fishers in the Mathabhanga river.

#### 3. 1. 1. 1. Age structure

From the interview with fishermen, four categories of age composition of fishers were found around the Mathabhanga river. (Figure 4). Among these age groups, 42.5% fishers were above 40 years of age group, followed by 30-40 years (30.0%), 20-30 years (17.5%) and 10-20 years (10.0%).

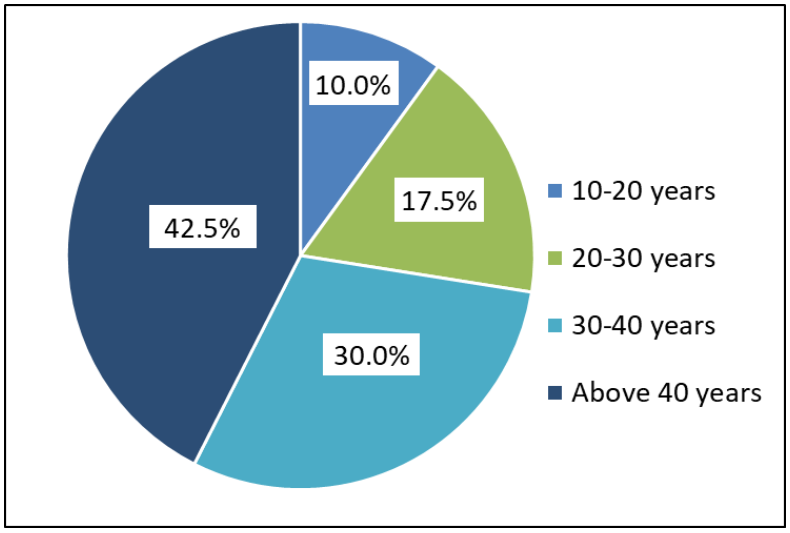


Figure 4. Age structure of fishermen in the study area of Mathabhanga river.

**3. 1. 1. 2. Fishing experience**

On the basis of experience, the fishermen were grouped into three categories, which are presented in (Figure 5). It was found that 55.0% fishers had 5-15 years of experience, 25.0% had 16-30 years and 20.0% fishers had above 30 years of experience in fishing activities.

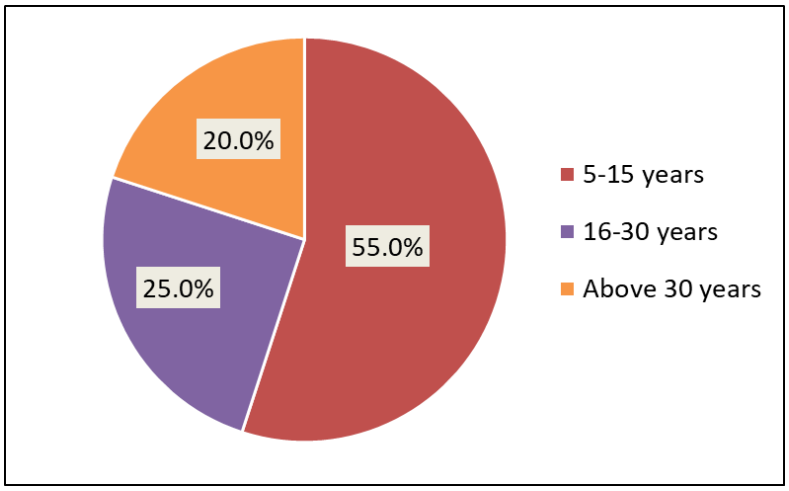


Figure 5. Fishing experience of the fishermen in the study area.

**3. 1. 1. 3. Educational status**

During the survey, four categories of educational status were found among the fishermen (Figure 6). Majority of the fishermen (62.5%) were observed to be illiterate, followed by primary education (20.0%), SSC (12.5%) and HSC (5.0%) in this order.

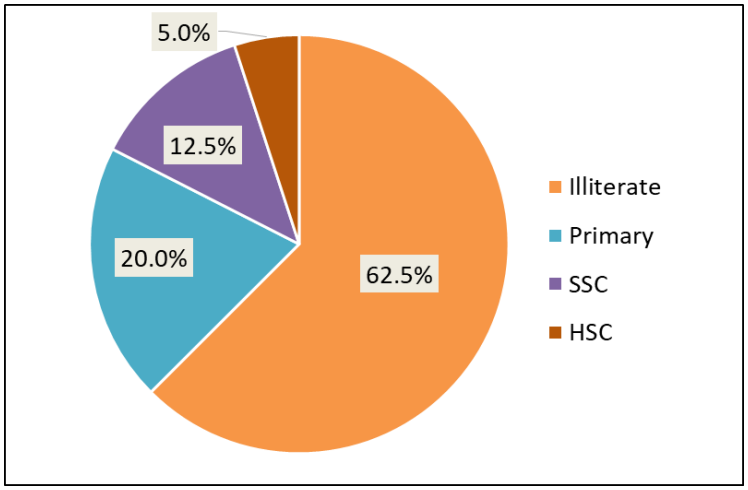


Figure 6. Educational status of fishermen in the survey area of the Mathabhanga river

**3. 1. 1. 4. Annual income of fishermen**

During the questionnaire survey, three categories of fishers were identified based on their annual income (Figure 7). It was found that around 50.0% fishermen had annual income between BDT 18,000 and 25,000, 40.0% fishermen had between BDT 30,000 and 40,000 and only 10.0% fishermen had annual income above BDT 50,000 (Figure 7).

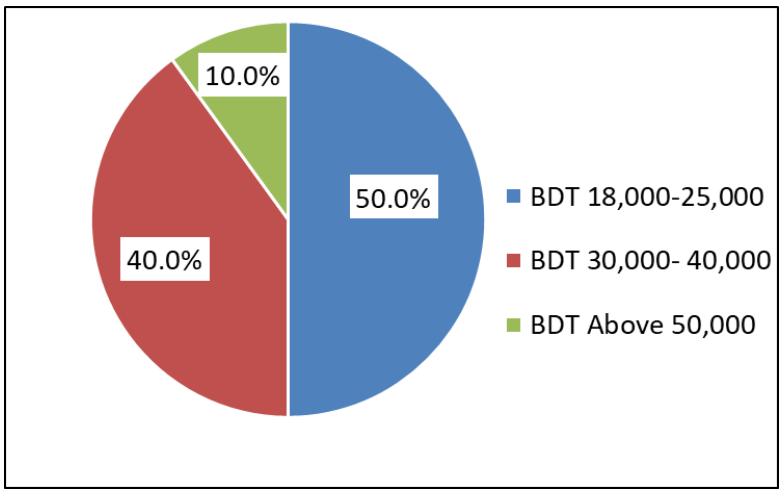


Figure 7. Annual income of the fishermen in the study area of Mathabhanga river

**3. 1. 2. Fishing practices**

**3. 1. 2. 1. Fishing seasons**

Throughout the field survey, the Mathabhanga river water was found to be encompassed along with various monsoon months such as:

i) Pre-monsoon season, started from April and ended in June and was considered to be the moderate season and catch of fish was the lowest in this season.

ii) Monsoon season, combined with the month of July, August and September during which fishing gears were widely used due to presence of current and high water level.

iii) Post-monsoon season, started from October and ended in December, and was regarded to be

the moderate peak season of fishing because most of the fishes were bred in this season.
iv) Dry season, combined with the month from January to March and the performance of fishing was less during this season.

**3. 1. 2. 2. Fishing gears used by the fishermen (%)**

In the study area, khepla jal (75.0%) was found to be used by the highest number of fishermen, followed by ber jal (67.5%), dharma jal (62.5%), kholshun (55.0%), borshi (50.0%), current jal (50.0%), tagi (37.5%) and koach (25.0%), while the lowest (17.5%) fishers used fiberhook (Figure 8).

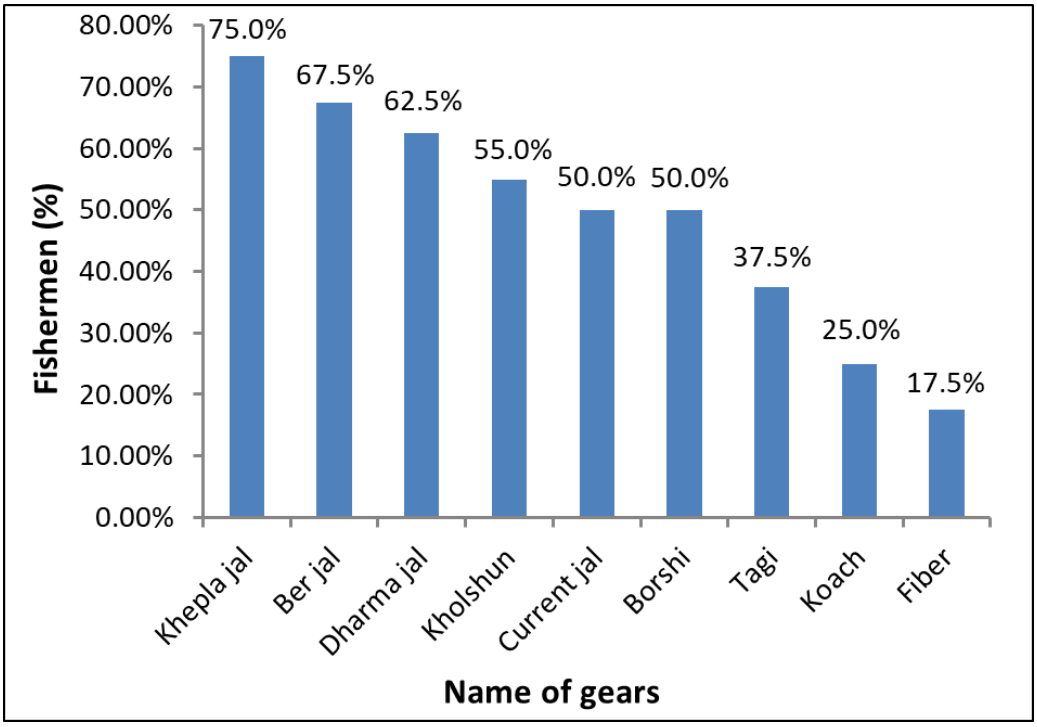


Figure 8. Fishing gears used by the fishermen (%) in the Mathabhanga river

**3. 1. 2. 3. Overall Catch Composition**

The percentages of various fish species were shown in Table 1. The fishermen mentioned that they used various types of gears to catch different species of fishes in the study area of Mathabhanga river. On the basis of the questionnaire survey, the percentages of catch composition of different fish species were estimated. The average percentage data were then calculated for each fish species and are summarized in Table 1. The percentages of various fish species were: rui (2.75%), catla (3.00%), mrigal (3.75%), kalibaush (4.00%), bata (8.25%), jatpunti (6.50%), titpunti (6.75%), sharpunti (5.50%), taki (9.63%), shol (5.75%), bowrani (0.25%), kajuli (0.33%), mola (3.14%), tengra (6.88%), buzuritengra (3.13%), boal (0.33%), rita (2.50%), ayre (1.36%), kachki (1.88%), kholisa (4.25%), guchi baim (4.00%), koi (3.75%), bele (2.75%), chanda (4.88%), kakila (0.94%) and magur (3.75%) (Table 1). From the result, taki (9.63%) was found to be caught at the highest percentage by the fishermen, while bowrani (0.25%) was the lowest percentage.

Table 1. Catch composition of fishes in the Mathabhanga river.

| Sl. no. | Name of fishes | | | Catch (%) |
|---|---|---|---|---|
| | **Group name** | **Local name** | **Scientific name** | |
| 1. | Indian major carp | Rui | *Labeo rohita* | 2.75 |
| 2. | | Catla | *Catla catla* | 3.00 |
| 3. | | Mrigal | *Cirrhinus cirrhosus* | 3.75 |
| 4. | | Kalibaush | *Labeo calbasu* | 4.00 |
| 5. | Minor carp | Bata | *Labeo bata* | 8.25 |
| 6. | Barb | Jatpunti | *Puntius sophore* | 6.50 |
| 7. | | Titpunti | *Puntius ticto* | 6.75 |
| 8. | | Sharpunti | *Puntius sarana* | 5.50 |
| 9. | Snake head | Taki | *Channa punctatus* | 9.63 |
| 10. | | Shol | *Channa striata* | 5.75 |
| 11. | Loach | Bowrani | *Botia dario* | 0.25 |
| 12. | | Kajuli | *Ailia coila* | 0.33 |
| 13. | Mola carplet | Mola | *Amblypharyngodon mola* | 3.14 |
| 14. | Cat fish | Tengra | *Mystus vittatus* | 6.88 |
| 15. | | Buzuritengra | *Mystus bleekeri* | 3.13 |
| 16. | | Boal | *Wallago attu* | 0.33 |
| 17. | | Rita | *Rita rita* | 2.50 |
| 18. | | Ayre | Mystus aor | 1.36 |
| 19. | Yellowtail mullet | Kachki | *Sicamugil cascasia* | 1.88 |
| 20. | Gourami | Kholisa | *Colisa fasciata* | 4.25 |
| 21. | Spiny eel | Guchi baim | *Mastacembelus pancalus* | 4.00 |
| 22. | Climbing perch | Koi | *Anabas testudineus* | 3.75 |
| 23. | Tank goby | Bele | *Glossogobius giuris* | 2.75 |
| 24. | Pomfret | Chanda | *Chanda nema* | 4.88 |
| 25. | Freshwater garfish | Kakila | *Xenentodon cancila* | 0.94 |
| 26. | Walking catfish | Magur | *Clarias batrachus* | 3.75 |

### 3. 1. 3. Biodiversity

#### 3. 1. 3. 1. Diversity, richness and evenness indices

The month-wise values of Shannon-Weaver diversity (H), Margalef's richness (D) and Pielou's evenness (e) indices were estimated and are summarized in Table 2. From Table 2, H and D values revealed that diversity and richness of fish species were the highest in the month of March (H = 2.99, D =4.45), followed by February (H = 2.96, D = 3.69) and January (H = 2.63, D

= 3.15), while the lowest in December (H = 2.60, D = 2.80). The Pielou's evenness (e) values were found to be slightly varied with the variations of total number of species, being the highest in December (e = 0.94) and the lowest in January (e = 0.91).

Table 2. The estimated values of Shannon-Weaver diversity (H), Margalef's richness (D) and Pielou's evenness (e) indices of fishes in the study areas of Mathabhanga river.

| Month | No. of species | No. of total individual | H | D | e |
|---|---|---|---|---|---|
| December | 16 | 211 | 2.60 | 2.80 | 0.94 |
| January | 18 | 222 | 2.63 | 3.15 | 0.91 |
| February | 24 | 512 | 2.96 | 3.69 | 0.93 |
| March | 26 | 277 | 2.99 | 4.45 | 0.92 |

**3. 1. 3. 2. Group-wise catch composition**

Interview with fishers showed that the highest amount of fish caught by the fishermen was barb (18.75%), followed by major carp (13.50%), minor carp (8.25%), snakehead (15.38%), mola carplet (3.14%), catfishes (14.2%), mullet (1.88%), gourami (4.25%), spiny eel (4.00%), climbing perch (3.75%), tank goby (2.75%), pomfret (4.88%), freshwater garfish (0.94%) and walking catfish (3.75%), while the lowest amount of catch contained the loach (0.58%) (Figure 9).

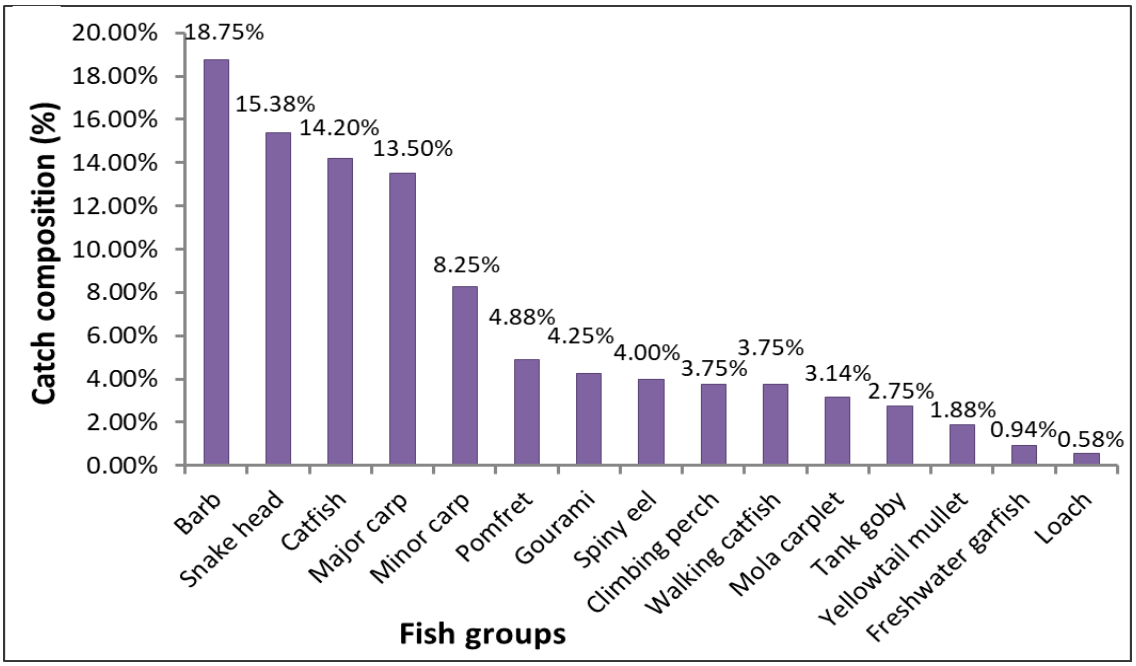


Figure 9. Percentage catch composition of different fish groups in the Mathabhanga river.

**3. 1. 3. 3. Other aquatic species**

Besides the different types of fishes, some other aquatic species were found during the interview with the fishermen in the Mathabhanga river. Those were aquatic birds, mussels, turtles, crabs, snails, snakes and frogs (Table 3).

Table 3. Other aquatic species found in the Mathabhanga river.

| Sl. no. | Species of other aquatic animals | | |
|---|---|---|---|
| | **Group name** | **Local name** | **Scientific name** |
| 1. | Aquatic bird | Maachranga | *Alcedo atthis* |
| | | Bok | *Grus grus* |
| 2. | Crab | Mud crab | *Scylla serrata* |
| 3. | Snail | Apple shamuk | *Pila globosa* |
| 4. | Mussel | Jhinuk | *Lamellidens marginalis* |
| 5. | Turtle | Kossop | *Melanochelys tricarinat* |
| 6. | Snake (aquatic) | Guisaap | *Varanus bengalensis* |
| 7. | Frog | Kuno bang | *Bufo melanostictus* |

### 3. 1. 3. 4. Threats of fisheries biodiversity

The threats of fisheries diversity can be occurred by various reasons. From the survey, 40% destruction of biodiversity was found to be caused by overexploitation, followed by 25% from water pollution and 20% from habitat degradation, wherein the lowest (15%) destruction was caused by the changes of river course. (Figure 10).

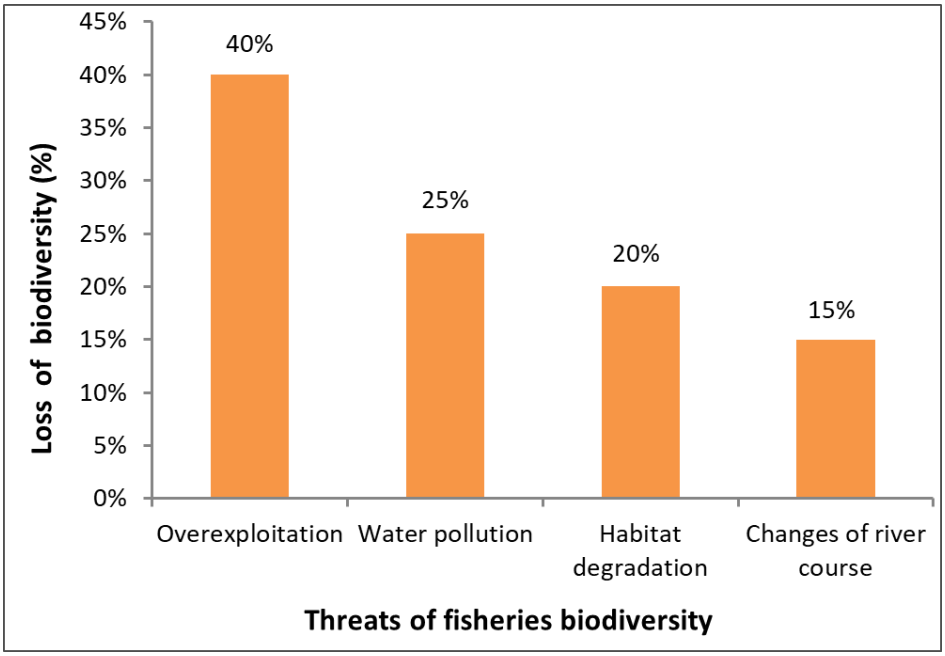


Figure 10. Threats of fisheries biodiversity in the Mathabhanga river

### 3. 1. 3. 5. Threatened species of fishes

From the interview with the fishers, it was proved that many fish species were abundant once in the Mathabhanga river but now became scarce. The list of the threatened species of fishes are presented in (Table 4). As shown in Table 4, mohashol (*Tor tor),* lalkholisha (*Colisa*

*labius),* chitol *(Chitala chitala),* foli *(Notopterus notopterus),* kanipabda *(Ompok bimaculatus)* were found to be critically endangered species; bacha (*Eutropiichys vacha*), baghayre (*Barius bagarius*), gajar (*Channa marulius*), pabda (*Ompok pabda*), bashpata (*Ailia colilia*), gonia (*Labeo gonia*), gutum (*Lepidocephalus guntea)* were endangered species; dhela (*Osteobrama cotio*), bata (*Labeo bata),* bowrani *(Botia Dario),* kajoli *(Ailichthys punctata)* were vulnerable species in this order.

Table 4. The threatened species of fishes in the Mathabhanga river.

| Sl. No. | Local Name | Scientific Name | Ecologically important species | Commercially important species |
|---|---|---|---|---|
| | | **Critically Endangered Species** | | |
| 1. | Mohashol | *Tor tor* | ✓ | ✓ |
| 2. | Lalkholisha | *Colisa labius* | ✓ | |
| 3. | Chitol | *Chitala chitala* | ✓ | ✓ |
| 4. | Foli | *Notopterus notopterus* | ✓ | ✓ |
| 5. | Kanipabda | *Ompok bimaculatus* | ✓ | |
| | | **Endangered Species** | | |
| 6. | Bacha | *Eutropiichys vacha* | ✓ | |
| 7. | Baghayre | *Barius bagarius* | ✓ | ✓ |
| 8. | Gajar | *Channa marulius* | ✓ | ✓ |
| 9. | Pabda | *Ompok pabda* | ✓ | ✓ |
| 10. | Bashpata | *Ailia colilia* | ✓ | |
| 11. | Gonia | *Labeo gonia* | ✓ | |
| 12. | Gutum | *Lepidocephalus guntea* | ✓ | |
| | | **Vulnerable Species** | | |
| 13. | Dhela | *Osteobrama cotio* | ✓ | |
| 14. | Bata | *Labeo bata* | ✓ | |
| 15. | Bou Rani | *Botia Dario* | ✓ | |
| 16. | Kajoli | *Ailichthys punctata* | ✓ | |

**3. 1. 3. 6. Conservation measures**

**3. 1. 3. 6. 1. Create awareness among the community people**

It was found from the questionnaire interview that fishermen and other local community peoples around the study area of Mathabhanga river that they did not have sufficient knowledge about the fishing as well as conservation of fish and other aquatic species.

**3. 1. 3. 6. 2. Building up fish sanctuary**

During the survey, the fishers opined to establish fish sanctuary around the Mathabhanga river to protect threatened fish species, juvenile fishes. Fishes get a shelter in spawning ground for natural propagation. Proper maintenance of fish sanctuary also reduce the causes of

extinction of fishes. It also helps for holding fish stock, preserving biodiversity and improving of fish production.

**3. 1. 3. 6. 3. Limitation of the use of destructive gears**

From the questionnaire survey, we observed that fishermen used banned fishing gears, which destroyed fish, fingerlings and juveniles due to improper knowledge of fishermen.

**3. 1. 3. 6. 4. Limitation of overfishing**

It was found in the study area that fishermen did not have enough knowledge about overfishing as well as it's negative impact on fisheries. They also operated their fishing activities during spawning and breeding season. As a result many brood fish could not spawn and ultimately reduced the overall fish production.

**3. 1. 3. 6. 5. Water pollution control**

The survey revealed that agricultural chemicals, domestic wastes, garbage and oil spills were the principal causes of water pollution in the Mathabhanga river. From these wastes, toxic substances entered into the food chain of tropic level and thus impeded the aquatic system.

**3. 1. 3. 6. 6. Fishing acts and regulations**

From the questionnaire survey with the fishermen, we found that fishermen did not follow fishing rules and regulations as they did not have any training about these rules and regulations. Fishers used different illegal fishing gears and operated destructive fishing activities, which reduced the fish production.

**3. 2. Discussion**

**3. 2. 1. Fishers profile**

The observation from the present study revealed that about 50% families were totally depended on fishing from the Mathabhanga river for their livelihood. From the result, three categories fishers were found around the Mathabhanga river. Rahman et al. (2015) reported that a total of 50% of both the professional and subsistence fishermen were living around the area of Talma river. From the interview with fishermen, four categories of age compositions of fishers were found around the studied area in which 42.5% fishers were above 40 years of age, 30.0% were between 30 and 40 years, 17.5% were between 20 and 30 years, while only 10% fishers were between 10 and 20 years. Baki et al. (2015) found that 48% respondent was within the age group of 31-40 years in Turag-Buriganga river near Dhaka. It was observed that 55% fishermen had the fishing experience for 5-15 years, followed by 25% fishermen for 16-30 years and 20% fishermen for >30 years. Hossen et al. (2018) found 52% fishermen, who had fishing experiences <15 years. The findings of the study is similar to this study.

On the basis of questionnaire survey, four categories of educational status were found among the fishermen. Among them 62.5% fishermen were illiterate, 20.0% had primary education, 12.5% had secondary education and 5% had higher secondary education. Kabir et al. (2012) also reported that among the fishermen of Old Brahmaputra River, 88.0% were illiterate, 2.0% could sign only and remaining 10.0% passed primary level. Kabir et al. (2012) revealed

that about 60% of the fishermen had annual income from BDT 24000 to 35000 and 30% of the respondent had income in the ranged between BDT 35000 and 45000 in the old Brahmaputra river, which was more or less similar with the findings of Ali et al. (2009) and the present study.

**3. 2. 2. Fishing practices**

**3. 2. 2. 1. Fishing gears**

Various types of fishing gears were found to operate in the study area and were mostly of traditional types. Mainly fishing nets, traps and wounding gears were used in the Mathabhanga river. Among them, khepla jal (75.0%) was found to be used by the highest number of fishermen, while the lowest (17.5%) fishers used fiberhook. Kabir et al. (2012) reported that net and trap were mainly used in Brahmaputra River. Nurullah et al. (2005) described that 6 different types fishing trap were used for catching SIS in Bangladesh. The net was also found to be used in Potuakhali, Barishal, Comilla, Dhaka, Khulna and Chittagong districts of Bangladesh (Das and Bandayapaddaya 2000). These findings were more or less related to the present study.

**3. 2. 2. 2. Overall Catch composition**

The result showed that several fish species were available in the Mathabhanga river including rui (2.75%), catla (3.00%), mrigal (3.75%), kalibaush (4.00%), bata (8.25%), jatpunti (6.50%), titpunti (6.75%), sharpunti (5.50%), taki (9.63%), shol (5.75%), bowrani (0.25%), kajuli (0.33%), mola (3.14%), tengra (6.88%), buzuritengra (3.13%), boal (0.33%), rita (2.50%), ayre (1.36%), kachki (1.88%), kholisa (4.25%), guchi baim (4.00%), koi (3.75%), bele (2.75%), chanda (4.88%), kakila (0.94%) and magur (3.75%). Rahman et al. (2015) reported the percentage of catch of different fish species in the Talma river including rui (0.88%), catla (0.86%), kalibaush (0.45%), mrigal (0.81%), titpunti (2.77%), mola (1.39%), sharpunti (1.89%), raicon (1.64%), gutum (0.86), rani (1.69%), taki(1.51%), shol (1.31%), khalisha (2.77%), lal chanda (0.91%), bailla (2.02%), napit koi (0.30%), guchi baim (2.14%), tengra (3.03%). Murtuza (1992) also found the similar indigenous major carps and exotic fish species in the Meghna river.

**3. 2. 3. Biodiversity**

**3. 2. 3. 1. Diversity, richness and evenness indices**

The month-wise fish diversity (H), richness (D) and evenness (e) of fishes in the study aera was estimated. The value of Shannon-Weaver diversity index (H) usually increases when the number of species increases. A value of H near 4.6 would indicate that the numbers of individuals are evenly distributed between all the species (Bibi and Ali, 2013). The H and D values revealed that diversity and richness of fish species were the highest in the month of March (H = 2.99, D =4.45), followed by February (H = 2.96, D = 3.69) and January (H = 2.63, D = 3.15), while the lowest in December (H = 2.60, D = 2.80). Here evenness values varied with the variation of total number of species. Rahman et al. (2015) also reported the Shannon-Weaver diversity (H), Margalef richness (D) and evenness (e) values from March to October of Talma River at Northern Part of Bangladesh and found that highest values (H = 1.51, D =7.41, e = 0.73) in the month of October and the lowest values (H = 1.37, D =6.97, e = 0.66) in the month of March, These results are similar to the present study.

**3. 2. 3. 2 Group-wise catch composition**

The study showed that among the varieties of fish, the highest amount of fish caught by the fishermen was barb 18.75%, followed by major carp (13.50%), minor carp (8.25%), snakehead (15.38%), mola carplet (3.14%), catfishes (14.2%), mullet (1.88%), gourami (4.25%), spiny eel (4.00%), climbing perch (3.75%), tank goby (2.75%), pomfret (4.88%), freshwater garfish (0.94%) and walking catfish (3.75%), while the lowest amount of catch contained the loach (0.58%). Galib (2008) reported that the highest catch of catfish was (12.90%), followed by major carps contained (11.26%), barbs remained at (11.00%) and loaches constituted (1.30%) of the total catch in Chalan beel. Pramanik et al. (2017) also reported that twenty (20) common groups were recorded in the present study. Catfishes contributes the highest percentage (29%) followed by mudskippers (12%), barbs & minnows (10%), perches (8%), carps (6%), clupeids (5%), eels (5%) and anchovies 4%. mullets, croakers and sleepers contribute 3% each whereas gars, feather backs, threadfins and flatheads shares 2% each. In addition, snakeheads, tarpons, pony fishes and pipefishes represent only 1% each, these findings were more or less similar to the present study.

**3. 2. 3. 3. Other aquatic species**

Various aquatic species were found in the Mathabhanga river. The findings of the study were also related to those reported by Halwart (2006).

**3. 2. 3. 4. Threats of fisheries biodiversity**

The threats of fisheries diversity can be ranked under four interacting categories such as, 40% destruction of biodiversity in the Mathabhanga river, water pollution caused 25% of loss, changes of river course resulted in 15% of loss and habitat degradation caused 20% of biodiversity loss in the river. Islam et al. (2017) found that the overexploitation of fishes was 40% responsible for the biodiversity destruction in the Bhairab River and water pollution caused 35% loss of biodiversity. Henceforth, river course change resulted in 15% of loss and habitat degradation caused 10% of biodiversity loss of the river, the findings of these study is similar to the present study.

**3. 2. 3. 5. Threatened species of fishes**

From the questionnaire survey, it was evident that many fish species (such as chitol, foli, gajar, bata etc.) were once abundant in the Mathabhanga river but now became scarce. Galib et al. (2013) identified a large number of fish species (41.72%) as threatened from the river choto Jamuna in the northern part of Bangladesh. In addition, 32.80% of threatened fish species were identified in the northwestern part of Bangladesh from the study by Parvez et al. (2019), these study were more or less similar with the present study.

**3. 2. 3. 6. Conservation measures**

It revealed from the present survey that lack of awareness, uses of banned fishing gears, water pollution, lack of established sanctuary, improper maintenance of rules and regulations, domestic and industrial garbage, and agricultural runoff were the principal causes of decreasing fish diversity. To stop the damage of fish biodiversity as well as retain the total

stocks, conservation measures and effective administration strategies are exceptionally fundamental. Raj (2002) reported freshwater fish biodiversity and their conservation measures in India. He suggested to take necessary actions like establishment of sanctuary, determination of the environmental requirements of the species etc. Moreover, hydrological improvement and biological network, protection of habitat and disposal of all destructive fishing gears are immediately needed to maintain fish biodiversity (Hossain, 2014; Rahman, 2015; Galib et al., 2018). Several illegal fishing gears have been highly damaging juvenile fish, which include set bag nets (badha jal, behundi jal and pona jal), beach seine nets (moshari jal, char ghera jal and ber jal) and small meshed monofilament net (current jal). Appropriate conservation activities would be necessary to control destructive fishing gears, particularly banned gears that capture threatened species. So, fishermen must have to follow the rules and regulations for the uses of these destruction gears. Government and local leaders must have to give them proper training on fishing practices and conservation measures to maintain fish biodiversity in the Mathabhanga river to a greater extent.

# 4 Conclusion

Mathabhanga river is a very considerable zone for fishes and aquatic species in Bangladesh. During this study, we came to know about the diversity of fishes and other aquatic species. From the survey, we could also know the fishing activities by fishermen using different fishing gears to determine the catch composition of various fish species, biodiversity index, threatened species and also realized that what types of measures will be taken by Government to conserve fish species. Illegal fishing gears such as current jal, ber jal, moshari jal, char ghera jal, pona jal must be limited for fishing. There are many threats such as water pollution, habitat degradation, changes of pathway and overexploitation should be reduced by proper management. Government should trained up all illiterate fishermen and river side peoples about the negative impact of water pollution, destructive fishing gears, fishing during breeding season and also trained up to maintain all fishing rules and regulations. Public awareness must have to be increased about the effect of water pollution. Through these ways, it would be possible to conserve and rehabilitate the valuable fish biodiversity in the Mathabhanga river in a sustainable manner in commensurate with national demands.

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## Conflict of interests

The authors declare that they have no conflict of interests.

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