

## Original Research Article

# ICHTHYOFAUNAL DIVERSITY OF GHAGHARA RIVER, SIWAN (BIHAR), INDIA

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### Abstract

The Ghaghara River, a key tributary of the Ganges, flows through northern India, providing essential water resources for agriculture, communities and biodiversity. The river's fish diversity is vital for maintaining local ecological balance and supporting livelihoods. Fish biodiversity and diversity indices were studied in the study area from August 2021 to July 2022. Data was collected from four locations namely Darauli (S-1), Rakauli (S-2), Phulwariya (S-3) and Semariya (S-4) of the Ghaghara River and we found 61 species belonging to 47 genera, 21 families and 07 orders. [Cypriformes](#) [Cypriniformes](#) was the most predominant order, contributing to 42 % of fish species, followed by Siluriformes with (31%), Perciformes (18%). Cyprinidae is the most abundant family; contributing 39.3% (24 species) fish fauna followed by the family Bagridae (06 species) and Sisoridae. Total number of individuals, relative abundance (percentage catch), minimum and maximum size of each species were calculated. However, the river's aquatic ecosystems, particularly its fish populations are increasingly under threat due to human activities, including habitat degradation, pollution, overfishing and the construction of hydropower projects. This study aims to assess the fish diversity of the Ghaghara River and explore the current conservation challenges and opportunities.

**Keywords:** *Ghaghara River, Fish Diversity, Species composition, Bihar.*

### Introduction

Life on Earth is diverse on many levels, starting with genes and proceeding to the richness and complexity of species, life forms and functional functions, all organized in spatial patterns that range from biological communities to ecosystems, regions and beyond (Colwell, 2009). In other terms, it refers to the diversity and variability of living species their genetic differences and the

habitats in which they live. The various climatic and physical factors lead to the great biodiversity. Biodiversity has been seen in a number of ways, based on the opinions of experts in various professions. It has also been called "life" or "wilderness" in a number of instances. Detecting uncommon species and the underlying complexity of the environmental template make it difficult to quantify patterns of variety at the species level, even when the creatures are well known to science. Biodiversity is described as the genetic and biological diversity of populations, species, communities, and ecosystems (Winter and Hughes, 1997). Biodiversity affects biological systems' ability to adjust to environmental changes and is required for ecosystems to deliver goods and services including nutrient cycling and clean water (Rahbek and Colwell, 2011). Bihar has a high potential for aquatic bioresources and provides substantial opportunities for inland fishing and aquaculture development. The state accounts for approximately 14.68% of the total national fish diversity (Lakra, 2010). Aquatic resources comprise 28,500 kilometers of rivers and canals, 1.38 lakh hectares of reservoirs, 1.61 lakh hectares of ponds and tanks, 1.33 lakh hectares of floodplain lakes, and unused water. The total fish production from all resources in the state is 3.93 million tons (2009-2010) ([www.fisheries.bihar.nic.in](http://www.fisheries.bihar.nic.in)). The state's fish biodiversity has been rapidly declining in recent decades as a result of the introduction of exotic fish species (Dwivedi and Nautiyal, 2010; Pathak et al, 2011) and anthropogenic environmental degradation, such as urbanization, damming, water abstraction for irrigation and power generation, and pollution. These effects have severely strained rivers and other natural water bodies, wreaking havoc on the variety of freshwater fish (Lakra, 2010). The purpose of this study was to provide the first comprehensive description of fish in the Ghaghara River in Bihar's Siwan district, as well as to investigate the current ichthyofaunal variety.

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## **Materials and Methods**

The Ghaghara River, a major tributary of the Ganga River system in northern India, has been selected for the current study. The river rises in the Mapchachungo glaciers on Tibet's southern Himalayan slope at an elevation of around 3,962 metres. This river spans 1,080 kilometers until it joins the Ganges near Revelganj in Bihar. Fish biodiversity and diversity indices were studied in this article from August 2021 to July 2022. Data was collected from four locations: Darauli (S-1), Rakauli (S-2), Phulwariya (S-3), and Semariya (S-4) of the river. GPS was used to accurately record the positions of sampling stations.

## Study Area

The Ghaghara River, also known as the Karnali River in Nepal, flows through northern India and Nepal. The river is an important tributary of the Ganges River, covering an area of about 507 km in India. It serves as a vital ecological resource, supporting a rich diversity of fish species and providing livelihood opportunities to local communities.

### Geographical location of Ghaghara River

Darauli (S1 – Site 1)	Rakauli(S2 – Site 2)	Phulwariya (S – Site 3)	Semaria (S4 – Site 4)
26°04'41.3" N 84°07'18.8" E	26.03'38.4" N 84.22'01.3" E	25°89'56.9" N 84°49'24.7" E	25.79'59.0" N 84.62'25.9" E

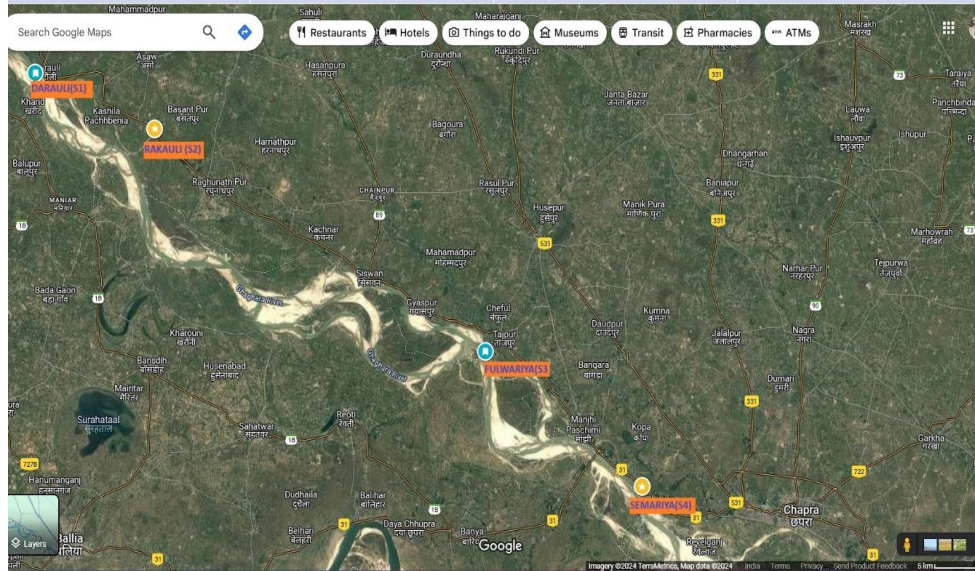


Fig. 1. Map showing Ghaghara River Sampling Sites

## Fish sampling and Data Collection

Experimental fishing was conducted using local and skilled fishermen's expertise. Fishes were collected using various nets and photographs were taken before formalin preservation.

Specimens were fixed in separate jars. Smaller fishes were directly placed in the formalin solution while the larger ones were given an incision on the abdomen before fixing for better penetration of the preservative. The bottles/jars that were collected Fish specimens were labelled with proper serial numbers, locality, date of collection and local name of fish used in that region.

### Data Analysis

One aspect of biodiversity is species' Relative Abundance (RA), which describes how frequent or uncommon a species is in relation to other species in a given area or population. The percentage composition of an organism of a specific sort in relation to the overall number of organisms in the region is known as relative abundance.

$$\text{Relative Abundance} = \frac{\text{Number of Individuals of a Species}}{\text{Total Number of Individuals of all Species}} \times 100$$

The Shannon-Wiener Diversity Index is a commonly used index to quantify species diversity, which includes both species richness and the relative abundance of species.

$$H' = - \sum_{i=1}^s (p_i \times \ln(p_i))$$

Where:

- H' = Shannon-Wiener Diversity Index (species diversity)
- S = Total number of species in the sample
- p<sub>i</sub> = Proportion of individuals of species i in the total sample (calculated as the number of individuals of species i divided by the total number of individuals)

The Shannon index provides a measure of diversity that accounts for both the number of species (richness) and their relative abundances. A higher value of H' indicates greater diversity.

### Results and Discussion

The distribution pattern of fishes in river Ghaghara showed variations among different sites. Out of 61 species, 15 species were distributed throughout the river from (S1 to S4) five, seven and two species are confined to only in upper, middle and lower regions respectively.

The species viz *Salmotomabacaila*, *Channapanctatus*, *Puntius ticto*, *Mastacembelus armatus*, *Mystus cavasius*, *Cirrhinus mrigala*, *Clupisoma garua* were ranked. Conversely, the *Clarias batrachus*, *Anabas testudineus*,

*Glyptothorax telchitta*, *Amblypharyngodon mola*, *Labeo dero*, and *Aspidoparia morar* were the scarcest species (occurrence frequency < 10%). The common carp (*Cyprinus carpio*) is the only common non-native species (occurrence frequency > 50%). The relative abundance of throughout distributed fish species was also

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varied across the stretch. The species *Salmostomabacaila* and *Puntiustictos* showed higher abundance in each site. Interestingly, some of the species of high conservation importance showed relatively high relative abundance in different sampling sites (*Ompok pabda* and *Channamarulius* from site 2; *Ompok bimaculatus*, *Notopterus notopterus* from site 3; *Sperataaor*, *N. notopterus*, *Labeocalbasu*, *Sperataaor*, *N. notopterus* and *Rita rita*, *S. seenghala* and *Mystus vittatus* from site 4 indicating relatively stable population in spite of heavy fishing pressure and habitat degradation. The site wise distribution of families, genera and species in river are represented in the table given below.

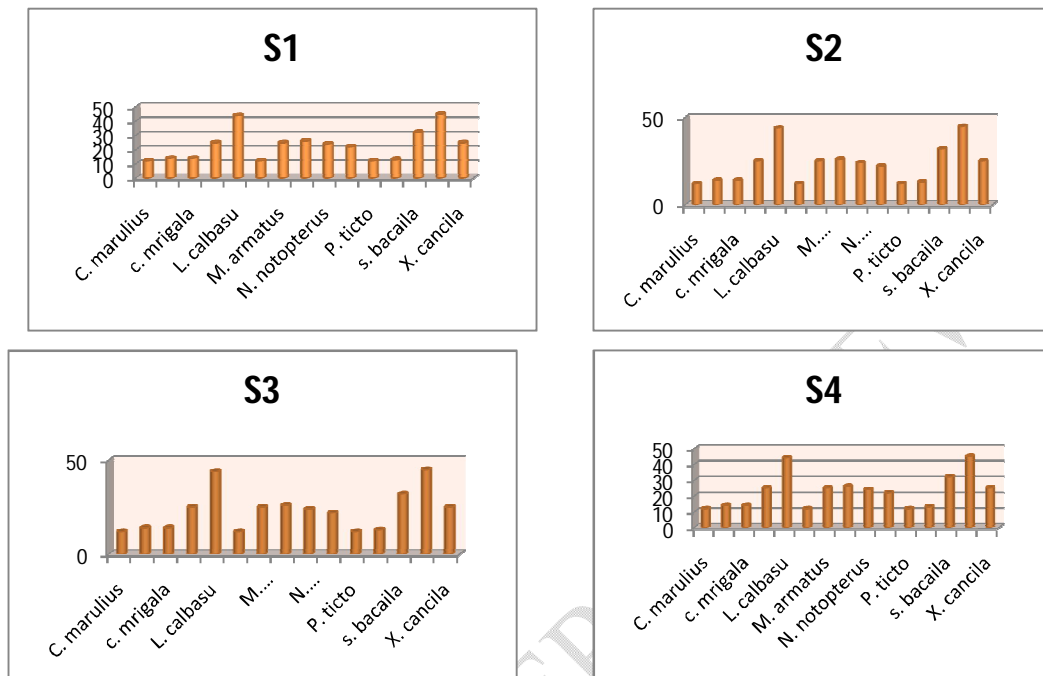
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**Table-1.**  
**Site-wise occurrence of fish species in River Ghaghara**

Sl. No	Species	Darauli (S1)	Rakauli (S2)	Fulwariya (S3)	Semariya (S4)
1.	<i>Ailiacoila</i>				√
2.	<i>Amblypharyngodon</i> <i>Motamola</i>		√		
3.	<i>Anabastestudineus</i>			√	
4.	<i>Aspidopariamorar</i>		√		
5.	<i>Bagarius bagarius</i>				√
6.	<i>Botialohachata</i>			√	
7.	<i>Catlacatla</i>		√		√
8.	<i>Chaguniuschagunio</i>				
9.	<i>Chandanama</i>	√	√		
10.	<i>Channamarulius</i>	√	√		√
11.	<i>Channapunctatus</i>	√	√		√
12.	<i>Channa striatus</i>		√		√
13.	<i>Chelalaubuca</i>				
14.	<i>Chitalachitala</i>				√
15.	<i>Cirrhinus mrigala</i>	√	√		√
16.	<i>Cirrhinus reba</i>		√		√
17.	<i>Clarias batrachus</i>			√	
18.	<i>Clarias gariepinus</i>			√	
19.	<i>Clupisoma garua</i>	√	√		√
20.	<i>Colisa fasciatus</i>	√	√		
21.	<i>Ctenopharyngodon idellus</i>				√
22.	<i>Cyprinus carpio</i>		√		√
23.	<i>Devario devario</i>	√	√		
24.	<i>Esomus danricus</i>	√			
25.	<i>Eutropiichthys vacha</i>		√		√
26.	<i>Gagata cenia</i>		√		
27.	<i>Glossogobius guiris</i>		√		

28.	<i>Glyptothorax Telchitta</i>		√		
29.	<i>Gudusiachapra</i>			√	
30.	<del><i>Heteropnestes</i></del> <i>Heterop neustesfossilis</i>			√	
31.	<i>Hypophthalmichthys molitrix</i>				√
32.	<i>Labeobata</i>		√		√
33.	<i>Labeoboggut</i>			√	
34.	<i>Labeocalbasu</i>	√	√		√
35.	<i>Labeodero</i>		√		
36.	<i>Labeogonius</i>		√		√
37.	<i>Labeorohita</i>	√	√		√
38.	<i>Lepidocephalus Gguntea</i>		√		
39.	<i>Macragnathus Ppancalus</i>		√		√
40.	<i>Mastacembalus Armatus</i>	√	√		√
41.	<i>Mystuscavasius</i>	√	√		
42.	<i>Mystustengara</i>		√		√
43.	<i>Mystusvittatus</i>	√	√		√
44.	<i>Nandusnandus</i>		√	√	
45.	<i>Nangranangra</i>			√	
46.	<i>Notopterus Nnotopterus</i>	√	√		√
47.	<i>Ompokbimaculatus</i>		√		√
48.	<i>Ompokpabda</i>		√		√
49.	<i>Osteobramacotio</i>		√		√
50.	<i>Puntiussarana</i>	√	√		
51.	<i>Puntiussophore</i>	√	√		√
52.	<i>Puntiusticto</i>	√	√		√
53.	<i>Rasboradaniconius</i>	√	√		√
54.	<i>Rhinomugilcorsula</i>			√	
55.	<i>Rita rita</i>				√
56.	<i>Salmostomabacaila</i>	√	√		√
57.	<i>Sperataaor</i>				√
58.	<i>Sperataseenghala</i>		√		√
59.	<i>Tetradoncutcutia</i>			√	
60.	<i>Wallagoattu</i>	√	√		√
61.	<i>Xenentodoncancila</i>	√	√		√

Note: √ sign Indicates presence of a particular fish species.

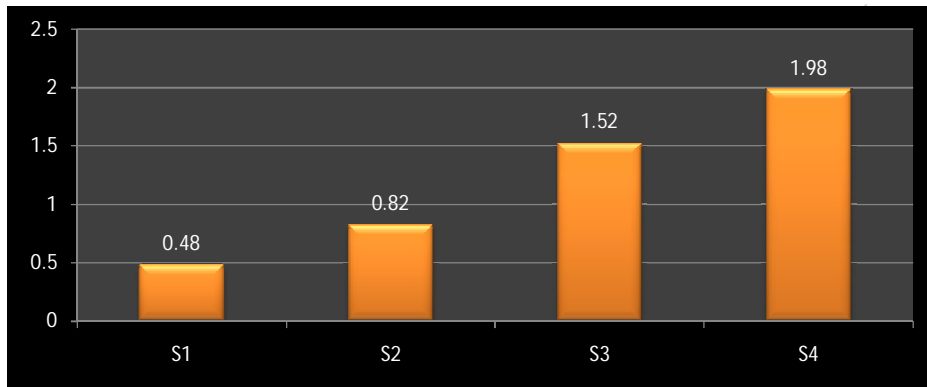


**Fig.2**Site-wiserelativeabundanceoffishspecies.

**Catchperunit effort(CPUE)**

Gill nets and drag nets of various sizes were the most common fishing gear in the Ghaghara River. The capture per unit effort was computed using a gill net. The mean values of c.p.u.e. at several sample locations ranged from 0.52 to 2.14 kg/man/hour. Higher values of c.p.u.e. at site 4 indicate greater fishing intensity, which might be attributed to the presence of large-sized fish and their favored habitat characteristics such as deep pools, rural and semi-urban land use patterns, low to moderate river velocity, etc.

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**Fig.3, Mean CPUE of total fish population in different sampling sites of Ghaghara River.**

**Diversity indices**

The various diversity indices were calculated in each selected sampling sites of river Ghaghara which includes: Species richness, Shannon-Weiner index, Simpson index, Species dominance index, Pielou evenness. Various diversity indices were calculated at each selected sampling site of the Ghaghara River, including species richness, the Shannon-Weiner index, the Simpson index, the species dominance index, and Pielou's evenness.

**Species richness**

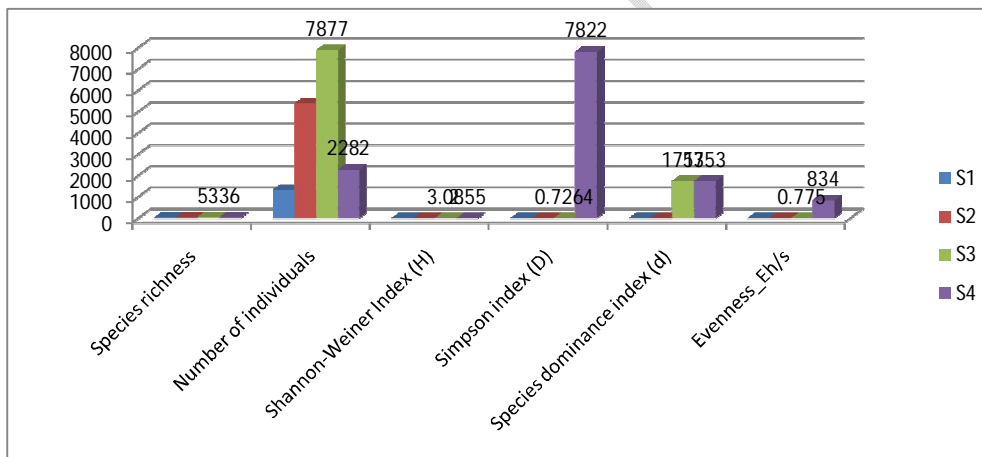
The species richness at four sample sites varied significantly, with higher richness seen in the mid to downstream zones. Sites 3 (53 species), 2 (41 species), and 4 (37 species) had the highest species richness, whereas sites 1 and 4 had the lowest (22 and 36 species, respectively). The presence of migratory fish and channel confluence may have contributed to the high level of species diversity in the midstream area. The lower number of fish species in the upper section (site 1) might be attributed to water scarcity, low depth and flow, and the limited channel width of the river.

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**Table 2**  
**Fish diversity indices of Ghaghara River**

Diversity indices	Sampling sites
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	S1	S2	S3	S4
Species richness	24	41	53	36
Number of individuals	1339	5386	7877	2282
Shannon-Weiner index (H)	2.69	2.11	3.08	2.55
Simpson index (D)	0.0887	0.0884	0.07264	0.07842
Species dominance index (d)	0.2018	0.1931	0.1753	0.1753
Evenness $e^{-H/S}$	0.8486	0.7772	0.775	0.834



**Fig .4 Diversity index at different sampling sites. Bars with the different superscripts are statistically different ( $p < 0.05$ ).**

Assessment of the threat status of 61 fish species of river Ghaghara as per recent Lakra and Sarkar (2006), and Lakra *et al.*, (2010), showed six fish species as endangered (EN), 17 species vulnerable, 27 lower risks and data on 12 species were not available to categorize them under any threat category. Out of 61 species,

about 28 % of species are under threats (either endangered or vulnerable) and 44% under low risks. The site wise analysis of conservation status of fishes of Ghaghara River showed that site 4 (Semariya) having more threatened species whereas at site 1 (Darauli), less number of threatened species were observed. The major natural as well as anthropogenic factors responsible for declining of fish habitat and diversity species in river Ghaghara was recorded which includes: reduced water flow, river pollution, urbanization, illegal fishing and introduction of invasive species. Biodiversity and its conservation are regarded as one of the major issues of enabling sustainable use of natural resources. The present study is the first of its kind for the River Ghaghara and tries to quantify the species and their occurrences. The presence of 62 species indicates rich species diversity in this river. Payne *et al.*, (2004) described 30 and 56 fish species in Allahabad stretches of River Ganga.

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## Conclusion

River Ghaghara of the Ganges basin is found to support considerably rich fish diversity and also supported threatened fishes, with a well-defined pattern based on habitat status and land use pattern. ~~A total 61 species belonging to 47 genera 21 families and seven orders were recorded. Cypriformes was the most predominant order, contributing to 42 % of fish species, followed by Siluriformes with 31 %, Perciformes (18 %). Cyprinidae is the most abundant family, contributing 39.3% (24 species) fish fauna of river Ghaghara followed by the family Bagridae (six species), Sisoridae.~~ Since, no previous studies were available in this River of these locations so the results of present study is the first report and baseline data for further study to compare and calculate the rate of extinction of species. In this study we observed a significant structure of fish community in a complex, comprehensive dataset, and identified certain environmental factors such as depth, flow, dissolved oxygen and substrate as a major component. These components found to be the most important habitat variable in shaping fish distributions. The findings in this study provide specific guidance on channel habitats with inclusive ranges of depths, substrate and current velocities needed to support the threatened fish species of the River and therefore to include in conservation planning. Furthermore, our results suggest the importance of local environmental influences on the threatened fishes can be used to guide protection and management activities and support restoration efforts of the fish habitat.

Management measures should be planned keeping in view the habitat requirements and associated relationship with the fish assemblage at local scale. The river ecosystem of the Ghaghara is vitally important in maintaining considerable freshwater diversity. It is recommended that further studies should be made to expand research on enhancement of indigenous fish species by adopting habitat restoration and species rehabilitation at local scale. The use of illegal methods to catch fishes should be banned in the area to prevent further depletion of freshwater fish resources in this river. The data obtained on the fish biodiversity, habitat parameters with relations to fish species distribution and assemblage patterns may provide current relevant information for fisheries department as well as to the other stakeholders including fisher populations for proper conservation of aquatic biodiversity of this important tributary of Ganga basin.

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