

**FISH DIVERSITY AND SOCIO-ECONOMIC STATUS OF GOMTI RIVER  
FISHERMEN AT CUMILLA SADAR BANGLADESH**

Mohammad Shamsil Arafeen<sup>1,2,\*</sup>, Jarin Tasnim<sup>1,2</sup>, M. A. Habib Siam<sup>1,2</sup>, J. K. Owaresat<sup>1,2</sup>,  
Abdullah Al Asek<sup>1,2</sup>, Sabira Ahmed Sara<sup>2</sup> and Md. Manzoorul Kibria<sup>1,2</sup>

*Halda River Research Laboratory, Department of Zoology, University of Chittagong,  
Chittagong-4331, Bangladesh*

**ABSTRACT:** The Gomti River originates in eastern Tripura, India, and flows westward into Bangladesh, supporting a variety of fish species along its course. This study focused on evaluating the fish diversity and the socio-economic status of fishermen in the Gomti River at Cumilla Sadar Upazila, Cumilla, Bangladesh. Researchers identified 37 fish species from 5 orders and 15 families, with most species belonging to the Cypriniformes and Siluriformes orders. According to the IUCN Bangladesh (2015), 9 species were classified as near threatened, 3 as endangered, and 4 as vulnerable. The data included metrics such as species richness, the Shannon-Wiener diversity index, and species evenness. In July, the river's species richness was recorded at 32, the Shannon-Wiener diversity index at 3.30372, and species evenness at 0.66074. By December, these values decreased to 9 for species richness, 2.10556 for the Shannon-Wiener index, and 0.66423 for species evenness, reflecting a decline in fish diversity in the Gomti River. Information was also gathered through interviews with 30 randomly chosen fishermen and focus group discussions using a structured checklist. The findings showed that 54% of the fishermen had annual earnings between BDT 91,000 and 1,20,000. The majority of the fishermen were aged between 35 and 50 years, with 87% married, an average family size of 5-7 people, and mostly living in nuclear families. Additionally, 53% of the fishermen had education only up to the junior secondary level. Most fishermen depended on allopathic doctors for healthcare, and their living conditions, including housing and sanitation, were poor. Various indicators of livelihood suggest that the fishermen are living in dire conditions. To address these challenges, adopting community-based aquatic resource management strategies could boost fish production and improve the living standards of the communities along the Gomti River.

**Key words:** Fish, Diversity, Gomti River, Fishermen, Socio-economic Condition, Bangladesh.

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\*Author for correspondence: <shamsilarafeen@cu.ac.bd>; <sup>2</sup>Department of Zoology, University of Chittagong, Chittagong-4331 Bangladesh

### INTRODUCTION:

Bangladesh is home to a vast array of inland water resources, such as rivers, oxbow lakes, ponds, natural depressions, floodplains, reservoirs, and marine and coastal waters. Major river systems include the Padma, Meghna, Jamuna, Brahmaputra, Gomti, Karnaphuli, Teesta, and Surma (Joadder *et al.*, 2015). These rivers, which extend over 24,140 km and have more than 230 tributaries, ultimately flow into the Bay of Bengal (Siddique *et al.*, 2007). Globally, there are around 32,000 fish species, with nearly 40% inhabiting freshwater. Bangladesh itself has about 251 freshwater fish species (Hossain *et al.*, 2012), including key carp species like Kalibaus, Rui, Catla, and Mrigal. Inland open waters contribute approximately 28.16% to capture fisheries, while closed waters contribute around 57.10% to culture fisheries (DoF, 2022).

Inland waters are categorized into open and closed waters, covering a total area of 4.3 million hectares in Bangladesh. About 6% of these waters are used for closed-water culture fisheries, while 94% are dedicated to open-water capture fisheries. The classifications of inland open waters include primary and secondary rivers, natural depressions (beels), floodplains, oxbow lakes, borrow-pit canals, and natural canals (Kibria and Ahmed, 2005).

Fish and fishery products are vital sources of food and animal protein for millions of impoverished people in Bangladesh (Hossain *et al.*, 2013). As per the Department of Fisheries (DoF, 2022), approximately 19.5 million people rely on the fisheries sector, either directly or indirectly, for their livelihoods. Fishing in Bangladesh's many rivers, canals, and water bodies is a crucial source of sustenance and income for the populace. The Gomti River, in particular, is a key source of fish for communities in the Cumilla district.

The Gomti River, a transboundary river between Bangladesh and India, is located in the Cumilla District of southeastern Bangladesh. It stretches 95 kilometers in length and 65 meters in width, following a winding path. Originating from the northeastern hills of Dumur, Tripura, India, the Gomti enters Bangladesh at Golabari in Cumilla after flowing for 150 kilometers. The river flows near Cumilla city, passing through Shahpur, Tikkarchor, Chandpur, Kaptan Bazar, and Palpara, before moving through Moynamoti, Debidwar, and Companiganj, eventually merging with the Meghna River at Daudkandi. The portion of the river from Golabari to Companiganj is considered the upper stream, while the remaining part is the lower stream.

Knowing the state of the research area's fish diversity is one of the goals of the current investigation. Therefore, the purpose of this study is to ascertain the present status and availability of fish species in the Gomti River at Cumilla Sadar Upazila in the Cumilla district, as well as the contribution of fish production to national production and the socioeconomic status of the involved fish farmers.

**MATERIAL AND METHODS**

*Study area:* The study was conducted from Chandpur (23.478924 ° N, 91.189571 ° E) to Shahpur (23.470370 ° N, 91.242310 ° E), covering Cumilla Sadar Upazila. Within this area, samples were collected from four sampling points (Table 1 and Fig. 1), Namely Chandpur (SP<sub>01</sub>), Tikkarchor (SP<sub>02</sub>), Jaluapara (SP<sub>03</sub>), and Shahpur (SP<sub>04</sub>). All four points were situated in Cumilla Sadar Upazila in Cumilla district, Bangladesh.

**Table 1: Sampling Points**

Sampling Points No.	Latitude	Longitude
SP <sub>01</sub>	23°28'45"N	91°11'17"E
SP <sub>02</sub>	23°28'14"N	91°12'07"E
SP <sub>03</sub>	23°28'18"N	91°12'41"E
SP <sub>04</sub>	23°28'17"N	91°13'53"E

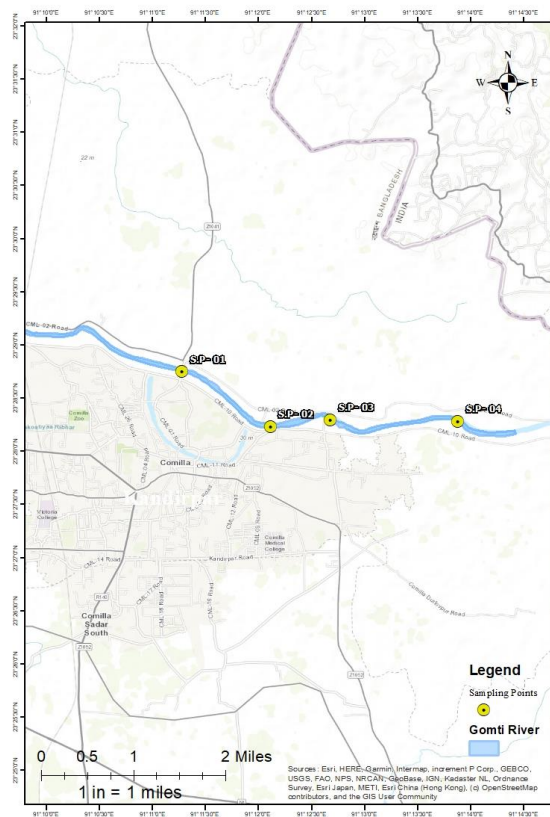


Fig. 1. Map of the Gombi River, Cumilla Sadar Upazila, Bangladesh

*Study Period:* The Gomti River in the Cumilla district of Bangladesh was the subject of a study on the fish diversity and socio-economic state of fishermen during the period between July 1, 2023, and December 31, 2023. Sampling was made at each of the four points (SP<sub>01</sub>, SP<sub>02</sub>, SP<sub>03</sub>, and SP<sub>04</sub>) once in a month.

*Data Collection:* Fishermen in the local fishing community were provided the primary data, which also included on-site observation during operations. During the monthly sampling time, samples were collected from the catch of the locally selected fishermen while they were fishing at the chosen sampling sites. Throughout the research period, visits were made once per month. By conducting interviews with 30 fishermen and obtaining personal communications from local residents, information regarding the types of fish caught and the socioeconomic circumstances of the fishermen was gathered. With the use of a semi-structured questionnaire system, face-to-face interviews were conducted. In order to cross-check interviews, secondary information was acquired from the important informants, such as the District Fisheries Officer (DFO), the Upazila Fisheries Officer (UFO), and the necessary GO and NGO personnel. The collected data were compiled and discussed to have a clear idea about the fish faunal diversity and socio-economic conditions of fishermen in the Gomti River (Siddique *et al.*, 2007).

*Data Analysis:* Identifying a fish is a preliminary approach to carry on any research. Morphometric measurements and meristic characters are considered the easiest and most authentic methods for the identification of specimens which is termed as morphological systematics (Nayman, 1965). These characters are helpful for species recognition and classification (Jayram K.C., 1994; Hossain *et al.*, 2016). The morphometric characters of a fish species are also used to compare the life history and morphological trends of populations across regions (Hossain M.Y. *et al.*, 2017). These relationships between various body parts of fish can be used to assess the well-being of individuals and to determine the possible difference between separate unit stocks of the same species. Length-length relationships are still scarce for most of the tropical and subtropical fish species (King M., 2007; Martin-Smith K.M., 1996; Hossain *et al.*, 2009). The body measurements of different fish species and different fish stock may differ considerably (Jayram K.C., 1994; Talwar P.K. and Jhingran A.G., 1991).

*Species assemblage and fish diversity analysis:* In this study, the Shannon-Wiener diversity index ( $H'$ ), Pielou's species evenness index ( $J'$ ) and species richness index ( $S$ ) were calculated to evaluate the status of fish diversity using the following formulae:

Shanon-Wiener diversity index,

$$H' = -\sum P_i \ln P_i$$

Here,  $\Sigma$ : A Greek symbol that means “sum”,  $H'$  is the diversity index and  $P_i$  is the relative abundance ( $s/N$ )

Pielou’s Evenness index,

$$J' = H'/H_{\max}$$

Species evenness, denoted by  $J'$ , by dividing the observed Shannon-Wiener Diversity Index ( $H'$ )

by the maximum possible diversity ( $H_{\max}$ ), we obtain our desired result for Species Evenness ( $J'$ ).

Species richness ( $S$ ) is the number of species within a defined region. The species richness of a region is obtained through sampling or via a census.

$N$  is the total number of individuals.

## RESULT AND DISCUSSION

*Fish Diversity of Gomti River:* During the six-month study period, from July 2023 to December 2023, a total presence of 37 fish species belonging to 5 orders and 15 families was identified during the study period in the Gomti River at Cumilla Sadar Upazila, Cumilla, Bangladesh. The family Cyprinidae had the highest number of documented finfish species, with 14 species, followed by the family Bagridae with 5 species (Table 2). Here is the finfish of the Gomti River with Order, Family, Species, Local name, and threatened status (IUCN Bangladesh 2015).

(EN: Endangered, VU: Vulnerable, LC: Least concern, DD: Data deficient, NT: Near threatened, NE: Not Evaluated) of the 37 fish species recorded in the study area, three are endangered (8%), four are vulnerable (11%), nine are near threatened (24%) and nineteen are the least concerned (51%) in Bangladesh, according to IUCN Bangladesh (2015) (Fig. 2). In the upper stream of the river, the fish species are found scarce, but in the lower streams, various fish species are found. The fish diversity exhibited significant variation across several months, including in July with a count of 290, in August 241, in September 162, in October 110, in November 51, and in December with a count of 27 individuals of different species. The Shannon-Wiener diversity index  $H'$  exhibited a range of 2.10 to 3.30, reaching its peak in the month of July, 2023 and its lowest point in the month of December, 2023 (Table 3, Fig. 4). In the present study, the highest dominant order was Cypriniformes which covered 40% of the total, followed by Siluriformes at 30%, Perciformes at 22%, Osteoglossiformes at 5% and Synbranchiformes at 3% (Fig. 3).

**Table 2: List of fish biodiversity of the Gomti River and current status**

Order	Family	Sr. No.	Scientific Name	Local Name	Status in BD	Global Status
		01	<i>Amblypharyngodon mola</i>	Mola/Moilla	LC	LC
		02	<i>Systemus sarana</i>	Shar punti	NT	LC
		03	<i>Salmostoma phulo</i>	Fulchela	NT	LC
		04	<i>Puntius ticto</i>	Tit punti	VU	LC
		05	<i>Puntius sophore</i>	Jatpunti	LC	LC
		06	<i>Puntius brevis</i>	Punti	DD	NE
Cypriniformes	Cyprinidae	07	<i>Osteobrama cotio</i>	Dhela	NT	LC
		08	<i>Labeo bata</i>	Bata	LC	LC
		09	<i>Labeo rohita</i>	Rui	LC	LC
		10	<i>Cirrhinus mrigala</i>	Mrigal	NT	VU
		11	<i>Cirrhinus reba</i>	Bhagna	NT	LC
		12	<i>Aspidoparia jaya</i>	Jaya	LC	NE
		13	<i>Danio aequipinnatus</i>	Chebli	DD	LC
		14	<i>Labeo calbasu</i>	Kalibaus	LC	LC
	Cobitidae	15	<i>Lepidocephalus guntea</i>	Gutum	LC	LC
		16	<i>Mystus vittatus</i>	Tengra	LC	LC
		17	<i>Mystus bleekeri</i>	Gulsha	LC	LC
	Bagridae	18	<i>Mystus cavasius</i>	Gulsha tengra	NT	LC
		19	<i>Mystus gulio</i>	Nuna tengra	NT	LC
		20	<i>Sperata seenghala</i>	Ayer	VU	LC
Siluriformes		21	<i>Ompok bimaculatus</i>	Boali pabda	EN	NT
	Siluridae	22	<i>Wallago attu</i>	Boal	VU	NT
		23	<i>Ompok pabda</i>	Pabda	EN	NT
	Schilbeidae	24	<i>Eutropiichthys vacha</i>	Bacha	LC	LC
	Clariidae	25	<i>Clarias batrachus</i>	Magur	LC	LC
	Heteropneustidae	26	<i>Heteropneustes fossilis</i>	Shing	LC	LC
	Ambassidae	27	<i>Chanda nama</i>	Chanda	LC	LC
	Anabantidae	28	<i>Anabas testudineus</i>	Koi	LC	DD
	Nandidae	29	<i>Badis badis</i>	Koi bandi	NT	LC
Perciformes		30	<i>Nandus nandus</i>	Meni/ Bheda	NT	LC
	Channidae	31	<i>Channa punctata</i>	Taki	LC	LC
		32	<i>Channa striatus</i>	Shol	LC	LC
	Gobiidae	33	<i>Glossogobius giuris</i>	Bailla	LC	LC
	Eleotridae	34	<i>Eleotris fusca</i>	Budh bailla	LC	LC
Osteoglossiformes	Notopteridae	35	<i>Chitala chitala</i>	Chital	EN	NT
		36	<i>Notopterus notopterus</i>	Haila	VU	LC
Synbranchiformes	Mastacembelidae	37	<i>Mastacembelus pancalus</i>	Guchi baim	LC	LC

The range of Pielou's evenness ( $J'$ ) index is between 0.660 to 0.674. The peak value was documented in October 2023 and its lowest point was in July 2023 (Table 3, Fig. 4). The Shannon-Wiener diversity index  $H'$  is a commonly employed metric for assessing and comparing the level of variety among different

ecosystems. The anticipated value ranged from 2.10 to 3.30, with the highest value occurring in July and the lowest value occurring in December (Table 3) (Fig. 4). A Shannon value of 3 is only recorded in areas with robust and diverse biodiversity. The range of Pielou's evenness ( $J'$ ) index is from 0 to 1. The current study found that the observed value was relatively high, ranging from 0.660 to 0.674.

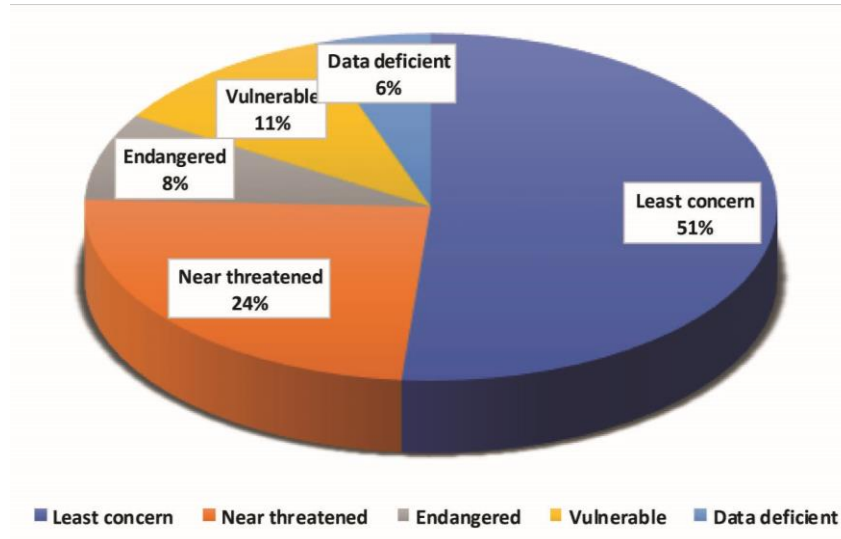


Fig. 2: IUCN Bangladesh status (2015) of threatened fish in Gomti River

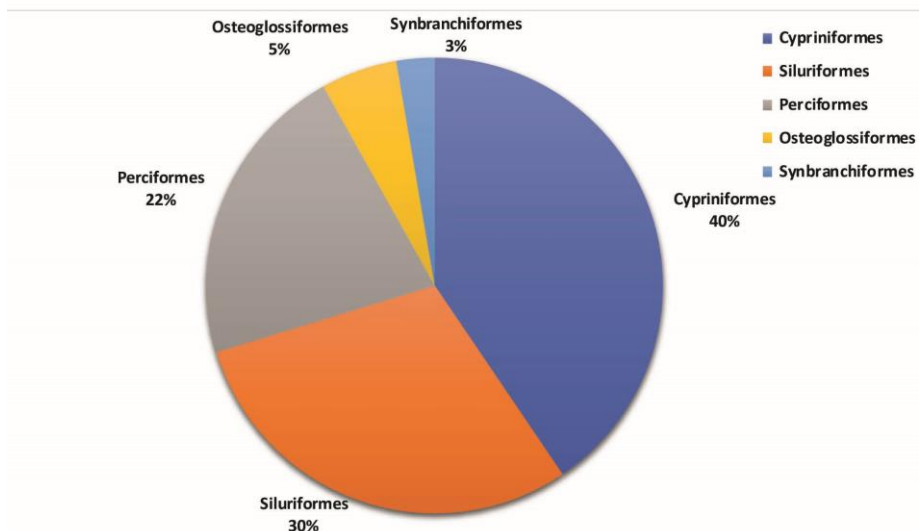


Fig. 3: Percentage (%) of Fish Species according to Fish Orders in Gomti River

**Table 3: Biodiversity index of Gomti River**

Index	July, 2023	Aug. 2023	Sep. 2023	Oct. 2023	Nov. 2023	Dec., 2023
S	32	30	20	15	13	9
N	290	241	162	110	51	27
Diversity (H')	3.30372	3.25398	2.89851	2.63356	2.46740	2.10556
Evenness (J')	0.66074	0.66421	0.67065	0.67408	0.66678	0.66423

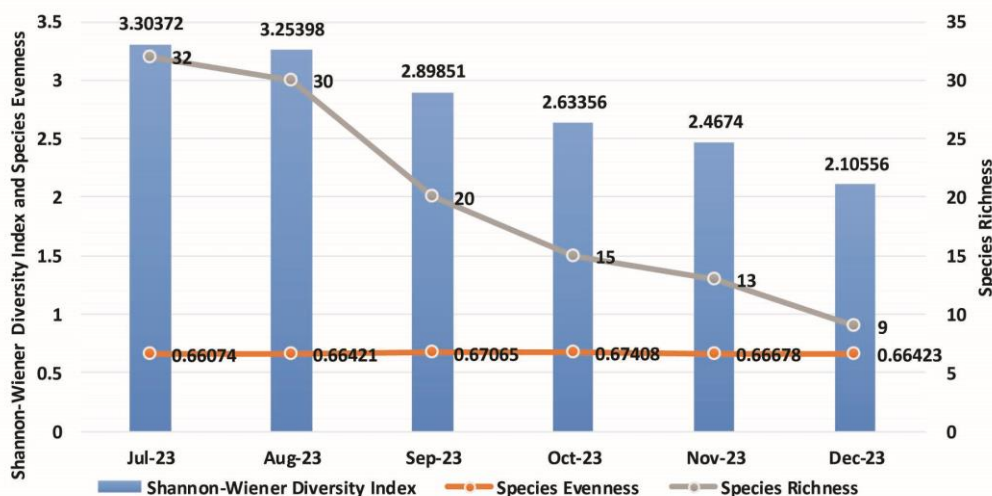


Fig. 4: Graph representing the Shannon-Wiener diversity index, Species Evenness and Species Richness in six different months

The maximum value was documented in October, while the minimum value was seen in July. The diversity indices mentioned above exhibited minimal variation. The species richness index ranged from 9 to 32, with the highest number of 32 species recorded in July and the lowest number 9 reported in December (Fig. 4). The dominance plots revealed the curve representing July 2023 exhibited the highest diversity with 32 species while December 2023 had the lowest diversity with 9 species recorded in this study (Fig. 4).

*Analysis of Socio-economic Conditions of Fishermen:* This study aimed to determine the socio-economic status of fishermen. A particular emphasis was placed on the following variables: age, marital status, education, family size, children's education, annual income, having a banking account, income sources, family type, health facilities, nature of treatment, sanitary facilities, and other socioeconomic difficulties.

*Age Group:* Age of the respondents ranged from 18 to above 50 years. The highest numbers of fishers (56%) were in the middle (36 to 50) age group,



whereas 27% were in the old (above 50) age and the lowest 17% in the young (below 35) age group (Table 4)

*Family Size;* The Family was categorized into small families (2 to 4 members), medium families (5 to 7 members), and large families (7+ members). The respondent households had an average family size of 60% in medium (5 to 7) members. Whereas 23% in large (7+) members and 17% in small (2 to 4) members (Table 4).

*Family Type:* The family functions as a unit for income generation, consumption, reproduction, and social interaction. In the present study which was conducted in Cumilla sadar upazila, people are coming from the village for their livelihood. Two types of family patterns were found *i.e.* nuclear family and joint family. In the case of family type, 77% nuclear and 23% joint families were observed in the study area (Table 4).

**Table 4: Socio-economic characteristics of the fishers**

Characteristics of respondents	Number of fishermen	Percentage (%)
Age	Young (18 to 35)	5 17%
	Middle age (36 to 50)	17 56%
	Old (Above 50)	8 27%
Family size	Small (2 to 4 members)	5 17%
	Medium (5 to 7 members)	18 60%
	Large (7+ members)	7 23%
Family type	Nuclear family	23 77%
	Joint Family	7 23%

*Education Status:* Most of the fishermen (53%) had education up to junior secondary level, only 17% of fishermen were SSC and above passed, and the rest 30% were below primary level (Table 5).

*Marital Status:* The present study found that married person is more likely to have this occupation as their livelihood, where about 87% of the fishermen were found to be married and 13% of the fishermen were found to be unmarried (Table 5).

*Yearly Income:* The annual income of fish farmers varied from below 60,000 up to 120,000 BDT. The selected fishermen were grouped into five categories based on the level of their annual income. The highest 54% of fishers earned BDT 91,000 to 120,000 per year and the lowest 10% of fishers earned BDT above 120,000 (Table 6).

**Table 5: Education and marital status of the fishermen**

Characteristics	of respondents	Numbers of fishermen	Percentage (%)
Education	Illiterate	0	0%
	Below primary level	9	30%
	VI-VIII	16	53%
	SSC and above	5	17%
Marital status	Married	26	87%
	Unmarried	4	13%

*Having Banking Account:* In the study area, 87% of fishermen have their own bank account and the rest 13% don't use any banking account (Table 6). That means people are more concerned about using banking facilities.

*Income Sources:* It was found that about 13% of fishermen depended only on fishing for their bread and butter. Instead of this, the majority of the fishermen had their secondary income sources like agriculture 23%, livestock 17%, laborer 37%, and 10% others for their livelihood (Table 6).

**Table 6: Some other socio-economic characteristics of fishermen**

Characteristics	of respondents	Number of fishermen	Percentage (%)
Yearly income	<60,000 BDT	4	13%
	61,000-90,000 BDT	7	23%
	91,000-120,000 BDT	16	54%
	>120,000 BDT	3	10%
Having banking account	Banking account	26	87%
	No banking account	4	13%
Income sources	Only fishing	4	13%
	Agriculture	7	23%
	Livestock	5	17%
	Laborer	11	37%
	Others	3	10%

*Nature of Treatments:* The nature of the treatments that were enjoyed by the fishermen was satisfactory. Health service status was categorized into three groups: Allopathic, Homeopathic, and Kabiraj. The highest proportion (87%) of fishermen depended upon allopathic, 10% depended on homeopathic and the rest 3% in kabiraj (Table 7).

*Housing Condition:* In the study area, the houses of fishermen were of two main types. Kacha and semi-pucca. Housing condition was slightly dominated by kacha (57%) and 43% used semi-pucca. (Table 7).

*Drinking Water facilities:* The drinking water condition of the fishermen was observed more or less satisfactory. About 53% used their own tubewell and 47%

used a neighbor's tube well (Table 7). They all were concerned about drinking pure water.

*Sanitary Facilities:* The sanitary conditions of the fishermen were observed to be in good condition. About 77% of people used semi-pucca toilets. The remaining 23% used kacha toilets (Table 7).

**Table 7: Facilities for the fishermen**

Characteristics	of respondents	Number of fishermen	Percentage (%)
Nature of the treatments	Allopathic	26	87%
	Homeopathic	3	10%
	Kabiraj	1	3%
Housing conditions	Kacha	17	57%
	Semi-pucca	13	43%
Drinking water facilities	Own tubewell	16	53%
	Neighbor's tube well	14	47%
Sanitary facilities	Kacha	7	23%
	Semi-pucca	23	77%

Bangladesh is home to 700 rivers that span the entire country. While much research has been conducted on major rivers such as the Padma, Meghna, and Jamuna, there is limited focus on smaller rivers. The Gomti River is one of these lesser-studied rivers in Bangladesh, and recent research on it is sparse. Bhuiyan (2022) identified 10 orders and 24 families of fish in the Gomti River, whereas this study found 5 orders and 15 families. The variation in findings can be attributed to factors such as differences in water levels, water quality, soil quality, and other natural characteristics between the upper and lower reaches of the river. Moreover, different species are present in different locations based on these environmental conditions. This study identified 37 species across 5 orders and 15 families, with Cypriniformes being the most diverse group by species count and number of individuals, followed by Siluriformes. Similar patterns have been observed in other rivers in Bangladesh, including the Mahananda (Mohsin & Haque, 2009), the Padma (Rahman *et al.*, 2012), and the Choto Jamuna (Galib *et al.*, 2013). In July, species richness was measured at 32, with the Shannon-Wiener diversity index at 3.30372 and species evenness at 0.66074. A marked decline was observed in December, with species richness dropping to 9, the Shannon-Wiener index falling to 2.10556, and species evenness slightly decreasing to 0.66423, indicating a reduction in fish diversity in the Gomti River over the study period. Most fishermen rely on allopathic doctors for healthcare, and their housing and sanitation conditions are inadequate. Based on various livelihood indicators, it is clear that fishermen are

living in impoverished conditions. To improve fish production and enhance the livelihoods of fishermen, it is crucial to implement community-based aquatic resource management strategies.

*Recommendations:* The Gomti River is well-known for its scenic beauty and serves as a popular recreational spot for the residents of Cumilla town. Surrounded by lush greenery and agricultural fields, the river offers a stunning landscape. It is a vital ecosystem that plays a key role in maintaining the region's ecological balance. Additionally, the river is an important means of transportation for the local community, with many using boats to cross it. However, the town's growth has led to the construction of restaurants and buildings along the riverbanks without proper waste management, resulting in the direct dumping of sewage and waste into the river. The winter season brings lower water levels, which encourages indiscriminate fishing practices, posing a threat to the river's aquatic biodiversity. To preserve the river's fish diversity, the following measures are recommended

1. Prohibit fishing in interconnected rivers during fish spawning season (March to July) and ban harmful fishing gear like nets and hooks throughout the year.
2. Establish fish sanctuaries in strategic locations, especially near densely populated areas, to control pollution and sustain biodiversity.
3. Establish co-management institutions involving local stakeholders and agencies for effective conservation. Relocate unplanned settlements on riverbanks to planned areas to protect habitat and biodiversity, while providing alternative income sources and support for affected fishermen.
4. Conduct awareness campaigns using various media to educate the local population about fisheries regulation and pollution control.

These measures aim to address the threats posed by urbanization, overfishing, and pollution to the River Gomti's biodiversity and ensure sustainable management for their socio-economic conditions and future generations.

### **CONCLUSION**

The study aimed to assess the ecosystem of the Gomti River in Cumilla Sadar Upazila by examining the diversity of fish species and evaluating the current socio-economic conditions of the local fishermen. Over a six-month period, 37 fish species were identified across four sites, based on field observations and information from local fishermen. The predominance of Cypriniformes and Siluriformes indicates their widespread presence in the river. Ecological analysis revealed various biodiversity indices. In July, species richness was recorded at 32, with a Shannon-Wiener diversity index of 3.30372

and species evenness at 0.66074. A significant decline was observed in December, with species richness dropping to 9, the Shannon-Wiener index falling to 2.10556, and species evenness at 0.66423, reflecting a decrease in fish diversity. The co-management system of the Gomti River failed to significantly improve the socio-economic conditions of the fishermen, who lacked access to essential services. Environmental and human factors, such as overfishing, siltation, the use of illegal small mesh fishing nets, and indiscriminate use of fishing gear, have severely depleted fish stocks and biodiversity. The lack of an effective management policy has exacerbated these issues. It is recommended that the government introduce a proper licensing system for legitimate fishermen, involve government and non-governmental organizations in training programs to enhance the fishermen's socio-economic status, and ensure their active participation in the management process. In conclusion, immediate conservation efforts are needed to address the declining fish diversity in the Gomti River, ensuring its ecological health and the sustainability of various fish populations.

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*Compliance with ethical standards:* This research does not contain any studies with human participants.

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