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# Biodiversity, Richness and Evenness of freshwater fish species at Chashma barrage Mianwali, Punjab, Pakistan

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**Abstract**

Biological diversity is defined by variations in physiology, morphology, and habitat among organisms. In Pakistan 19 Ramsar sites are present which have a wide diversity of fishes. Diversity of fish varies according to the various sites at Chashma barrage. A variation occurs in species of the different sites. The weekly survey basis data collected from the Chashma barrage site and Kundian site by the physical method using caste and drag nets. Data was also collected by local fisherman by indirect method to identify fish species. A total five months data collected from August to December 2022. In the current study total of 758 fish specimens were collected. The Shannon- Weiner index of all months was (H') 3.12Species Richness (R) was 30 and Evenness (H/S) was 0.91.where as in site 2 Kundian was 754 specimems Shannon diversity was (3.15) species Richness was (30) and Evenness (0.92). It is concluded that main Chashma barrage area is highly rich in species and diversity among this area is also high A wide variety of fish species present among this site.

***Keywords****: Biodiversity, Chashma barrage, fishes, morphology*

## INTRODUCTION

Fish is considered as one of the major source of protein and is nutritionally rich diet. It is the most diverse and important fundamentals that are playing an important role in the wealth of several counties (Khan et al., 2020). Approximately, 48% of the vertebrates on the planet earth are fishes. In Pakistan, there is both fresh and marine water resources, which is enough for high seafood production and can rise the economy of country. There are about 193 freshwater fish species in Pakistan, many of them are economically and commercially important species. Based on morphology fish is one of the diverse group that can inhabit several habitats (Laghari, 2018).

It is important to study the diversity and distribution of fishes, because it gives us knowledge about the biodiversity of an area. Many different fish species inhabit different water habitat on the planet earth (Mamilov et al., 2021).

The relative abundance and composition of fish species may vary due to environmental fluctuation and seasonal variation. Several aquatic ecosystems have been altered completely due to construction of dams on river water, which consequently influence the migration of some fish species (Zhou et al., 2019).

It is important to emphasize that freshwater fish have a primary role to play in addressing 'hidden hunger'. Fish in freshwater provide several important benefits to humans, including pest control, biomedical research, and a sense of connection to nature. As a food source, wild and farmed fish are the most commonly used. As a nutritional source, it provides protein, calcium, omega-3 fatty acids, vitamin A, vitamin D, vitamins B, lysine, iron and zinc when other nutritional sources are unobtainable or extremely costly (Radinger et al., 2019).

The actual failure in the diversity and distribution of various freshwater fishes is due to several factors such as loss of habitat, pollution, industrial wastes, saltation, diseases, illegal hunting, water abstraction, exotic species introduction etc. (Lamothe et al., 2018).

Chashma barrage is located on Indus River (largest river) in district Mianwali, Punjab Pakistan. It is important due to its unique beauty; it is considering the home of fish and bird's fauna. It is important wetland due to its important characteristics and territory of many migratory birds. Very limited studies on ichthyfauna are conducted in Chashma barrage and some sites are not yet explored. So, the current study is important to explore many hidden fish diversity and distribution of Chashma barrage Current study aimed to explore the diversity and distribution of ichthyo-fauna of Chashma barrage.

## METHODOLOGY

### Study Area and Data Collection

A weekly fish survey was conducted at the Chashma Barrage from August to December 2022. Local fishermen assisted in the study by identifying optimal sampling areas within the barrage. Over this five-month period, a total of 758 fish specimens were collected.

### Sampling Technique

Sampling was carried out between 8:30 AM and 1:30 PM using various nets. A cast net (throw net) was employed to capture fish species, while a drag net was deployed along the riverbed to collect smaller specimens. All collected samples were preserved in the Department of Zoology, Minhaj University, Lahore, for further analysis.

### Species Identification and Diversity Analysis

Fish species were identified using standard dichotomous keys. To quantify biodiversity, three key indices were calculated:

Shannon-Wiener Index (H'): This measures species diversity, incorporating both richness and evenness. It was calculated using the formula: H' = -∑(pi * ln(pi)), where pi is the proportion of individuals belonging to species *i* (Shannon and Wiener, 1963).

Species Richness (SR): This represents the total number of species present in a sample, calculated using Margalef's index: SR = (S – 1) / ln(N),

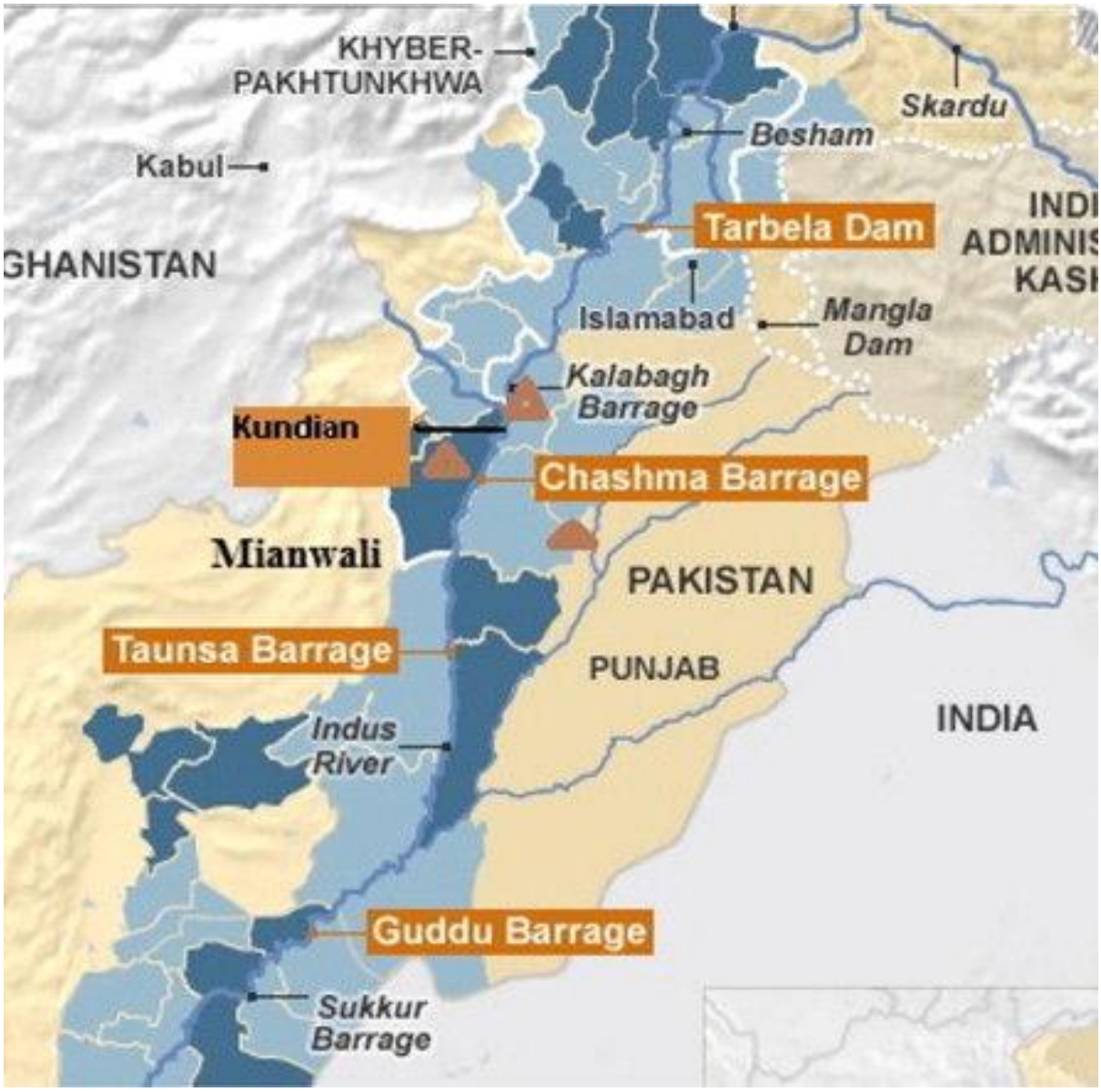


**Figure 1. Map of Chashma barrage**

## RESULTS AND DISCUSSION

In the current study total of 758 specimens were collected total of fish species were 30 and total five months data was collected which showed that in October month higher number of specimens (175) was recorded and in month of November maximum diversity of fish specimens was (170). In the months of August and September, the diversity of fishes was low which was (123).

Further, findings revealed that in site 1 the large number of fish species of about 27 in each was found during three months including August, November and December. However, in other two months such as September and October a total number of fish species were 25 in each. The trend of number of species in each month was August, November and December > September and October.

After the species identification analysis, the results of the present study explore that the most abundant family in site 1 of the barrage was family Cyprinidae of having total number of species 11. After that, secondly, the rich abundant family in site 1 were families Bagridae and Sisoridae, which contain total number of 04 species in each family. Besides this, other families including Cichlidae, Schilbediae, Channidae and Siluridae contain 02 species in each family (Fig. 1). Moreover, the smaller number of species of about 01 were recorded in each of the families Mastacembelidae, Botiidae and Osphronemidae (Table 2). The trend of species abundance on family basis was Cyprinidae > Bagridae and Sisoridae > Cichlidae, Schilbediae, Channidae and Siluridae > Mastacembelidae, Botiidae and Osphronemidae.

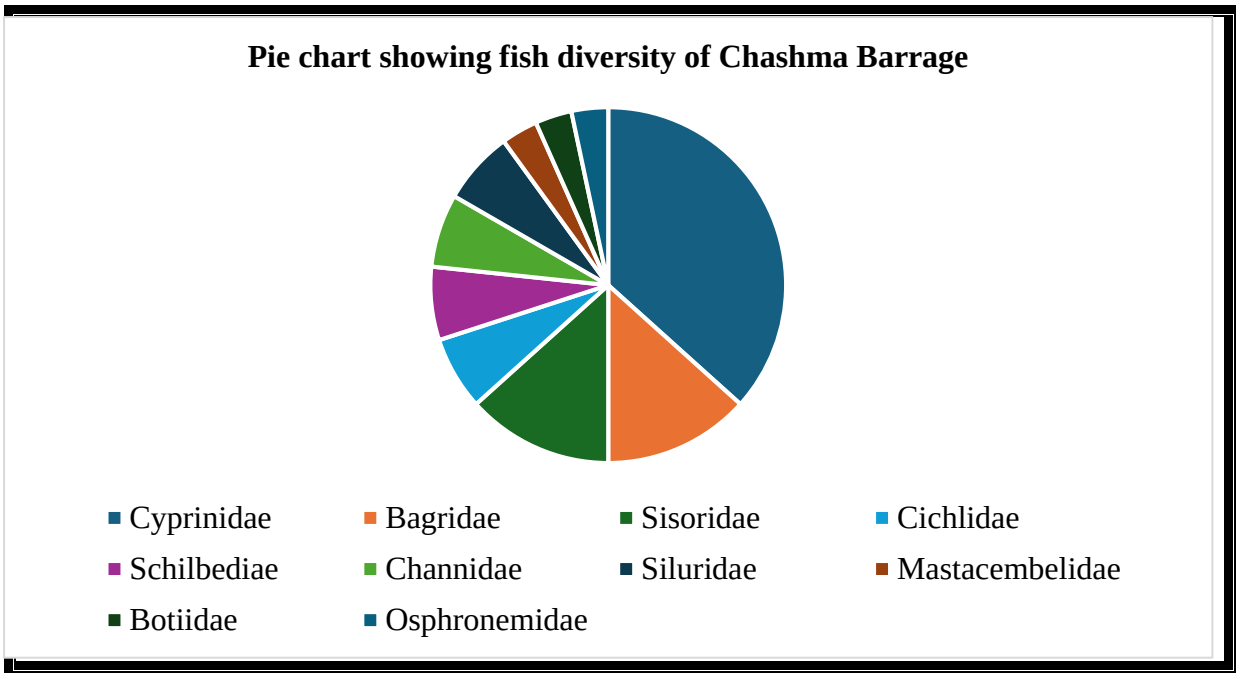


**Figure 1. Diversity of fish families of Chashma barrage**

**Table 1. Diversity of fishes in Chashma barrage site and Kundian site of barrage**

| Family | Species | Site 1 | Site 2 |
|---|---|---|---|
| Cyprinidae | *Cyprinus carpio* | 64 | 66 |
| | *Cirrhinus mrigala* | 60 | 55 |
| | *Catla catla* | 72 | 65 |
| | *Labeo rohita* | 64 | 62 |
| | *Cirrhinus reba* | 25 | 24 |
| | *Hypophthalmichthys molitrix* | 37 | 32 |
| | *Labeo calbasu* | 13 | 14 |
| | *Ctenopharyngodon idella* | 24 | 24 |
| | *Puntius chola* | 13 | 15 |
| | *Labeo gonius* | 10 | 9 |
| | *Barbodes sarana* | 7 | 15 |
| Bagridae | *Rita rita* | 29 | 19 |
| | *Mystus bleekeri* | 11 | 10 |
| | *Mystus vittatus* | 13 | 12 |
| | *Sperata seenghala* | 15 | 14 |
| Sisoridae | *Glyptothorax punjabensis* | 22 | 26 |
| | *Bagarius bagarius* | 14 | 24 |
| | *Sisor rabdophorus* | 11 | 7 |

| | | | |
|---|---|---|---|
| | *Glyptothorax cavia* | 6 | 3 |
| Cichlidae | *Oreochromis aureus* | 31 | 22 |
| | *Oreochromis niloticus* | 65 | 77 |
| Schilbediae | *Clupisoma garua* | 4 | 25 |
| | *Eutropiicthys vacha* | 3 | 12 |
| Channidae | *Channa marulius* | 11 | 9 |
| | *Channa punctuata* | 17 | 18 |
| Siluridae | *Ompok bimaculatus* | 17 | 14 |
| | *Wallago attu* | 39 | 31 |
| Mastacembelidae | *Mastacembelus armatus* | 16 | 17 |
| Botiidae | *Botia birdi* | 26 | 17 |
| Osphronemidae | *Colisa lalia* | 19 | 16 |
| Total | | 758 | 754 |
| Total species | | | |

**Table 2:** Diversity indices of species collected from site 1

| Index | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|
| No. of specimens | 123 | 123 | 175 | 170 | 167 | 758 |
| Shannon’s diversity (H') | 3.06 | 2.95 | 2.96 | 3.00 | 0.18 | 3.12 |
| Species Richness (S) | 27 | 25 | 25 | 27 | 27 | 30 |
| Evenness (H/S) | 0.92 | 0.91 | 0.92 | 0.91 | 0.05 | 0.91 |

**Table 3:** Diversity indices of species collected from site 2

| Index | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|
| No. of specimens | 155 | 164 | 153 | 145 | 137 | 754 |
| Shannon’s diversity (H') | 3.00 | 3.07 | 2.99 | 3.06 | 2.96 | 3.15 |
| Species Richness (S) | 28 | 28 | 25 | 25 | 27 | 30 |
| Evenness (H/S) | 0.90 | 0.92 | 0.93 | 0.95 | 0.89 | 0.92 |

**Table 4:** Comparison between ichthyfauna of site 1 and 2

| S.NO. | Parameters | Site 1 | Site 2 |
|---|---|---|---|
| 1 | No. of specimens | 758 | 754 |
| 3 | Shannon’s diversity (H') | 3.12 | 3.15 |
| 4 | Species Richness (S) | 30 | 30 |
| 5 | Evenness (H/S) | 0.91 | 0.92 |

After comparative analysis of fish fauna explored at site 1 and site 2 of Chashma Barrage, it was found that the total number of specimens collected at site 1 was 758 which is comparatively higher as compared to site 2 of having about 754 specimens recorded during the five month surveys to barrage. In addition, the number of species observed after proper identification by using different morphometric tools and taxonomic keys the findings revealed that in both sites high species diversity of about 30 species was found, so the richness of the species on both sites was 30. Moreover, comparatively, Shannon diversity and Evenness of species of site 2 was higher as compared to site 1.

It was found that the total number of 10 fish families were recorded from both sites of Chashma Barrage which representing the fish fauna diversity. The family Cyprinidae can be clearly viewed of having large number of fish species as compared to all other families. Followed by the other two families such as family Bagridae and Sisoridae It was found that the least number of fish species were recorded of the last three families including (Mastacembelidae, Botiidae and Osphronemidae).

The results of the study revealed that after five months' surveys to two different sites of barrage, the large number of fish specimens was recorded in site 1 of total 758 as compared to site 2 where the total number of specimens was 754. Whereas in site 2 the large number of fish specimens was recorded in the month of September followed by August and then October, but the least number of specimens was observed during month of December. Beside this, in both sites the number of fish species was 30. In addition, in both sites the most abundant number of fish species was observed in family Cyprinidae followed by Bagridae and Sisoridae, while the least abundant fish species was found in the families such as Mastacembelidae, Botiidae and Osphronemidae.

Furthermore, the values Shannon diversity index, Species Richness and Evenness at site 1 of the barrage was 3.12, 30 and 0.91 respectively. While in site it was 3.15, 30 and 0.92 respectively. However, after comparative analysis of both sites the Shannon diversity index of site 1 was lower as compared to site 2. The species richness both sites were same. Moreover, the Evenness of the species in site 1 was also lower than site 2.

The findings of our study revealed that the family Cyprinidae was the dominant family in Chashma Barrgae which is according to the study carried out by Abro et al. (2020), who studied fish fauna of Freshwater diversity in the Sindh province section of the Indus River. Other studies also obey the findings of the current study such as Muhammad, Iqbal and Saleemi (2018). They carried out research on Taunsa Barrage to explore their fish fauna which is located on the Indus River of Pakistan. Their results revealed that the large number of species was observed in the family Cyprinidae followed by Bagridae. Moreover, the findings of Shannon diversity index, species richness and Evenness was also according to the results of this study and the study conducted by Zaidi Zona, Ahmad and Zainab (2022) who evaluated the fish diversity of Upper Indus River basin.

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