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*Article*

# Fish biodiversity and livelihood of fishermen at an Oxbow lake of South-West Bangladesh

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**Abstract:** The present study was conducted to know the biodiversity status and assess the existing livelihood conditions of the fishers of Habullah Baor at Bagherpara upazila, Jashore district from November 2017 to April 2018. Sixty fishermen were randomly selected for collecting data through a semi structured questionnaire. The current study discovered that there were 11 different fish species from six orders and seven families in the Habullah baor. All of the sampled fishermen were Hindu. About 25% of the fishermen was young aged, majority was middle aged and 25% was old aged group. A total of 75% of the fishermen had nuclear family and 25% families lived in joint family. Among the fishermen 85% had a few decimal of cultivable land and 15% were truly landless. Annual income of the respondents varied from 30,000 to 70,000 BDT with an average of 42,833 BDT. All fishers had access to drinking water from tube wells. Most of the fishers lived in katcha houses. About 15% of the fishers enjoyed electricity facilities in their home. Among the fishermen investigated, majority had earthen latrine, 20% used tin shed latrine, 8% used concrete latrine and a few of them 10% had no latrine. There were no modern medical facilities in the villages. The respondents had no alternate income sources during the dry season and at the time of ban period. The fishers as a whole are leading measurable life due to great financial hardship. Proper conservation and management measures can be taken to enhance the availability of fish fauna in Habullah baor, so that, the fishermen can harvest ample fish on sustainable basis.

Keywords: fish biodiversity; fishing gears; livelihood of fishermen; training; education

## 1. Introduction

A baor or ox-bow lake is an u-shaped body of water that forms when a wide meander from the main stream of a river is cut off creating a free standing body of water (Baker *et al*., 1991; Cantonati *et al*., 2020). Habullah Baor is of the oxbow lakes, which found abandoned meander isolated or cut off from the main stream channel by depressing and filled with water in south-west Bangladesh. The bulk of oxbow lakes were discovered in south-western Bangladesh, but research on these lakes' biodiversity, ecology, population characteristics of the species that were present, taxonomy, and other factors was still insufficient (Azad *et al*., 2020; Biswas *et al*., 2009; Halim *et al*., 2018; Sharif *et al*., 2016).

The biodiversity is often used as a measurement of the health of biological system (Aerts *et al*., 2018; Vyas *et al*., 2009). The biodiversity of a water body also act as an ecological indicator and measurement of pollution for instance (Parmar *et al*., 2016; Sui *et al*., 2020; Zaghloul *et al*., 2020). Several biodiversity assessment studies were conducted in different water bodies in south-western Bangladesh, including small indigenous species (Samad *et al*., 2013), river ecosystem (Leela *et al*., 2018), plankton community in an oxbow lake (Raju *et al*., 2018), fish biodiversity (Ahamed *et al*., 2019; Biswas *et al*., 2021), aquatic weed diversity in different ecosystems (Adhikary *et al*., 2018; Islam *et al*., 2017b).

A sustainable livelihood found based on the development to improve the progress in poverty elimination by assessing the appropriate objectives, scope and priorities (Adhikary *et al*., 2018; Gilling *et al*., 2001; Islam *et al*., 2014; Islam *et al*., 2015; Singh and Chudasama, 2020; Yu and Huang, 2021). Socio-economic status is typically broken into three categories, high SES, middle SES, and low SES to describe the a family or an individual (Bradley, 2016; Darin-Mattsson *et al*., 2017). When categorizing a family or an individual into one of these groups, it was necessary to evaluate four or all three of the criteria (income, education, and occupation) (Avvisati, 2020; Chowdhury and Chakraborty, 2017; Hällsten and Thaning, 2022). For sustainable development and poverty alleviation, five different approaches had been adopted and the sustainable livelihood approach had been gradually expanded with its own core and principles for poverty focused development activities (Rahman *et al*., 2012; Stacey *et al*., 2021; Voumik, 2014).

Biodiversity plays an important role for the future sustainability of marine and fresh water natural resources that include commercial fisheries (Hiddink *et al*., 2008; Hossain, 2019; Hussain, 2010; Shamsuzzaman *et al*., 2017; Apon *et al*., 2019). Due to a variety of factors, some fish populations are declining despite the fact that fish is an essential traditional food item in Bangladeshi diets (Aziz *et al*., 2021; Hoque and Myrland, 2022; Rahman and Islam, 2020). A vital step in preventing the extinction of many species is to examine the biodiversity of various vulnerable fish species (Aziz *et al*., 2021; Miranda *et al*., 2022).

It is critical to possess in-depth knowledge of the linked population's livelihood patterns and the biodiversity state of any environment in order to improve the fisheries sector (Islam *et al*., 2014; Lynch *et al*., 2016). The state of the people's livelihoods serves as an illustration of their current position, lifestyle, and financial situation (Scoones, 2009). However, few studies on socio-economic conditions of fishermen were carried out by Al-Asif and Habib (2018), Islam *et al*. (2014), Hossain *et al*. (2016), Vaumik *et al.* (2017), Islam et al. (2021) and Razeim *et al*. (2017) but all these efforts lack specific information of livelihood like access to organizations, livelihood vulnerabilities and outcomes. Therefore, the present study was undertaken to determine the fish biodiversity status and livelihood of the fishermen of Habullah baor. This study will be the first baseline study on Habullah ox-bow Lake while it might be helpful for understanding the current fish biodiversity status and the livelihood status of fishers.

## 2. Materials and Methods

### 2.1. Study location and periods

This study was conducted on Habullah baor (oxbow lake) at Bagherpara Upazila under Jashore district, Bangladesh from November 2017 to April 2018 (Figure 1).

### 2.2. Sample population and data collection

Sixty fishermen from Habullah baor area were interviewed during the survey.

#### 2.2.1. Primary data

First-hand information was gathered through questionnaire interviews with fishermen from Habullah baor area. For this study, one of the PRA tool such as Focus Group Discussion (FGD) was conducted in baor area.

#### 2.2.2. Crosschecked interviews

After collecting the data through questionnaire interviews and FGD, crosscheck interviews were conducted with Upazila Fisheries Officer, Assistant Fisheries Officer, relevant NGO workers from the study area.

#### 2.2.3. Secondary data

Secondary source of information consist of published material such as journals (for example, Islam *et al*. (2017c), textbooks, university thesis (up to post-graduate level), newspaper and other sources. Moreover, appropriate government and non-government organizations reports were also taken into consideration for gathering information. The information regarding fish biodiversity was collected from fishermen and the nearest fish market.

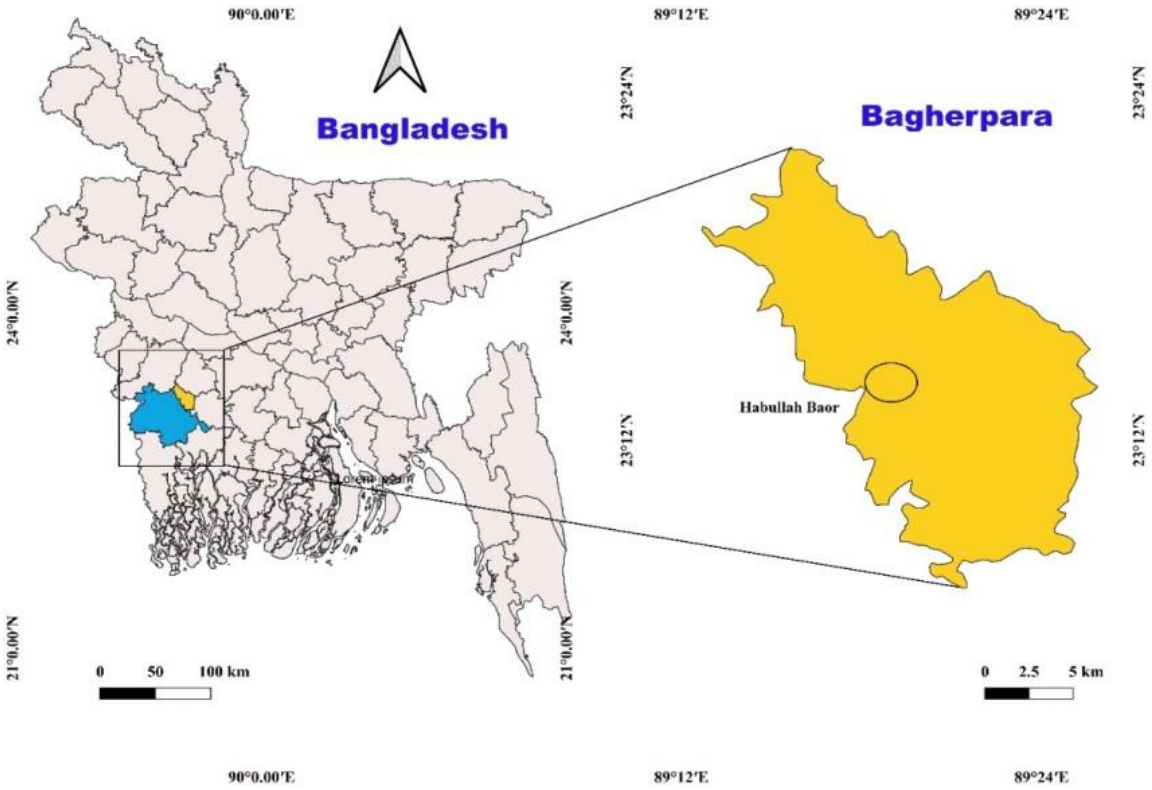


**Figure 1. Map of the Habullah baor at Bagherpara, Jashore.**

### 2.3. Data processing and preparation map

The data were analyzed using tabular and descriptive statistical techniques. The summary tables were prepared in accordance to the objective of the study. Data collected from various sources was entered into a database system using Microsoft office Software. The graphical presentation of data were conducted using OriginLab 2022 and the map was prepared using QGIS Version 3.26.3 (QGIS Development Team, 2019).

## 3. Results

### 3.1. Fish biodiversity and fishing gears used in Habullah baor

The current study discovered that there were 11 different fish species from six orders and seven families in the Habullah baor, some of which were seasonal and the majority of which were year-round (Table 1). Ten of the fish species identified in Habullah Bay were determined to be of least concern, while one species was determined to be vulnerable based on the IUCN Red List status. This study also found that, eight species of fishes were available all the year while three species could be found in a particular season.

**Table 1. Fish biodiversity in Habullah baor.**

| Order | Family | Scientific Name | Local name | IUCN status | Availability | |
|---|---|---|---|---|---|---|
| | | | | | Y | S |
| Anabantiformes | Channidae | *Channa marulius* | Gozar | LC | + | |
| | | *Channa orientalis* | Cheng | VU | - | + |
| | Nandidae | *Nandus nandus* | Bheda | LC | - | + |
| Beloniformes | Belonidae | *Xenentodon cancila* | Kakila | LC | + | - |
| Cypriniformes | Cyprinidae | *Pethia ticto* | Punti | LC | + | - |
| | | *Amblypharyngodon mola* | Maya | LC | + | - |
| | | *Osteobrama cotio* | Dhela | LC | + | - |
| Ovalentaria | Ambassidae | *Chanda nama* | Chanda | LC | + | - |
| Siluriformes | Bagridae | *Sperata aor* | Air | LC | + | |
| | | *Mystus tengara* | Tengra | LC | - | + |
| Synbranchiformes | Mastacembelidae | *Mastacembelus armatus* | Baim | LC | + | - |

* Least Concern (LC); Vulnerable (VU); Y=available year round; S=seasonally available species

Various types of fishing gears were found to be operated in the Habullah baor for catching fishes. It was observed that, most of fishermen used borsi (33.33%) followed by castnet (30%), current jal (20%), thelajal (10%), and dharmajal (6.67%) for harvesting fishes (Table 2).

**Table 2. Fishing gears used in Habullah baor.**

| Name of gears | Number of respondents | Percentage (%) |
|---|---|---|
| Cast net | 18 | 30 |
| Thela jal | 6 | 10 |
| Dharma jal | 4 | 6.67 |
| Current jal | 12 | 20 |
| Borshi | 20 | 33.33 |

### 3.2. Livelihood and socio-economic status of the fishermen at Habullah baor

#### 3.2.1. Family type

The current study found that, most of the fishermen had nuclear family (75%), while rest were joint type of family (25%) (Table 3).

**Table 3. Family type of fishermen at Habullah baor.**

| Family Type | Number of respondents | Percentage (%) |
|---|---|---|
| Nuclear | 45 | 75 |
| Joint | 15 | 25 |

#### 3.2.2. Family size

It was found that, about 50% of the fishermen had small family with 3 to 4 members, followed by medium family (33.33%) and large family (16.67%) (Figure 2).

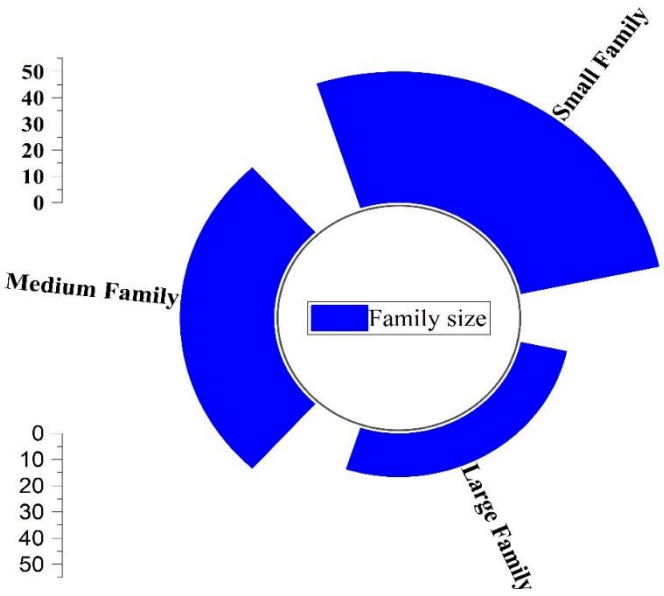


**Figure 2. Family size of fishermen (small=four members; medium=5-7 members; large=eight members and above).**

#### 3.2.3. Age group distribution

The present study found, majority (50%) of the fishermen were middle aged, followed by young aged (25%) and old aged (25%) (Figure 3).

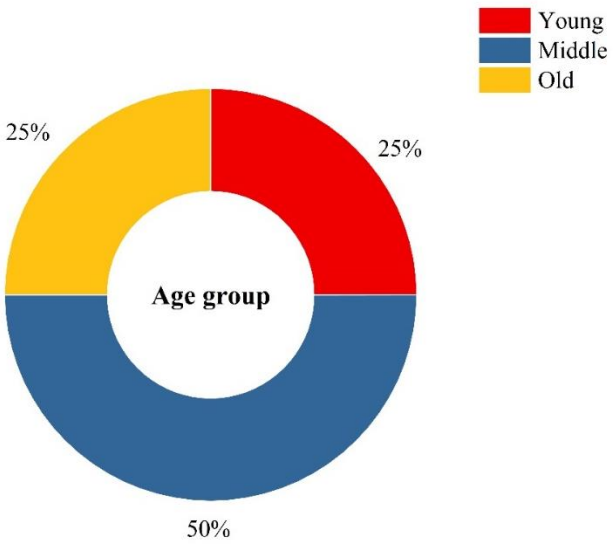


**Figure 3. Distribution of the fishermen according to their age (young=15-30 years; middle= 31-45 years; old= 46 years and above).**

### 3.2.4. Income sources

In the study area, majority of income came from baor fishing activity (58.33%), while rest of the fishermen were involved in others occupation such as agricultural activity, labors and tea stall business (41.67%) (Table 4).

**Table 4. Income sources of fishermen.**

| Income sources | Number of respondents | Percentage (%) |
|---|---|---|
| Primary | 35 | 58.33 |
| Secondary | 25 | 41.67 |

### 3.2.5. Educational status

This study found that, majority of fishermen had no institutional education (33.33%) while 25% of them could write their names only; followed by primary level (16.67%), secondary level (11.67%), S.S.C level (8.33%) and H.S.C level (5%) (Figure 4).

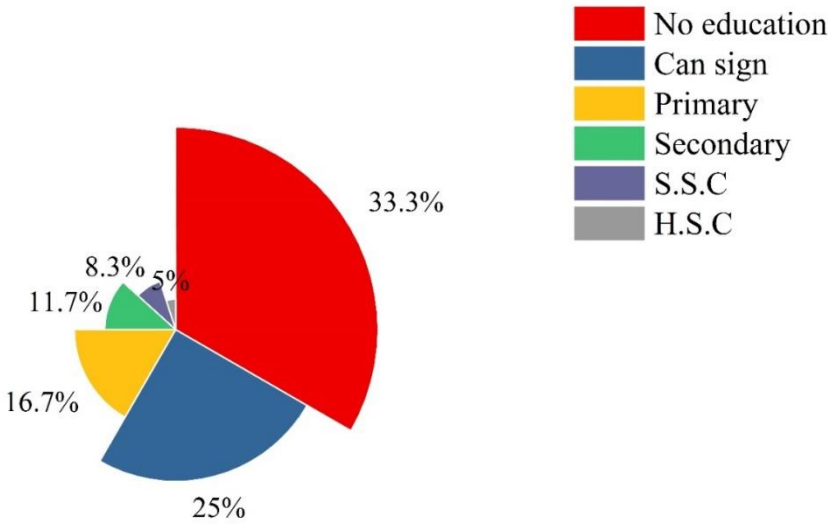


**Figure 4. Educational status of fishermen.**

### 3.2.6. Education of the children

The current study found that, most of the fishermen's children used to go to school (75%) while rest of the children did not go to school (25%) (Figure 5).

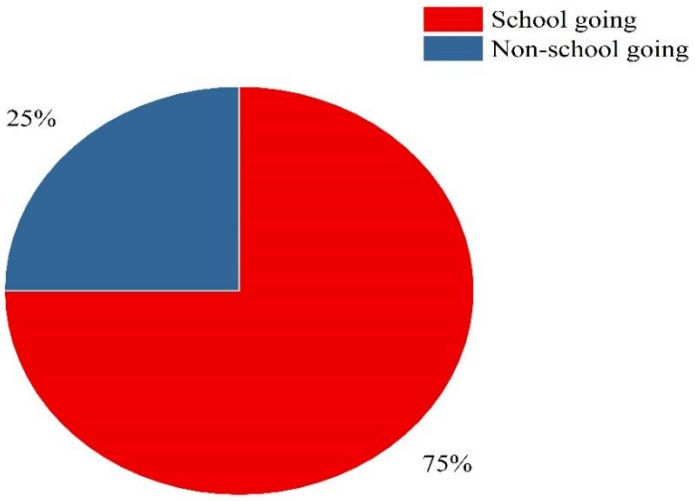


**Figure 5. Educational status of fishermen's children.**

### 3.2.7. Religious status

Current study found that, 100% fishermen was Hindu and we did not find any fishermen from other religions (Table 5).

**Table 5. Religious status of fishermen.**

| Religion | Number of respondents | Percentage (%) |
|---|---|---|
| Hindu | 60 | 100 |
| Muslim | 0 | 0 |

### 3.2.8. Household land holding

Most of the fishermen (85%) had at least few decimals of land (2-12 decimals) and a small segment of the fishermen (15%) were found landless and they owned the government khas land (Figure 6).

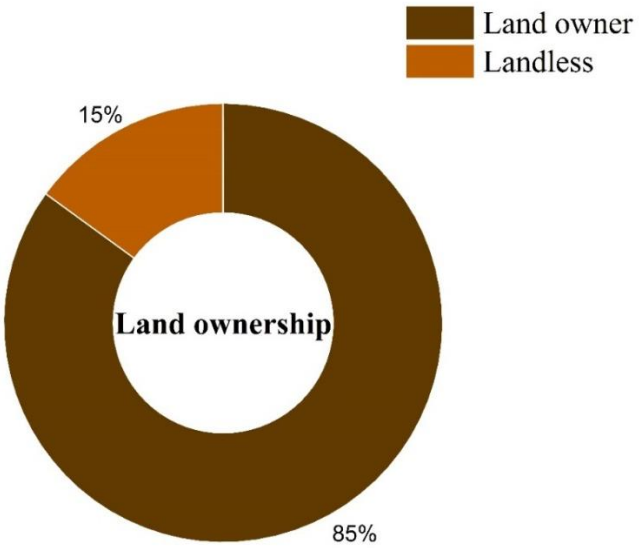


**Figure 6. Household land holding status of fisher's community.**

### 3.2.9. Housing conditions

The current study indicated that, majority of fishermen had katcha house (72%) made of shon, paddy straw, bamboo and wood timbers, while we found some houses were tin shed (24%) and pucca buildings (4%) (Figure 7).

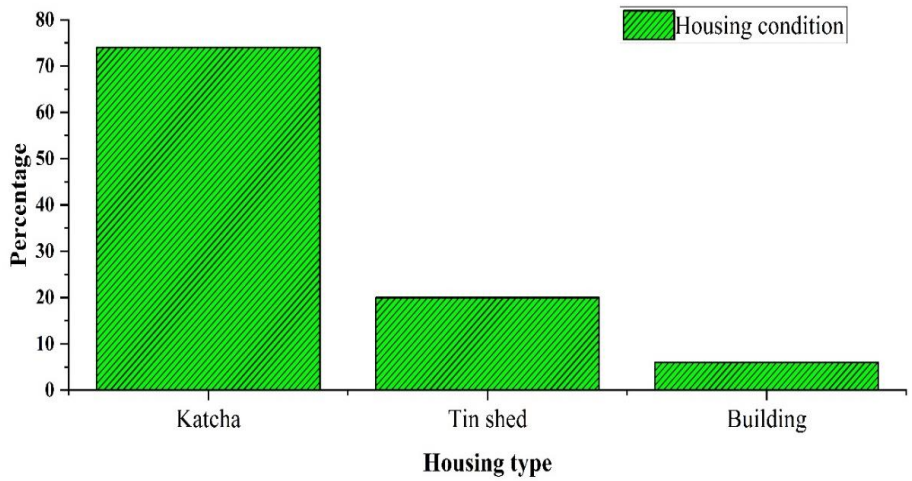


**Figure 7. Housing condition of the fishermen.**

### 3.2.10. Sanitation facilities

The current study observed that, majority of latrines of the fishermen were earthen (60%), while some tinshed (20%) and concrete latrines (8%) were also found in the fishermen community. We also found a small portion (10%) of fishermen house had no latrine (Figure 8).

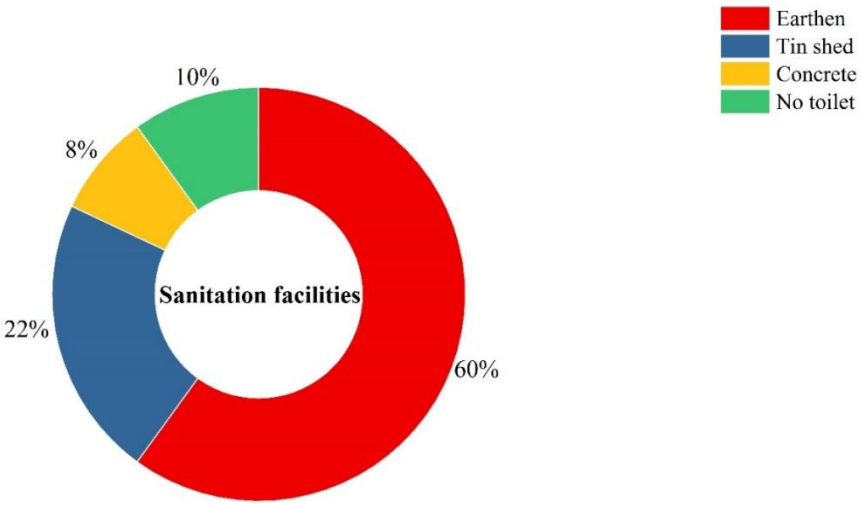


**Figure 8. Sanitation facilities in fishermen community.**

### 3.2.11. Household water facilities

This study found that, most of the fishermen had no tube-wells (80%) while they collect water from nearby places and 20% of fishermen had own tube wells (Table 6).

**Table 6. Distribution of the fishers according to their source of drinking water.**

| Household water facilities | Number of respondents | Percentage (%) |
|---|---|---|
| Own tube-well | 12 | 20 |
| Share neighbors tube-well | 48 | 80 |

### 3.2.12. Electricity facility

This study revealed that, majority of houses of fishermen has no electricity (85%), while 15% had access to electricity facility (Figure 9).

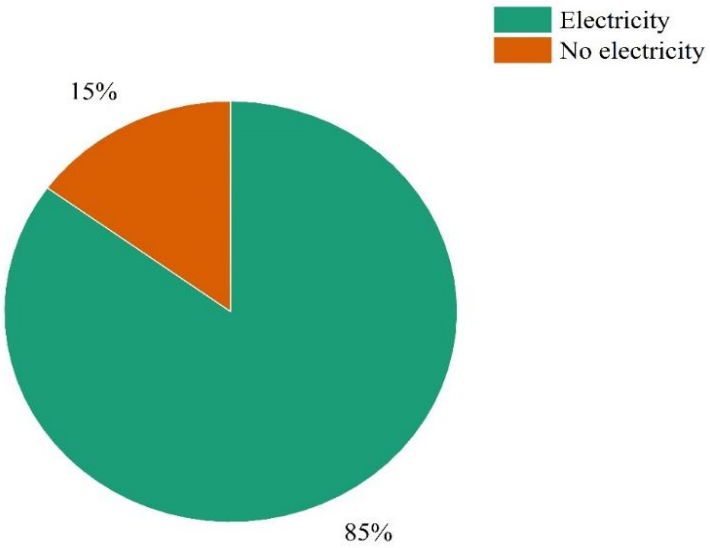


**Figure 9. Electricity facility in fishermen community.**

### 3.2.13. Medical facilities

The result suggested that, majority of fishermen and their families visited village doctors (66.67%) in case of any illness, while some used to visit government health complex (20%), and rest were treated by MBBS doctor (13.33%) (Table 7).

**Table 7. Medical facilities of fishermen.**

| Medical service | No. of fishermen (n=60) | Percentage (%) |
|---|---|---|
| Village doctors | 40 | 66.67 |
| Upazila health complex | 12 | 20 |
| MBBS doctors | 8 | 13.33 |

### 3.2.14. Bank account holder

It was observed that 58.33% fishermen had bank account and rest of 41.33% fishermen had no bank account (Table 8).

**Table 8. Bank account holder of fishermen.**

| Account holder | Number of respondents | Percentage (%) |
|---|---|---|
| Bank account | 35 | 58.33 |
| Non-bank account | 25 | 41.67 |

### 3.2.15. Annual income of the fishermen

The current findings suggested that, majority (33.33%) of fishermen had yearly income range of 35000-40000 BDT, while 28.33% of them received income range of 40000–45000 BDT. The highest range of income 45000–70000 BDT were receive by 13.33% fishermen. This data revealed that, the average income of fishermen community of Habullah baor were 42,833 BDT/year and 3,569 BDT/month (Table 9).

**Table 9. Annual incomes of the sampled fishermen in the surveyed areas.**

| Income range | No of fishermen | Annual income (BDT) | Percentage of fishermen | Average income |
|---|---|---|---|---|
| Tk 30000- 35000 | 15 | 525000 | 25 | |
| Tk 35000 -40000 | 20 | 800000 | 33.33 | 42,833 Tk/yr |
| Tk 40000 – 45000 | 17 | 765000 | 28.33 | 3,569 Tk/month |
| Tk 45000 - 70000 | 8 | 480000 | 13.33 | |
| **Total** | **60** | **2570000** | | |

### 3.2.16. Involvement of fishers in economic activities

The study area's primary source of income was fishing, and a sizeable portion of the local population still participates in fishing and activities linked to the fisheries. In the research region, there were around 5,950 persons who had a direct connection to fishing. Nearly every one of them worked as fisherman in a boat. All of the fishermen were capable of net mending, and some were involved in net manufacture. The fishermen were recognized and divided into two categories: boat owner-fishers and worker fishers, depending on their participation in various fishing and fisheries-related activities (Table 10).

**Table 10. Classification of fishers in study area.**

| Categories of fishers | Characteristics |
|---|---|
| **Boat owner-fisher** | The fisher have own fishing boat and fishing equipment or accessories, and accommodate about 8-10 laborer fishers per boat for fishing. |
| **Laborer fisher** | The laborer fishers do not have own boat but join with a boat owner fisher on catch sharing basis. |

### 3.2.17. Annual savings of fisher community

The present study suggested that, majority of fishermen (30%) had an annual savings of 1000-5000 BDT, followed by 5000-10000 BDT (25%), 10000-15000 BDT (20%), 15000-20000 (16.67%) and 20000-25000 (8.33%) (Table 11).

**Table 11. Annual savings of the sampled fishermen.**

| Annual savings range (BDT) | No. of fishermen (n=60) | Percentage (%) |
|---|---|---|
| 1000-5000 | 18 | 30 |
| 5000-10000 | 15 | 25 |
| 10000-15000 | 12 | 20 |
| 15000-20000 | 10 | 16.67 |
| 20000-25000 | 5 | 8.33 |

### 3.2.18. Livelihood outcome

It was found that, 41.67% fishermen improved their livelihood status while 58.33% of fishermen failed to improve their livelihood status through fishing (Table 12).

**Table 12. Livelihood outcome of fishermen.**

| Improve | Number of respondents | Percentage (%) |
|---|---|---|
| Yes | 25 | 41.67 |
| No | 35 | 58.33 |

### 3.2.19. Training

It was found that, minor portion of fishermen (33.33%) received training and rest of 66.67% did not receive any training related with fisheries activities (Table 13).

**Table 13. Training facilities of fishermen.**

| Receiving of training | Number of respondents | Percentage (%) |
|---|---|---|
| Yes | 20 | 33.33 |
| No | 40 | 66.67 |

### 3.2.20. Credit access and private sectors

The current study suggested that, majority of fishermen (80%) borrowed money from NGOs, while 8% from relatives and 12% fishers did not borrow any money from out sources (Figure 10).

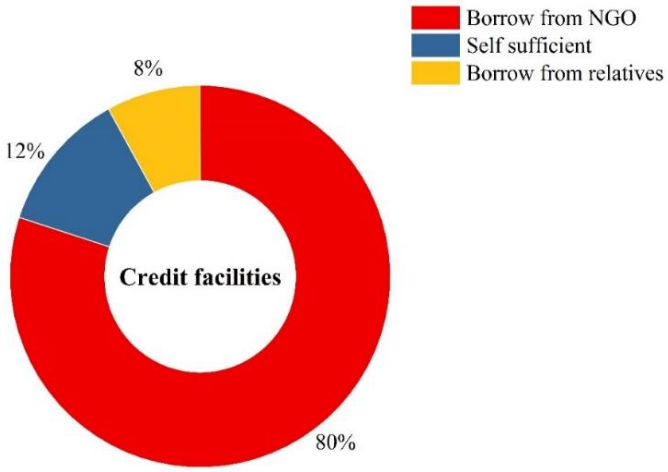


**Figure 10. Sources of credit facilities for fishermen.**

### 3.2.21. Occupational status

The current study suggested, majority (86.67%) of fishermen were engaged in fish selling and working as day labor as their main occupational activity, while a small proportion of the fishermen (13.33%) were found involved in boat driving and net making activities (Table 14).

**Table 14. Occupational status of studied fishermen.**

| Type | Number of respondents | Percentage (%) |
|---|---|---|
| Fishermen (fish seller and catcher) | 52 | 86.67 |
| Fishermen (boat driver and net maker) | 8 | 13.33 |

### 3.2.22. Social assets

The current study found that, almost all fishermen (100%) had low social status. There was no (0%) local leader, and member of school committee among the fishermen community (Table 15).

**Table 15. Social status of fishers.**

| Social status of fishers | Number of fishers (n=60) | Percentage (%) |
|---|---|---|
| Ordinary person | 60 | 100 |
| Local leaders/member of school committee | 0 | 0 |

### 3.2.23. Feed analysis of fishermen community

It was found that, during dry season, fishermen were mostly depended on vegetables and their fish consumption used to reduce to 2-3day/week from 5-6 days/week (Table 16).

**Table 16. Food menu of fisher community.**

| Food items | Wet season | Dry season |
|---|---|---|
| Rice | Daily | Daily |
| Fish | 5-6 days/week | 2-3 days/week |
| Vegetables | 4-5days/week | 6-7 days/week |
| Meat/egg/milk | Once or twice in every month | Rarely |
| Muri/chira/panthabhath | 6-7 days/week | 5-6 days/week |

## 4. Discussion

### 4.1. Biodiversity status of fish species

The current study found 11 different fish species from six orders and seven families in the Habullah oxbow lake, while some species had seasonal availability and most of them were available in whole year. The IUCN red list status of the fish species were assessed and found majority of the species were not in critical condition. The study of Islam *et al.* (2017c) found 39 species from Bhairab River and this study covered most of ecological and biodiversity status of some parts of that river. Different studies from Chalan beel found 114 fish species (Hossain *et al.*, 2009), 38 fish species belonging to 24 Genus, 17 families and 8 orders (Karim *et al*., 2020), 78 fish species (Siddique *et al.*, 2016) and 28 fish species belonging to 8 orders, 16 families (Khanom *et al.*, 2018). Another study from Kumira, Chittagong found amount of kilogram fishes caught by different fishermen and the catch composition (Mondal *et al*., 2018); however it could be suggested that, the future studies might be focused on the catch composition with the amount of fishes caught by fisher. This study focused on the common fish biodiversity of Habullah oxbow lake and found most of the fishes were small indigenous species; previous study of Mondal *et al.* (2020b) and Mondal *et al.* (2020a) one of the common species *Amblypharyngodon mola*. On the other hand, some similar studies also focused on the IUCN red list status of available biodiversity in different regions of Bangladesh and other countries (Abu Hena *et al.*, 2022; Kalimuthu *et al.*, 2022; Pramanik *et al*., 2017; Roy *et al*., 2022). The current study found, different fishing gears were used for catching fish from the Habullah baor including borsi, castnet, current jal, thelajal, and dharmajal. However the study of Ali *et al*. (2015) suggested that, fishermen were used gill net, cast net, fixed purse net, seine net, dip net, lift net and drag/ push net for fishing activity in Lohalia River in Patuakhali. Some other studies were also found similar types of fishing gears, for instance, Bay of Bengal (Haque *et al*., 2021), Surma River, Sylhet district (Mia *et al*., 2018), Ashura beel, Dinajpur (Ferdoushi *et al*., 2018), and Hatiya Island (Azam *et al*., 2014). During monsoon when water level increased the use of all types of gears was also increased simultaneously. Due to the presence of water current, traps were widely used in canal and adjacent shallow water up to October and then reduced gradually with the decreased in water level during rest of months. At the same time, number of nets used was also decreased, but the use of wounding gears increased which were generally used by the subsistence fishermen. These findings indicate that the use of different types of gear varies with the seasonal variation of water level in the beel.

### 4.2. Livelihood and socio-economic condition of fishermen

The current study found that, most of the fishermen had nuclear family, while rest were joint type of family. The study of Al-Asif and Habib, (2017) found that, around 66% fish farmers lived in joint families and 34% lived with separated families, while Sharif *et al*. (2015) showed, 86% of farmer and trader had nuclear family and rest of 14% had joint family in fishermen or fish trader of Jashore district. The current study found that, about 50% of the fishermen had small family with 3 to 4 members, followed by medium family and large family. Al-Asif and Habib (2017) found around 26% families had four members, 18% families had five members, 32% families had six members and 24% families had seven or more members in their family in Jashore district. This study found majority of the fishermen were middle aged, followed by young aged and old aged, while the study of Islam *et al*. (2017a) from Meherpur district suggested that, most of the fishermen were in the age group of 31-40 years. This statement was also supported by the study of Mondal *et al*. (2018) from two coastal villages, namely Kumira and Kattoli, Chittagong.

The current study found that, majority of income came from baor fishing activity, while rest of the fishermen were involved in others occupation such as agricultural activity, labors and tea stall business. The study of Adhikary *et al.* (2018) suggested, majority of fisher used to engaged with agriculture in Noakhali district as they had their own lands. The study of Vaumik *et al*. (2017) also found the similar result from Lalmonirhat district. This study found that, majority of fishermen had no institutional education followed by could write their names only, primary level, secondary level, S.S.C level and H.S.C level. The study of Al-Asif and Habib (2017) found

majority of fishermen had highest secondary level of education, while Al-Asif *et al*. (2015) found in Jashore district that, majority of fish fingerling traders had no experience of education, coincident with the current findings. As government made mandatory primary education for every children of the country, the current study found that, most of the fishermen's children used to go to school while rest of the children did not go to school. This result were supported by Adhikary *et al*. (2018), and Al-Asif and Habib (2017).

Current study found that, all of the fishermen was Hindu, however study of Al-Asif and Habib (2017) found 12% Hindu population among fisher in Jashore district. While result of Sharif *et al.* (2015) suggested that, all the fisher were Muslim as the area was populated by Muslim community. Most of the fishermen had at least few decimals of land (2-12 decimals) and a small segment of the fishermen were found landless and they owned the government khas land. The study of Al-Asif and Habib (2017) suggested that, majority of fisher had at least some decimal of own land, which supported the present study. On the other hand a study from Sundarban mangrove forest suggedted that most (78%) of the fry collectors were landless (Islam *et al*., 2015). The current study indicated that, majority of fishermen had katcha house made of shon, paddy straw, bamboo and wood timbers, which were supported the result of Al-Asif and Habib (2017), Adhikary *et al*. (2018), Al-Asif *et al*. (2015), Sharif *et al*. (2015), Islam *et al*. (2014), and Hossain *et al*. (2016). The current study observed that, majority of latrines of the fishermen were earthen, while some tinshed and concrete latrines were also found. The study of Al-Asif and Habib (2017) found a total of 100% of fishermen good sanitation facilities, however as this area of the baor was underprivileged area, the sanitation facilities were not so good at this area. This study found that, most of the fishermen had no tube-wells while they collect water from nearby places and minor portion of fishermen had own tube wells. The study of Al-Asif and Habib (2017) that the all the fishermen community had good water supply facilities, while the study from Noakhali district suggested that, majority of fishermen had their own tube-well (Adhikary *et al*., 2018). This study found that, majority of houses of fishermen has no electricity, while some had access to electricity facility while the study of Vaumik *et al*. (2017) found majority of the fisher had electricity facilities in Lalmonirhat district, which was found opposite with the present study. In Noakhali district it was also found that majority of fisher had electricity in their home or business institution (Adhikary *et al*., 2018).

The current result suggested that, majority of fishermen and their families visited village doctors in case of any illness, while some used to visit government health complex, and to MBBS doctors. The study of Al-Asif and Habib (2017) found almost all of the fisher visited to the MBBS doctor for their sickness, while in Noakhali most of the fisher used to visit to local kabiraj (Adhikary *et al*., 2018). Al-Asif *et al*. (2015) found that, majority of the fisher used to visit government health complex for their sickness in Jashore district. On the other hand, Sharif *et al*. (2015) found majority of fisher visited to the quack doctors. The present study observed that, majority of fishermen had bank account, which were found similar with the studies of Al-Asif and Habib (2017), Al-Asif *et al*. (2015), Sharif *et al*. (2015), Islam *et al*. (2014). The current findings suggested that, majority of fishermen had yearly income range of 35000-40000 BDT, while 28.33% of them received income range of 40000–45000 BDT. The highest range of income 45000–70000 BDT were receive by 13.33% fishermen. Studies of Al-Asif and Habib (2017), Vaumik *et al*. (2017), and Adhikary *et al*. (2018) discussed about the annual income of fishermen but however, the ranges were far higher than the current study, which could be due to the underprivileged area of Jashore district. The study area's primary source of income was fishing, and a sizeable portion of the local population still participates in fishing and activities linked to the fisheries. In the research region, there were around 5,950 persons who had a direct connection to fishing. Nearly every one of them worked as fisherman in a boat. All of the fishermen were capable of net mending, and some were involved in net manufacture. The fishermen were recognized and divided into two categories: boat owner-fishers and worker fishers, depending on their participation in various fishing and fisheries-related activities. The present study suggested that, majority of fishermen had an annual savings of 1000-5000 BDT, followed by 5000-10000 BDT, 10000-15000 BDT, 15000-20000 and 20000-25000. The study of Mozahid *et al*. (2018) suggested that majority of fishermen in Sunamganj district had no savings for their future. The current study found that, minor portion of fishermen received training from different organizations including the government agencies (DoF, BFRI, University, etc.), however study of Sultana *et al*. (2015) emphasized on the training for farm women, while some other studies also revealed that, fishermen used to receive training from different organizations (Al-Asif and Habib, 2017; Vaumik *et al*., 2017).

The current study suggested that, majority of fishermen borrowed money from NGOs, while some used to take money from relatives. Al-Asif and Habib (2017) found, fishermen used their own money for investing in any projects while some taken loan from bank and NGOs. The similar findings were also reported by Vaumik *et al*. (2017) and Sharif *et al*. (2015). The current study suggested, majority of fishermen were engaged in fish selling and working as day labor as their main occupational activity, while a small proportion of the fishermen were

found involved in boat driving and net making activities. The study of Adhikary *et al*. (2018) suggested, majority of fisher used to engaged with agriculture in Noakhali district as they had their own lands. The study of Vaumik *et al*. (2017) also found the similar result from Lalmonirhat district. The current study found that, almost all fishermen had low social status. It was also found that, during dry season, fishermen were mostly depended on vegetables and their fish consumption used to reduce to 2-3day/week from 5-6 days/week. One study from Noakhali district found that, before fish farming 64% fish farmer taken 2 times meal per day, 24% fish farmer taken 1 time meal per day and only 12% farmer taken 3 times meal per day (Adhikary *et al*., 2018).

## 5. Conclusions

The biodiversity and livelihood status of fishermen of Habullah Baor came out with the study. The IUCN red list status of available fish species in Habullah Baor was accessed. Livelihood conditions of the fishermen in Bagherpara upazila were not satisfactory. In the study area, fishermen were deprived of many facilities. The education level of the fishermen was not good. Lack of awareness as well as the poor income, the fishermen have to take loan from Mohajan at high interest.

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## Data availability

The data of this current investigation will be available upon valid request by any authority from the corresponding author.

## Conflict of interest

None to declare.

## Authors' contribution

Jamil: conceptualization, methodology, analysis and manuscript writing; B.M. Newaz Sharif: reviewing and editing; Lirong Yu Abit: data analysis, interpretation, graphical presentation and map preparation, reviewing and editing; Md. Idris Miah and Md. Shahjahan: Supervision, conceptualization, methodology, reviewing and editing. All authors have read and approved the final manuscript.

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