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DECLINATION OF FISH BIODIVERSITY AND SOCIO-ECONOMIC STATUS OF THE FISHING COMMUNITY OF MATHABHANGA RIVER IN CHUADANGA DISTRICT OF BANGLADESH

Farhana Haque*, Sharifa Marmita Noori, Jahid Hasan and Dinesh Chandra Shaha

Department of Fisheries Management, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706, Bangladesh.

***Corresponding e-mail:** farhanaislampur@yahoo.com

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ABSTRACT

The Mathabhanga river has abundant fish resources, which plays a significant role in maintaining and replenishing the fish resources. The study was conducted from March to October, 2019 by a questionnaire survey and socio economic study of the fishermen in the Chudanga district. However, fish bio-diversity has rapidly declined in the Mathabhanga River. In this study, 44 fish species were found in the Mathabhanga River belonging to eight orders, 18 families and 29 genera. According to the IUCN Red List, 24.99% of fish species were threatened. Among the threatened species, 13.63% were vulnerable, 9.09% endangered and 2.27% were critically endangered. About 45% of fishermen were illiterate and housing condition of fishermen were dominated by tin-shed with bamboo (65%). A significant proportion of fishermen depend upon village doctors (62%) and 86% of the fishermen were far from power plants. Majority (45%) of fishermen were landless and 75% of fishermen were engaged in fishing as their main occupation whereas 65% of the fishermen had annual income between Tk. 35000 to Tk. 55000. In addition, overall values of diversity richness and evenness indices were found 1.12, 4.99 and 0.57,for vulnerable, endangered, and critically endangered species, respectively. These results indicated that dam construction and other human activities have seriously destroyed the fish habitat and led to the decline in fish diversity. Therefore, the conservation of fish has become urgent in the Mathabhanga River, and an integrated management plan should be developed and effectively implemented.

Keywords: Catch composition, richness, evenness, diversity, livelihood

Introduction

Bangladesh is blessed with vast and well-diversified inland water closed waters, inland open waters, estuaries, brackish, and marine waters with potential fisheries resources (DoF 2020). Bangladesh, with its large river systems, has significant capture fishery potential and the suitable geographic location of Bangladesh comes with a large number of fish and other aquatic species (Shamsuzzaman *et al.* 2017). It is one of the largest aquacultures producing countries with an estimated production of 42.76 lac metric tons in the 2017-2018 fiscal and it would be 45.54 lac metric tons in the 2020-2021 fiscal (DoF 2020). In terms of production, Bangladesh ranks third in inland fish production among the countries of the world (FAO 2018). In fact, fish is the second staple food after rice in Bangladesh where the fisheries sector contributes about 60% of the national animal protein. But the per capita fish intake in the country amounts to 52 g/capita/day (DoF 2020) against a recommended level of 68 g/capita/day. This sector contributes 3.57% to GDP, 25.30% to agriculture, and 1.5% to the total foreign exchange earnings of Bangladesh (DoF 2020).

The total number of freshwater fish species occurring in Bangladesh compiled as 250 to 266 species (Rahman 2005, Siddiqui *et al.* 2007). Freshwater fish are not only the most diverse group of vertebrates but also have the greatest proportion of threatened species (Hasan *et al.* 2021). According to IUCN (2015) red list revealed 64 threatened freshwater fish species in Bangladesh, of which 9 are critically endangered, 30 are endangered, and 25 are vulnerable. The livelihood status of fishermen mostly depends on fisheries resources. In the last few decades, stress caused by anthropogenic degradation due to urbanization, construction of dams, abstraction of water for irrigation and power generation, and pollution had many negative impacts on the biodiversity of freshwater fish

species in the river (Sarkar *et al.* 2008). Fish assemblages are also an important element in aquatic ecosystems, which are used as one of four biological indicators for aquatic ecosystem assessment (Shaha *et al.* 2020). Recently, the importance of monitoring biodiversity in protected areas has been realized by developing countries.

The river Mathabhanga is an Indo-Bangla River which plays an important role in fisheries sector in South Bangle region and Bangladesh. The Mathabhanga is a branch of the Padma River (known in India as the Ganges River) located in Chuadanga, southwestern district of Bangladesh (23°21′–23°51′N, 88°38′–88°62′E). It is believed to be an important spawning and feeding ground for riverine fish species of southwestern Bangladesh (Hossain *et al.* 2006a).The Mathabhanga River is a transboundary river between India and Bangladesh. It has great influence on fish biodiversity and socio-economic status of fishermen. Around 700 families are directly involved in fishing and earning to maintain their` livelihood by fishing in the Mathabhanga River throughout the year. The fishing community is very important to enrich the fish biodiversity and economy of Bangladesh (Khan *et al.* 2013).Once the river was rich in fish biodiversity and the livelihood of thousands of fishers' families were fully dependent on Gorai River, but in the recent years due to many man-made and natural causes the availability of fish was drastically reduced. Fish assemblage structure in the Mathabhanga River of Bangladesh has not been well studied; although there are some scattered works on different biological aspects. However, the present study is undertaken with the following objectives, to assess the fish biodiversity and abundance of fish fauna in the Mathabhanga River, to evaluate the socio economic condition of the fishermen and prepare the recommendations for the improvement of aquatic environment to prevent the loss of biodiversity.

Materials and Methods

Study area and survey design: Site selection is a very important step for conducting any research work. The present study was carried out at Mathabhanga River, Chuadanga (Figure 1). The design of the present research work was presented below (Figure 2). The study was conducted for a period of 8 months from March to October, 2019. The data were collected monthly throughout the study period. A total of 40 fishermen were randomly selected from the villages including Shoighoria, Shampur, Sultanpur, and Joynagar surrounding the river. Both professional and subsistence fishermen living around the area of the Mathabhanga River were selected for the study. For this study, a combination of interview schedule, participatory rural appraisal (PRA) tool such as focus group discussion (FGD), social mapping and cross interviews with key informants were used for fishermen.

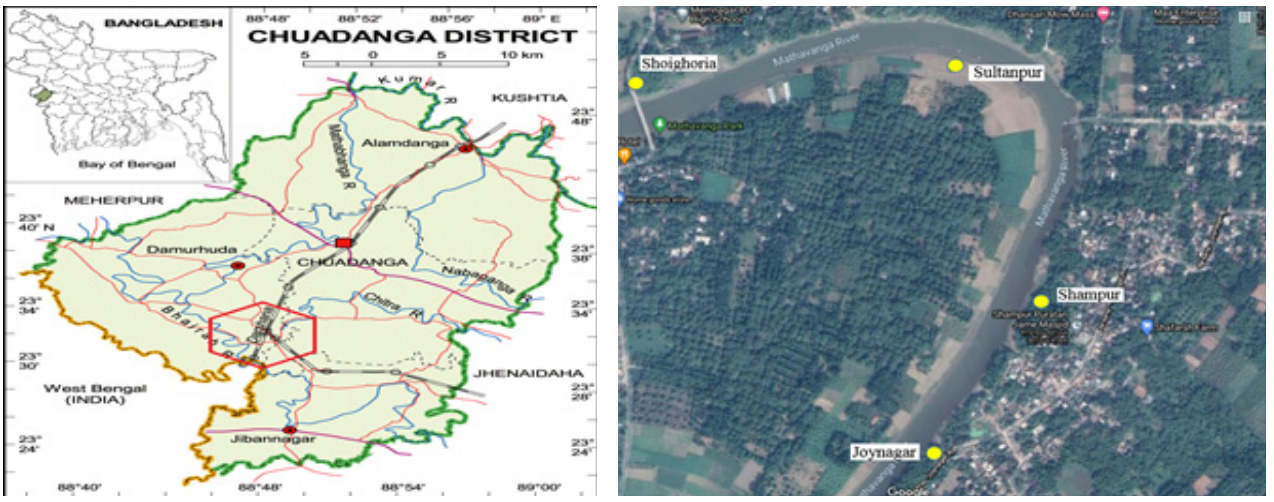


Figure 1. Map of Mathabhanga River at Chuadanga District.

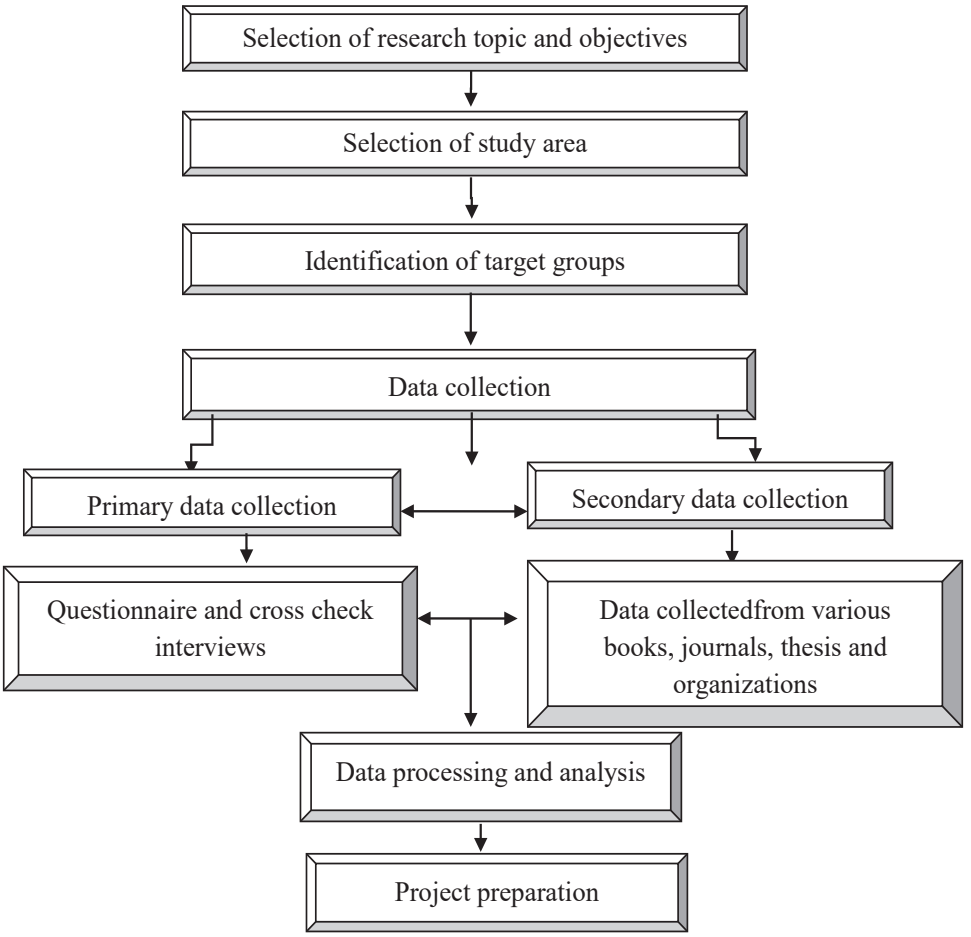


Figure 2. The research designs.

Preparation of interview schedule: Interview schedule is very important for collecting data by survey method. In order to get a complete picture of fish biodiversity and livelihood of fishermen and also to fulfill the objectives of the present study, a draft interview schedule was prepared. The draft interview schedule was then used for pre-testing a few sample respondents. The final schedule was developed in a logical sequence so that the fishermen could answer chronologically. The schedule included various questions related to socio-demographic condition, income source and net income of fishermen and family members, factors affecting the level of fish production and other relevant aspects of river fisheries.

Fish sampling: Fish sampling was done monthly with the help of traditional fishing nets viz. cast nets, seine net, lift nets and fishing trap (locally known as Poyamari). Fish samples were transported to the laboratory and identified based on their morphometric and meristics characters following (Bhuiyan 1964, Rahman 2005, Talwar and Jhingran1991). After identification, fish species were systematically classified (Nelson 2006). Fish diversity, evenness and richness indices were calculated for understanding the status of diversity (Shannon and Weaver 1949, Pielou, 1966, Bibi and Ali2013).

Statistical analysis: The collected data were summarized and processed for analysis. These data were verified to eliminate all possible errors and inconsistencies. Tabular technique was applied for the analysis of data by using simple statistical tools like averages and percentages. Finally, the processed data were transferred to a master sheet from which classified tables were prepared revealing the finding of the study. For processing and analysis purpose, SPSS 16.5, MS Excel MS word and PAST software have been used and fish biodiversity were calculated by online Shannon-Weaver species diversity index.

Results and Discussion

Fish biodiversity: A variety of fishes which comprised of 44 species of fish fauna were recorded at Mathavanga River belonging to 29 genera, 18 families and 8 orders**.** Cypriniformes was found the most dominant order in view of species variety. Siluriformes and Perciformes occupied second and third position of abundant recorded in Mathavanga River, respectively. Galib *et al.* (2013) found 63 species belonging to 41 genera, 23 families and 9 orders in Choto Jamuna River. Khan *et al.* **(**2013) found 42 fish species belonging 7 common group in Tista River. Hossain (2007) recorded 49 species in Chalan Beel area. The present study indicates that fish biodiversity was lower in comparison with the total fish population found in different areas.

Cypriniformes: During the present study 23 species with four families of Cypriniformes named Cobitidae, Balitoridae, Psilorhynchidae and Cyprinodontidae were recorded. Cypriniformes was the most dominant group in terms of both number of species and individuals consisting 52.27% of total fish population (Figure 3) and 57.71% in order-based fish species diversity (Figure 4). This indicates that Cypriniformes represented major contribution with larger number of species in respect to numerical composition in different open water bodies. Galib*et al.,* (2013) recorded 43.92% of Cypriniformes in ChotoJamuna River and Rahman *et al.* (2012a) recorded 35% of Cypriniformes species in the Ganges River.

Channiformes: During the study period 3.04% of total fish population and 6.82% in order based Channiformes were recorded.Three species of snakehead fish were recorded during the study period. Among them Taki (*Channa punctatus)* was found throughout the year in small amount. Shol (*Channa striata*) was found in small amount in monsoon season but Cheng (*Channa orientalis)* was rare. Galib *et al*. (2013) was found similar result in about 1.4% and 4.4% total and order based fish population, respectively in Choto Jamuna River.

Perciformes: During the study period 8.84% of total fish population and 11.36% in order based Perciformes species with four families (Osphronemidae, Ambassidae, Gobiidae and Pristolepidae) were recorded. Among them Napit koi (*Badis badis*) and Lalchanda (*Pseudambassis lala*) were rare in the study areas. Kalisa (*Colisa fasciatus*) was found throughout the year and Bailla (*Glossogobious giuris*) found in small amount. Rahman *et al.* (2012a) and Galib *et al.* (2013) were found 17.50 and 19.08% Perciformes species in the Ganges River and Choto Jamuna River, respectively which was larger than the findings of the present study due to over and illegal fishing in different periods of monsoon and reduce of river water.

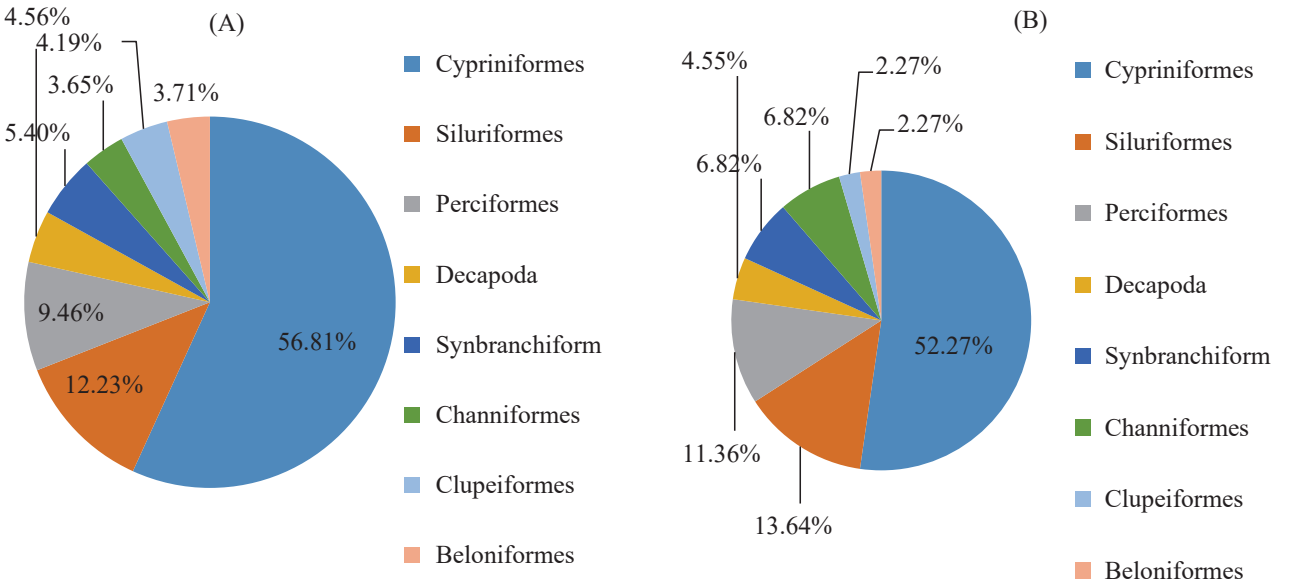


Figure 3. Identified fish species (%) on number based (A) and order based (B)

Siluriformes: Siluriformes was found the second most dominant order in view of species diversity. Around nine species of Siluriformes under Bagridae, Clariidae, Heteropneustidae, Erethistidae, Schilbeidae, Siluridae family were recorded in the study areas. About 12.45% of total fish population (Figure 3) and 13.64% in order based fish species diversity (Figure 4) were found. Among different types of catfishes, Magur (*Clarius batrachus*) was found throughout the year, Tengra (*Mystusvittatus*) also found throughout the year but small amount compare to Magur. Gulsatengra (*Mystus cavasius*) was found small amount throughout the year and in monsoon. Shing (*Heteropneustes fossilis*) was found large amount during monsoon. On the other hand, Aair (*Mystus aor*), Cheka (*Erethistes pussilus*) were rare in the study periods. Rahman *et al.* (2012) and Galib *et al*. (2013) were found 32.5 and 28.57% contribution of Siluriformes, respectively which was much higher than the present study. The possible reason may be siltation and lower level of water quality reduces the number of Siluriformes species in study area.

Decapoda: Two species of decapoda under Palaemonidae family were identified during the study period. Among them River prawn (*Macrobrachium daganum*) was found throughout the year and Monsoon River prawn (*Macrobrachium lumarre*) found in small amount. About 3.96% of total fish population and 4.55% in order-based fish species diversity was found during the study. Nath *et al.* (2010) was found 2.1% of Decapoda species in their study in accordance with the recent study. It indicates that Decapoda are available in this study area due to favorable environment.

Synbranchiformes: Three species of Synbranchiformes with one family named Mastacembelidae were recorded during the present study. About 5.66% of total fish population and 6.82% in order-based fish species diversity was found. Under Synbranchiformes Guchibaim (*Macrognathus pancalus*) was found throughout the year, Lal baim (*Mastacembelus armatus*) was found in small quantity but the Tara baim (*Macrognathus aculeatus*) was rare in the study area. Similar results were estimated by Rahman *et al*. (2012) and Galib *et al*. (2013). They reported that 3.75% and 3.37% contribution, respectively in their study.

Clupeiformes: During the present study one species Kachki (*Corica soborna*) under the family named Clupeidae of Clupeiformes order was recorded. It was found throughout the year. Clupeiformes was the lowest dominant species in terms of both number of species and individuals consisting 4.03% of total fish population and 2.3 % in order based fish species diversity. Rahman *et al.* (2012a) and Galib *et al.* (2013) were found the similar results in their study. They found 5% and 3.17% contribution, respectively.

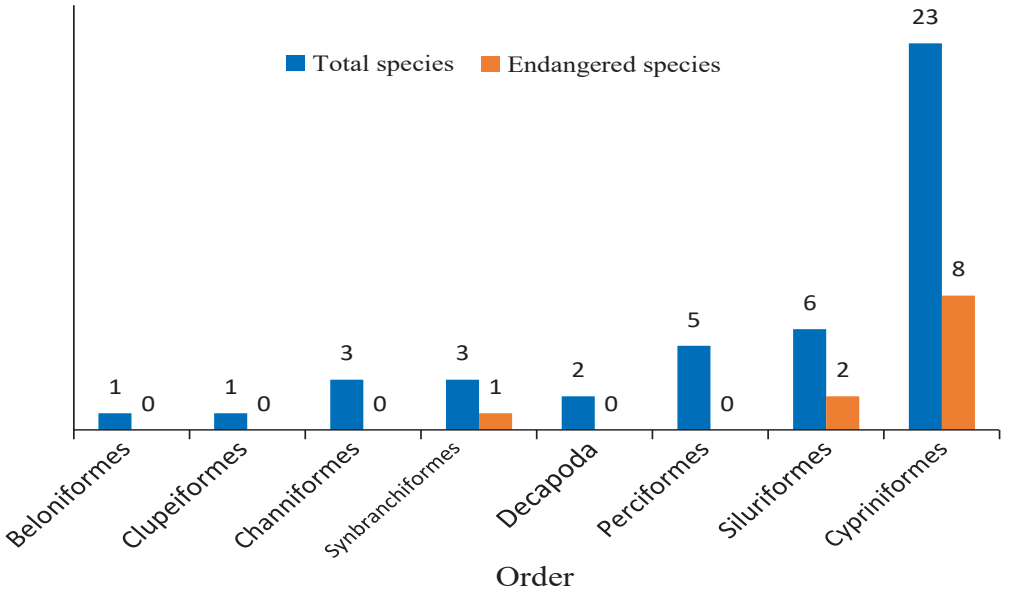


Figure 4. Total fish species and endangered fish species recorded in Mathabhanga river.

Beloniformes: Only one species Kakila (*Xenentodon cancila*) under the family Belonidae of Beloniformes order was identified. It was found throughout the year. Beloniformes was the lowest dominant species in terms of both number of species and individuals observed consisting 3.88% of total fish population (Figure 3) and 2.3% in order based fish species diversity (Figure 4). the findings of the present study are in agreed with the Rahman *et al*. (2012a) and Galib*et al.* (2013). They found 1.3% and 1.6% contribution, respectively. This observation clearly indicates that Beloniformes species is declining day by day of all types of water bodies in Bangladesh.

From the present study, the highest numbers of fishes were identified under the order of Cypriniformes and the lowest in Beloniformes. In other orders, diversity of fishes among total 44 species were measured 6.8%, 11.4%, 6.8%, 13.6%, 2.3% (Figure 4) and number of fish individuals (2961 fishes) were 3.65%, 9.46%, 5.40%, 12.23% and 4.91%, for Channiformes, Perciformes, Synbranchioformes, Siluriformes and Clupeiformes, respectively (Figure 3). About 4.6% of total number of fishes was Decapoda which comprised of 4.6% regarding species diversity.

Identified threatened species: All the fishes found, 25.0% of the total individuals were threatened. Among the threatened species 13.6% were vulnerable, 9.09% endangered and 2.3% critically endangered. About 33.3% fishes belong to Synbranchiformes, 33.3% to Siluriformes, and 34.8% fishes under Cypriniformes were found to be threatened. Only 22.7% fishes were available throughout the year where as 22.7% fishes were rare and 6.8% fishes found very rare during the current study. Galib *et al.* (2013) found 41.3% fish species from the Choto Jamuna River were threatened. Ramman *et al.* (2012) recorded a total of 34 species as threatened in the Padma River among them 12.5% was vulnerable, 21.3% endangered and 8.75% was critically endangered. Major threats to fish biodiversity include habitat destruction and defragmentation, industrial (Carew & Co. Ltd) pollution, indiscriminate harvesting of fry and fingerlings, construction of barrages, construction of embankments. The construction of Farrakka barrage by India in the Ganges River and subsequent withdrawal of waters from the Padma are the key causes for destroying its and its tributary rivers including Mathabhanga River's fish biodiversity (Rahman *et al.* 2012)

Diversity, richness and evenness indices: The month-wise values of Shannon-Weaver diversity (*H*), Margalef's richness (*D*) and Pielou's (*e*) evenness were found to 1.1, 5.0 and 0.6, respectively. The value of diversity index ranged from 0.9 (May) to 1.4 (October), richness index ranged from 3.0 (April) to 7.0 (October) and evenness index ranged from 0.3 (March) to 0.9 (October). Diversity and richness indices showed that diversity of fish fauna was higher in the month of October than other months. The reason was lower level of water depth and lack of rainfall in this time allowing fishermen to haul their fishing gears

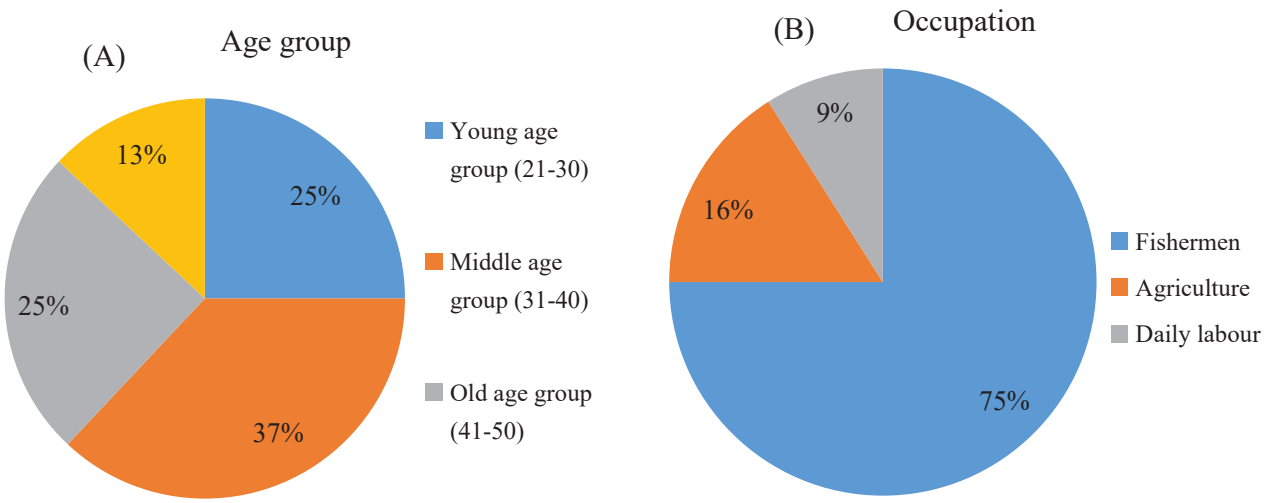


Figure 5. Distribution of fishermen according to their age group (A) and occupation (B).

more effectively and catch more fishes. Similar result was reported by Nath and Deka (2012), where they recorded the richest fish species diversity in the season winter (3.602). The lowest number of species diversity was recorded in the month of pre- monsoon season (2.938). During this period when India releases a huge amount of water and this water flows at full speed in Mathavanga River, the fishermen were unable to catch fish. The value of diversity index in this study was differed from the study of Galib*et al*. (2013).

Livelihood status of fishermen: The age of the fishermen ranged from 20 to 69 years with an average age of 38.7±11.06 years. The fishermen were classified into four categories (Figure 5) such as young (20-30 years), middle age (31-40 years), old (41-50 years) and the oldest (above 50 years). It appeared that young and middle age persons in the range of 20-40 years was the highest (62%) and above 50 years was the lowest (13%). Ali *et al*. (2009) found that most fishermen (50%) belong to the age group of 31-40 years in Mymensingh.

Religion can play a very important role in the socio cultural activities of people. It was found that Muslims were featuring as the absolute majority (81%) followed by Hindus (19%). There were no Buddhists or Christians (Figure 7). It was well known that only the lower caste of the Hindu community engaged in fisheries sector. Khan *et al.* (2013) was noted in their studies that Muslims represented as absolute majority of fishermen in the study area (70%). Similar results were also observed by Kabir *et al*. (2012), they found that muslims were featuring as the absolute majority of fishermen.

In Bangladesh, families were classified into two types: i) nuclear family; married couples with children, and ii) joint family; group of people related by blood and/or law. In this study, 40% family was nuclear family and 60% was extended family. The type of family was small compared to other areas and communities of Bangladesh. About 42.5% of the fishermen living in nuclear family and the rest (57.5%) in joint family in the District of Mymensingh (Ali *et al.* 2009).

Family size is defined as the number of persons, either working or not, belonging to the same family. In the study, average family size of fishermen was found to 6.2±1.8. Family was categorized as small family (members 2 to 4), medium family (members 5 to 6) and large family (members above 7). During the period of the investigation, small family constituted 18%, medium family constituted 46% and large family constituted 36% of the total surveyed fishermen. Similar result was foundby (Ali *et al.* 2009), recorded most of the fishermen (45%) belonged to the medium family (member 4-5) in Mymensingh District.

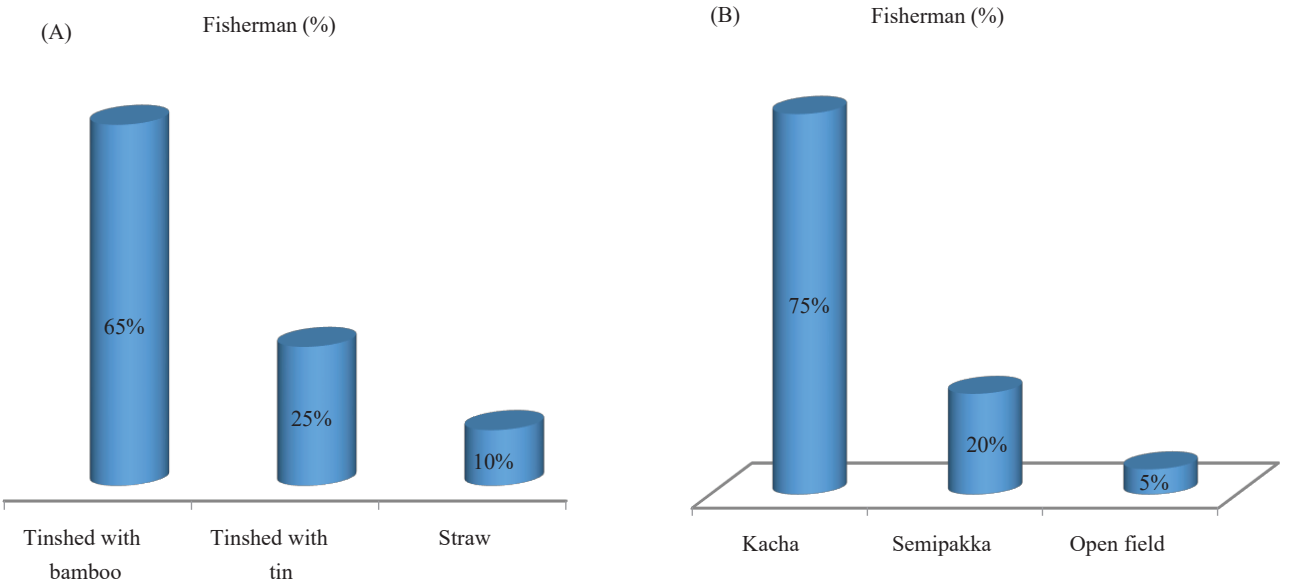


Figure 6. Distribution of fishermen according to housing condition (A) and sanitary facilities (B).

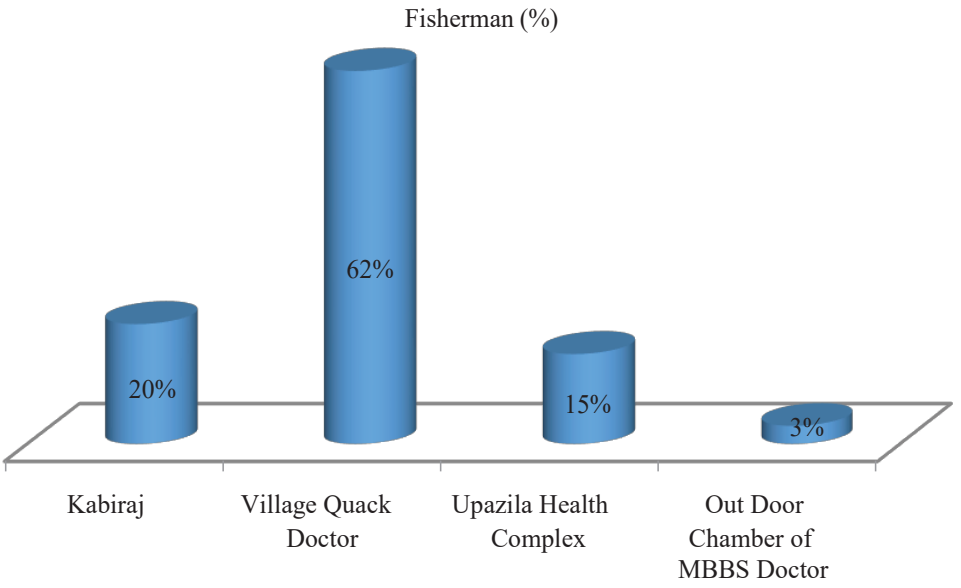


Figure 7. Distribution of fishermen according to health facilities.

Education is the key determinant of the lifestyle and status in a society. The fishermen in the locality had varying level of educational background. Most of the fishermen was illiterate (45%), small portion of them can sign only (25%). Some were primary level of educated (12.5%). 12.5%, 12.5% and 5% fishermen were educated at primary, secondary and SSC level. Khan *et al.* (2013) found the highest (68%) fishermen were illiterate and the lowest (22%) were SSC level of education of the fishing community in Tista River. The present study revealed that the education level of fishermen was very poor. The reasons were lack of awareness as well as the low income of the fishermen communities.

Status of physical properties: Housing condition of the fishermen were three main types: i) Tinshed with bamboo, only roof is tin, ii) Tinshed with tin, both roof and surroundings built by tin and iii) Straw, completely built by straw houses. Housing condition of the 65% fishermen were dominated by Tinshed with bamboo, followed by Tinshedwith tin (25%) and Straw (10%). No fisherman was found having pakka house.

The provision of clean and safe drinking water is considered to be the most valued elements in the society. The study showed that 100% of the fishermen used tube-well water for drinking purposes and among them 48% fishermen used their own tube-well, 40% used government tube-well and remaining 12% used neighbor's tube-well as a source of water for drinking. This scenario was very common among the fishermen in most areas of Bangladesh and similar results were noted by Khan *et al.* (2013) and Kabir*et al.* (2012).

Sanitary and health facilities: It was observed that sanitary conditions of the fishermen were very poor. Two types of toilets were used by fishermen: i) kacha- made of bamboo with leaf and inadequate drainage disposal and ii) semipakka- made of brick with leaf or tin and inadequate drainage disposal. In this study 75% of the toilets were kacha and 20% were semi pakka and 5% of the fishermen had no sanitary facilities (Figure 6). There was no pakka sanitation system in study area. The present study revealed that the sanitary conditions of the fishermen were not satisfactory in the study area where (Kabir*et al.* 2012) in

Table 1. Land properties of fishermen insurvey areas

Categories	No. of fishermen(n=40)	% of total fishermen
Landless	18	45.0
1-10 decimal	9	22.5
11-20 decimal	7	17.5
21-30 decimal	3	7.5
31-40 decimal	2	5.0
Above 40 decimal	1	2.5
Total	40	100

their study found that 60% of the farmers had semi pakka, 30% had kacha and 10% had no sanitary facilities.

The health facilities of fishermen were served by kabiraj, village quack doctor, Upazila health complex and outdoor chamber of MBBS doctor. A significant proportion of fishermen 62% depends upon village doctors who actually possess no knowledge on medical science, 20% depend upon village kabiraj and 15% on Upazila health complex,whereas only 3% fishermen got health service from outdoor chamber of MBBS doctors (Figure 7). The findings of the present study were more or less similar to the findings of Ali *et al.* (2009), Kabir*et al.* (2012) and Khan *et al.* (2013). All of them were found that health facilities enjoyed by the fishermen were not at all satisfactory. Generally, fishermen took health suggestions from unskilled, non-professional village quack doctor and kobiraj.This may be due to the lack of proper education, awareness and low income.

Electricity facilities: In the study area, 86% of the fishermen were far from power plants had no electricity facilities and the rest (14%) had access to electricity, which were similar to the findings of Ali *et al.* (2009) and Khan *et al.* (2013). From the present survey, it was found that there was lack of electricity facilities of most of the fishermen house.

Financial status: Majority of the fishermen (45%) were landless while only 40% of them had1-20 decimal lands and only 15% of fishermen had above 20 decimal lands. Usually the landless fishermen live in Government khasland and they were unable to buy land due to very low income (Table 2).

Most of the fishermen around the study area were involved in fishing as their main occupation. However, some were also engaged in agriculture and day labor as their main source of income. The present study revealed that 75% of fishermen were engaged in fishing, 16% in agriculture and 9% in daily labor.

The selected fishermen were grouped into four categories based on their annual income and found that about 25% of the fishermen annual income were between Tk. 25000 to Tk. 35000 and 65% were of Tk. 35001 to Tk. 55000 and only 10% of fishermen had annual income above Tk. 55000, which were more or less similar to the findings of Khan *et al.* (2013).

Table 2. Annual incomes of the fishermen in the surveyed areas

Categories (Tk.)	No. of fishermen (n=52)	% of fishermen
25000-35000	10	25
35001-45000	15	37.5
45001-55000	11	27.5
Above 55000	4	10
Total	40	100

Conclusion

The Mathavanga River plays a significant role in maintaining and replenishing the fish resources. However, fish resources have rapidly declined inthe MathavangaRiver. The results have further shown that fish composition and diversity has rapidly declined in the Mathavanga River. The month-wise Shannon-Weaver diversity (*H*), Margalef's richness (*D*) and Pielou's (*e*) evennessanalysis were found 1.12, 4.99 and 0.57, respectively. At present, loss of biodiversity is an alarming but the earliest effective management is essential to deal with this issue.These results indicated that anthropogenic activities and their subsequent environmental disturbances may have seriously destroyed the fish habitat and led to the decline of fish diversity. At the same time, it would have also potential impacts on fish diversity. The socio economic condition of the fishermen in the adjacent area was not satisfactory. Due to the lack of awareness as well as the poor income of the fishermen families, the education level of the fishermen children didn't go so far. Thus, the conservation of fishes has become urgent, and an integrated management plan should be developed and effectively implemented.

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