



Fish Biodiversity and Suggested Conservation Measures of Transboundary River Someshwari in Netrokona, Bangladesh

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Authors' contributions

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

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ABSTRACT

Considering the importance of fish biodiversity for sustainable management of river fisheries, this study aims to explore and evaluate the fish biodiversity of Someshwari River along with conservation measures from November 2020 to October 2021. Data collection was carried out in Jaria, Susang Durgapur, Shivganj Bazar and Bijoypur of Netrokona district. Questionnaire interview, Focus Group Discussion (FGD), Direct observations, Key Informant Interview (KII) was used to collect data. During the study period, 23 species under 12 families were determined.

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Among them 6 finfish species are endangered, 4 are critically endangered, 5 are vulnerable, 7 are data deficient, and 2 are not threatened, respectively which includes highest catch catfishes at about 26.62%. However, the lowest amount catch constituted the Mirror carp of about 5.29%. After the catfish, the second highest catch was 15.9% of small prawn. Another dominant group major carps contained 11.26%, and barbs remained at 11% of the catch and the loaches constituted 1.3% of the total catch. In addition, other groups like Mola carplet 7%, gourami 2.20%, Spiny eels 9.86% etc. were found in the Someshwari river. There were about 81% fish for food and 17% ornamental fish. Fourteen distinct types of fishing equipment were used namely: nets, traps, hooks, and lines, and wounding equipment. Finally, indiscriminate use of harmful gear, extraction of sand and rock, inadequate supervision of Governments and Non Governmental organizations, pollution from the adjacent areas, high interest rate of bank loan were understood as common constraints in the study area. Therefore, recommendations were made to improve river fisheries management through habitat restoration, increasing public awareness, prohibition on exploiting brood fish and active participation for sustainable catch.

Keywords: Fish biodiversity; conservation; transboundary; someshwari river.

1. INTRODUCTION

Bangladesh has the third largest aquatic fish biodiversity in Asia, after China and India. This species diversity has been attributed to the world's largest flooded wetland (Bengal Delta). The drainage basins of the Ganges, Brahmaputra, and Meghna are significant fish habitats. The main fishing grounds include rivers, estuaries, beels (natural depressions), baors (dead rivers), flood lands (seasonal floodplains), and a man-made lake (Kaptai lake). A total of 290 rivers, 54 of which are international, make up this so-called "land of a hundred rivers." Additionally, fisheries play a significant role in the wealth and well-being of the planet. According to Food and Agricultural Organization (FAO) fish now provides a significant source of nutrient-rich food and animal protein for a large portion of the world's population since worldwide fish food supply has increased faster than global population growth over the past 50 years [1]. According to the report, The State of World Fisheries and Aquaculture 2022, Bangladesh is ranked third internationally for inland capture fisheries and fifth globally for fish production from aquaculture. According to Department of fisheries Fisheries (DoF) industry increases the agricultural Gross Domestic Production (GDP) by 22.14% and 2.43%, respectively. Fish makes up around 60% of the daily amount of animal protein consumption. More than 12% of the population of Bangladesh is employed in this sector, both full and part-time [2]. Total fish production was 47.58 lakh MT in 2021-22, whereas inland open water (capture) contributes 27.78% and inland closed water (culture) contributes 57.39% to total production [2]. Reports of Fisheries Statistical Yearbook of Bangladesh states that the nation is

fortunate to have access to vast open water resources with an enhanced aquatic variety that includes about 260 species of freshwater fish [3]. According to Hossain [4], 293 riverine fishes, 475 marine fishes, 23 exotic species, as well as a variety of other vertebrates and invertebrates, are known to call Bangladesh's aquatic bodies home. "Finfish are most often observed among the aquatic wildlife, followed by crustaceans and molluscs. The diverse aquatic habitats in Bangladesh support a wide variety of fish. The total number of freshwater fish species occurring in Bangladesh compiled as 250 to 266 species" [5,6]. "A modest estimate puts it to a total figure of 260 species. However, a number of species have been added to the list" [7]. Of the recorded species, 36 are migratory, 104 are classified riverine species, and the remaining 113 are Floodplain resident species [8]. Additionally, freshwater bodies of Bangladesh are known to be habitat of 26 species of Molluscs, 4 species of crabs, and 20 species of prawns [6]. A pressing concern in Bangladesh at the moment is the reduction in fish species abundance in the country's interior waters [9]. Lack of awareness of human is causing huge damage to water resources across the nation. As a result of these factors, plant and wildlife diversity has been declining over the planet [10]. International Union for conservation of nature (IUCN) assessed total number of available freshwater fish species in Bangladesh was 260 of which, 64 species have been found Threatened, which is 25.3% of the total species [11]. The Someshwari, one of the major Transboundary River, maintain a diverse aquatic biota that is home to several endangered and unique fish species. Until it empties into the Kangsha river, the Someshwari river flows through Susang-Durgapur and other parts of the

Netrokona district, Bangladesh. A river branch merges with the Balia River as it travels in the direction of Kalmakanda. A second river branch enters the haor regions of the Sunamganj district and discharges into the Surma River. The river is a tabernacle of native wild fish and other aquatic creatures, and previously it was simple to witness fish playing in the water. However, a number of issues, such as river obstruction, habitat destruction, bridge building, and aquatic pollution, have lately come into play. Due to over exploitation, altered water flow patterns, climate change, and several other human activities, fish species has begun to disappear and production of river is declining day by day. According to certain theories, a variety of new growth phases in fish species is caused by seasonal variations in environmental elements, sex, gonad development, and physiological state of the fish at the time of collection [12]. However, proactive measures should be implemented in order to protect these natural resources. The results of this study will help to learn more about the aquatic biodiversity of the Someshwari River, its current state, the main factors contributing to its loss of biodiversity, and the current conservation trend.

2. MATERIALS AND METHODS

2.1 Study Area

Someshwari River is located on Durgapur Upazila in the Netrokona district of Bangladesh. The primary locations for data and fish sample collection were Shibganj (25°12'30"N, 90°66'88"E) Dakumara (25°12'74"N, 90°66'71"E), Kullagora (25°14'26"N, 90°66'76"E), and Bijoypur (25°17'42"N, 90°65'87"E) in Bangladesh's Netrokona district. Four sampling points were chosen to cover selected locations shown in Fig. 1. Data was collected using a locally accessible fishing net. Fish samples were collected and kept in plastic vials with formalin solution. The relative abundance of various species was categorized as extremely common, common, moderately found, uncommon, and very rare, which are also calculated.

2.2 Data Collection

Fish samples were collected during visits to the regions that were selected. The majority of the fishermen who were fishing in the rivers and other natural water bodies, as well as from the fish landing facilities and fish markets depicted in

the sample collection. Sampling was done from November 2020 to October 2021, throughout 12-month period. Due to the one-month spacing between each sampling, each point was sampled twice. Among the recorded fish species most of them were recorded from the adjacent fish catching area of river. All of the unidentified fish samples were preserved with 10% formalin in plastic jars before being delivered to the lab for identification. Before conducting experiment we sought consent from ethical approval committee and followed the ethical guidelines for animal strictly. From the study sites, pertinent information was gathered, including the local name of the fish samples that were obtained, their origin, range, and availability, among other things. Secondary information was collected from Upazilla Fisheries Office regarding the fisheries resources on the basis of this information a preliminary survey was conducted in the study area. Primary data were collected also from target groups through questionnaire interviews, PRA such as focus group discussion (FGD) and cross-check interviews with key information. Participatory Rapid Appraisal (PRA) is a group of methods to collect information from target groups. The advantages of PRA over other methods are that the information collected is likely to be more accurate. It is a bottom-up approach. It is generally used for collecting more accurate information with wider participation. A questionnaire was created in accordance with the study's objectives to collect data from the fishermen and target groups. Before creating the questionnaire, a draft was created and then pre-tested in the study area while keeping the study's objectives in mind. During this pre-testing, special attention was made to incorporating any new information not included in the draft timetable. The questionnaire was then finished after required alterations and modifications were made based on the feedback received from the fisherman. The final questionnaire was then prepared in a logical order so that the target group may respond in order.

2.3 Morphometric and Meristic Analysis

Digital cameras were used to take individual color photographs of the collected fishes in their fresh state from various perspectives. Morphometric and meristic characteristics of the collected species were then examined in the laboratory of the Department of Fisheries Biology and Genetics, BAU, Mymensingh.

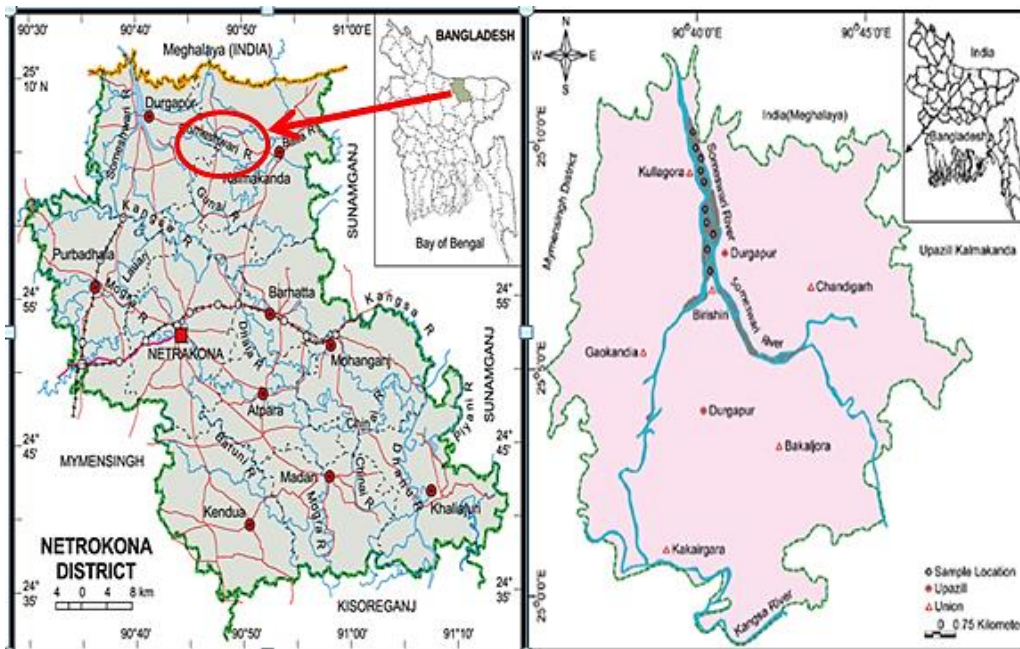


Fig. 1. Map showing the geographical location of the study area

2.4 Identification, Preservation, and Statistical Analysis

Fish were identified using the Rahman [13] taxonomy guide and Talwar and Jhingran [14] for their categorization. Further pertinent literature and Fish Base were also examined. For the preservation of fish samples, specialized glass jars and containers of various shapes and sizes were set up at the laboratory of the Department of Fisheries Biology and Genetics. Graphs and Tables were represented by Microsoft Excel. The Microsoft Excel was used to plots graphs for dissemination of the results. Data with the locally used units and percentages were calculated for further analysis.

3. RESULTS

3.1 Fish Species

Someswari River is one of the rivers which lost its golden past in respect of water flow, fish species diversity as well as aquatic biodiversity in recent years. A total of 23 species of fish belonging to 12 families were observed during the study period among them 14 species are in least concern category, 4 species in vulnerable condition and single species are in the risk of Near threatened and critically endangered condition which are shown in Fig. 2.

3.2 Fish Biodiversity

In Someshwari River, the number of food fish was much higher than the ornamental fishes. In the sampling location it was found that there were about 81% food fish and 17% ornamental fish and the rest of 2% used as trash fish which is showed in Fig. 3.

Survey with fisher's shows that the highest number of fish caught by the fishers was catfishes at about 26.62%. However, the lowest amount catch constituted the loaches of about 1.3%. After the catfish, the second highest catch was 15.9% of small prawns. Another dominant group, the major carps contained 11.26% and barbs remained at 11% of the total catch. In addition, other groups like Mola carplet 7%, gourami 2.20%, Spiny eels 9.86% were found in the Someshwari River. Here is given a frequency distribution available fish species in Fig. 4.

3.3 Fishing Gears

The fishermen generally used boats in the river for the transportation of nets and related materials during fishing. In the sampling area of Someshwari River, fishermen usually follow fishing techniques such as netting, trapping, spearing and dewatering. The Table 1 represents the list of fishing gears that are generally used in Someshwari River.

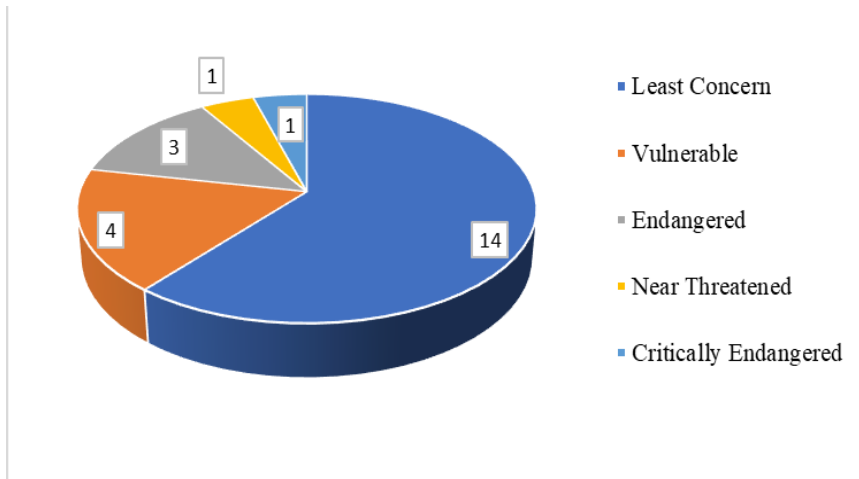


Fig. 2. Fish species conservation status

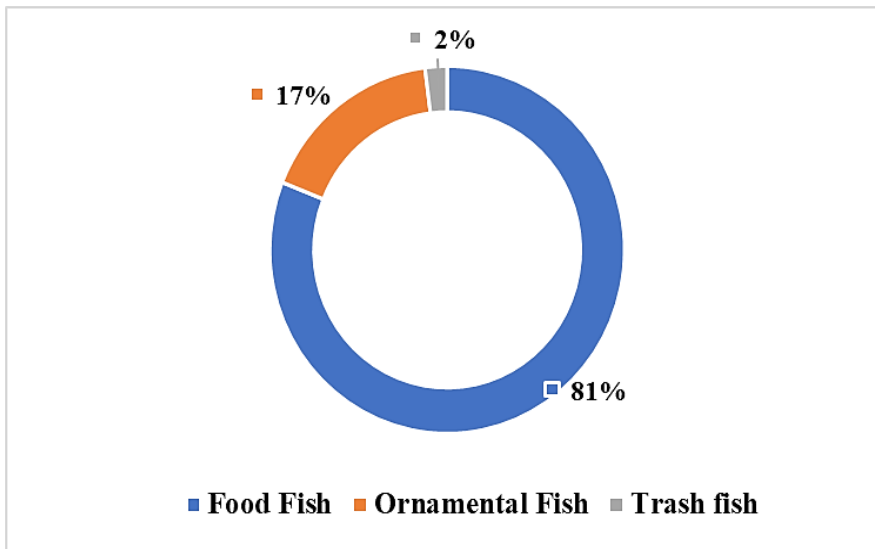


Fig. 3. Use of trapped fish

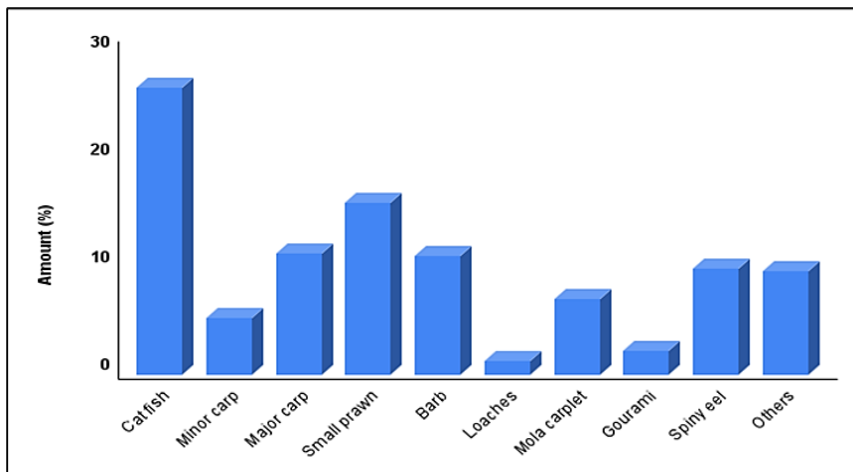


Fig. 4. Frequency distribution of fish species

Table 1. List of fishes with their common name, scientific name and IUCN status from Someshwari River during study period

Sl. No.	Common name	Scientific name	IUCN Status	
			BD	Global
1	Mola	<i>Amblypharyngodon mola</i>	LC	LC
2	Chingri	<i>Macrobrachium rosenbergii</i>	LC	LC
3	Foli	<i>Notopterus notopterus</i>	VU	LC
4	Kaikka	<i>Xenentodon cancila</i>	LC	NE
5	Potoka	<i>Chelonodon fluviatilis</i>	LC	LC
6	Taki	<i>Channa punctata</i>	LC	LC
7	Guchi	<i>Mastacembelus pancalus</i>	LC	LC
8	Koi	<i>Anabas testudineus</i>	LC	DD
9	Bele	<i>Glossogobius giurus</i>	LC	DD
10	Pabda	<i>Ompok pabda</i>	CR	NT
11	Kajuli	<i>Ailia coila</i>	LC	NT
12	Kalo buzuri	<i>Mystus tengara</i>	LC	LC
13	Tengra	<i>Mystus bleekeri</i>	LC	LC
14	Ranga Khailsa	<i>Colisa lalia</i>	LC	LC
15	Chanda	<i>Chanda nama</i>	LC	LC
16	Boal	<i>Wallago attu</i>	VU	NT
17	Puti	<i>Pethia ticto</i>	VU	LC
18	Baim	<i>Mastacembelus armatus</i>	EN	NE
19	Koi bandi	<i>Badis badis</i>	NT	LC
20	Kalibaus	<i>Labeo calbasu</i>	LC	LC
21	Rani	<i>Botia dario</i>	EN	LC
22	Bou	<i>Botia dayi</i>	EN	NE
23	Gutum	<i>Lepidocephalichthys annadalei</i>	VU	LC

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

Table 2. The fishing gears used in the river Someshwari

Group	Types of gears	Specific names of gears
Fishing Nets	Seine net	Ber jal / Behundijal
	Lift net	Dhormajal / Moiyajal
	Gill net	Current jal
	Dip net	Thelajal
	Cast net	Kheplajal
	Fishing Traps & Fish holders	Fishing Traps & Fish holders
Chai / Duhoir		
Ghuni		
Vair		
Kholsun		
Wounding gears	Hooks and Lines	Koch/pachha
		Chhip borshi
		Dhela/ Wheel borshi

Among them, wounding gear is mainly used by local people which causes great loss of fish diversity. According to season and availability of different species of fish, different types of fishing gears were used. Fishing activity continued throughout the year. In Someshwari River, about 52% of the people used fishing nets for catching fish. They also used traps, hooks and lines and wounding gears.

3.4 Conservation Measures

The withdrawal of water in the upstream resulted in reduced water flow in the downstream leading to siltation and habitat degradation of Someshwari River. The fish abundance of the river has been drastically reduced due to destruction of habitats and destructive fishing practices.

3.5 Community Based Fisheries Management (CBFM)

CBFM is a strategy that were undertaken through the active participation of an organized community. According to survey, respondent mention that CBFM is playing a great role in the following sector-improvement of biodiversity; maintenance of fishing gears; fish production improvement; impacts on social stability; impacts on poverty alleviation; fish species availability; management of pollution and siltation and management of river basin and water quality.

3.6 Fishing Gears

In the study area, different types of fishing gears were found to operate in the river like ber jal, jhaki jal, current jal, thela jal, Dharma jal, bair.

Some of them are destructive for fish biodiversity. their impact depends on mesh size, small-mesh sine net is much more destructive. Available fishing gears and their uses with the impact on biodiversity is given in Table 3.

Fishers mentioned that before establishing the CBFM approach, they used their fishing gears without understanding their proper use, what type of fishing gears are usable in cases of different depth, species, and season, which indicate improper fishing. Further, they did not follow any fishing rules other than profit. As such fishing was done indiscriminately and, in most cases, it was overfished by using the destructive fishing gears. That improper fishing caused reduction of fish species from the water body, a barrier to proper growth and development of the fishes.

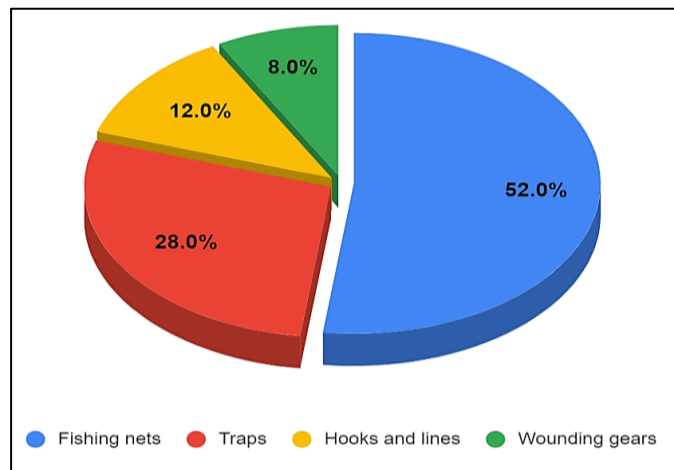


Fig. 5. Types of gear used in river Someshwari

Table 3. Available fishing gears and their impacts

Name of gear	Local Bengali Name	Main use of the gear types	Impact on fish biodiversity
Gill net	Current jal, Fash jal	The most effective for catching small fish.	High: The most commonly used and most destructive for fish biodiversity
Lift net	Dharma jal	Operated from bank of beel	Medium: Used of this gear during post breeding season was destructive for biodiversity.
Seine net	Ber jal, Huter/Gaitta jal	More fish were caught by seine nets than any other basic method. Can have large, medium or very small mesh.	High/ Medium: Impact depends on mesh size, small-mesh sine net is much more destructive for biodiversity
Push	Thela jal	Small net mounted on a triangular frame. Used in late monsoon and dry season	Medium: Harmful during post breeding season
Spear	Koch, Teta Achra	Spears were used during early and late mosoon periods	Low: Not harmful

3.7 Pollution

Unlawful and unregulated extraction of sand, oil spillage from mechanized boats, human waste, and domestic garbage were observed to be the main causes of water pollution of the Someshwari River. Toxic waste entering the water bodies, and disturbing the food chain and so the aquatic ecosystem. Pollution of river water is the highest threat to the ecosystem of the Someshwari River and it is the main cause of losing fisheries biodiversity.

4. DISCUSSION

A total 23 species of fishes under 12 families were observed during the study of the river, Someshwari (Jaria, Susang durgapur). DoF [15] estimates that there are roughly 115 freshwater fish species in the Bhairab River, divided into 13 orders and 31 families. Alam et al., [10] reported that 78 fish species were recorded in the Chikadubi beel fish sanctuary of Dingaputa haor. Hossain et al. [16] recorded a total of 115 fish species in 29 Families and 4 shellfish species in 2 families (3 prawns and a crab). Chowdhury et al. [17] claimed that 46 fish species were found in the Naaf River. In the Padma distributary of the Ganges River, 80 different species of fish were counted by Rahman et al. [18]. According to Hossain et al. [19], the Meghna River basin's estuary is home to 53 different kinds of fish. There are 63 kinds of fish in the Choto Jamuna River, according to another source [20].

Fish variety is quite abundant in the Kangsha and Someshwari River. Although 66 fish species were included in the Someshwari River in the earlier research by Chakraborty and Mirza (2010), there are currently 56 fish species extent in the Someshwari River. The Someshwari River's declining biodiversity is therefore readily apparent in recent years. According to IUCN Red list (2015) 23 collected fish species were categorized where 6 fin fish species are endangered, 4 are critically endangered, 5 are vulnerable, 7 are data deficient, 2 are found not threatened. Further-more research by Islam et al. [21] on the Fayra River, roughly 42% of the species are uncommon. 29.82% of species are less common, while 7.89% are extremely uncommon. Fishermen used 14 different types of fishing gear, including nets, traps, hooks and lines, and wounding gear in the study region. 13 different types of fishing gears were noted by BCAS [22] at 4 beels in the districts of Netrokona and Sunamganj. In the Hatia region, thela and bagdara jal are used to collect shrimp PL. *Penaeus monodon* collection causes a significant

loss of biodiversity to the ecosystem by washing away other shrimp Post Larvae, finfish fry, and plankton [23]. According to Hossain et al. [24], 161 species were captured in the estuary of the Naaf River using various types of nets. About 185 species were recorded by Islam et al. [25] in Bangladeshi coastal waters using an estuary set bag net. Kabir et al. [26] did a survey on the ancient Brahmaputra-river region, and they discovered that the fishermen primarily utilized laki jal and Diarma jal, Current jal, Moiya jal, Ber jal, Thella jal, Bair, Chandi bair, Borshi for catching different types of fish species. Work Hooks and Lines ing on the gears of the Meghna Estuary. The people largely depend on fish to meet their protein needs, especially the poor in rural areas. In the past, the major source of fish production in Bangladesh was the inland open water capture fisheries [27]. However, freshwater fishes are decreasing at an alarming rate and becoming threatened due to a variety of causes. Overfishing, rapid extraction of fish seed and bloodstock, destructive and unregulated fishing practices, pollution, introduction of exotic species, loss of aquatic habitat due to siltation, dam construction, and other anthropogenic activities have been the major causes of fish species loss. Therefore, proper measures should be taken to protect and conserve them.

5. RECOMMENDATIONS

To protect and conserve the freshwater fishes the following measures should be taken-

1. Threatened fishes should be artificially bred in order to conserve endangered species.
2. Cryogenic gene banking should be created for the conservation of freshwater fishes.
3. Habitat management practices should be enhanced to prevent habitat damage,
4. Fish sanctuaries are a crucial and effective instrument for the preservation and natural conservation of vulnerable species.
5. Training of Govt. organizations and NGOs should be undertaken for the conservation of freshwater fish biodiversity.
6. Illegal sand and rock excavation should immediately stop with the help of government administration.
7. Community Based Fisheries Management can be implemented.

6. CONCLUSION

Immediate conservation steps should be taken to conserve the existing fish species of the Someshwari River. Strict implementation of rules

and regulation to control use of illegal fishing gears in river is strongly recommended. Establishment of sanctuary in the river is also suggested where there will be no fishing activities. Establishment of legal protection for certain threatened species can be a solution to save the decreasing aquatic biodiversity, especially those are rated Critically Endangered in Bangladesh.

ETHICAL APPROVAL

Animal Ethic committee approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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