

RESEARCH ARTICLE

STUDY OF FISH DIVERSITY IN MARSYANGDI RIVER WITHIN THE LAMJUNG DISTRICT

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ABSTRACT

A study was conducted to investigate the fish diversity and water quality parameters of the Marsyangdi River, addressing gaps in comprehensive research on its fish fauna. From November 2023 to June 2024, research was conducted across four permanent sites: Bhulbhule, Gairi, Bhotewodar, and Paudi, during both winter and summer seasons. Fish were captured using various nets, with detailed observations on species' colors and ecological characteristics. Twenty three species of fish belonging to 5 orders, 6 families and 15 genera were recorded from the different sites. With 48% of the species, the most prevalent family was Cyprinidae, followed by Cobitidae (26%), Sisoridae (8.6%), and Channidae (8.6%) while Anguilidae and Synbranchidae each had only 4.3% of the species. Seasonal variations were significant, with only 17 species recorded in winter and 23 species recorded in summer. The study identified 14 least concerns, three near threatened, one common, one vulnerable, one endangered and one data deficient species across different sites. Higher fish catch (555 individuals) was recorded in Summer than in winter (391 individuals). Water quality assessments revealed seasonal differences, with higher dissolved oxygen levels in winter and warmer water temperatures in summer, while pH levels remained relatively stable throughout the two seasons. The findings underscored anthropogenic threats such as unlawful exploitation, habitat degradation, and dam development adversely affecting fish diversity in the Marsyangdi River. Recommendations included the urgent need for systematic monitoring of fish populations, documentation of catch data to substantiate trends, and the implementation of conservation measures.

KEYWORDS

Diversity, water quality, ecological characteristics, dissolved oxygen, and others

1. INTRODUCTION

Nepal is a land linked country situated between Palearctic and Oriental biogeographically realms. The country has snowcapped mountains on the Northern side, which is also a major source of water resources in Nepal. In Nepal, there are 252 species of fish known to exist, comprising 236 indigenous species and 16 exotic species (Shrestha, 2019). Approximately 40% of fish, the most varied group of vertebrates in the world, reside in freshwater environments (Ghorbani et al. 2013). Freshwater resources of Nepal covers about 5% of the total area of the country which constitute about 2.27% of world's fresh water resources, that harbors multiple aquatic habitats, supporting high diversity of fishes (Gair and Regmi, 2022). The water resources of Nepal include many rivers, streams, lakes, reservoirs and ponds. It has more than 6000 rivers and streams with four main river systems such as the Gandaki, the Koshi, the Karnali and the Mahakali. Others such as Mechi, Rapti, Bheri, Bagmati, Narayani, Trishuli, Marsyangdi etc. holds equal importance (Sharma and Shrestha, 2001). Together with freshwater resources, Nepal also extends from eastern to western Himalayan summed with different topographical features with many climatic and ecological zones support rich fish diversity (Khatri et al., 2020). Mountainous region, ranging between altitudes of 20000-16000ft supports Schizothorax sps, Garra sps., at the same time lower part ranging between an altitude of 9000-2000ft supports fishes like Tor putitora (Sahar), Catla catla (Catla), Labeo dero (Rohu), etc. and the lower part of Terai region, at an altitude above 70m supports fish species like

Labeo rohita (Rohu), Wallago uttu (Buhari), Channa gachua (Murrel), and others. (Gair and Regmi, 2022). As compared to the other ecosystems, freshwater ecosystems are most endangered ecosystem in the world because of the multiple reason such as pollution in water resources, overexploitation, habitat destruction and invasion by exotic species (Gair and Regmi, 2022). The Lamjung district is situated in Nepal's northeastern western development zone. At 776 meters above sea level, it has a subtropical climate on average. The Majuwa, Dordi, Paundi, Naudi, and numerous more minor feeder streams that eventually merge into the Marshyangdi River drain this area (Mandal and Jha, 2013).

The Marshyangdi River is a snow-fed perennial Himalayan River with a length of about 153 km that drains the watershed (area = 4787 km²). It flows eastward through Manang District and then southward through Lamjung District. The main tributaries of Marsyangdi river are Khangsar river, Jharsang river, Dordi river, Paudi river, Chepe river, Chundi river, Daraudi, Nangdi river, Khudi river, Dhud river, and Nar river (Singh et al., 2021). The major sources of the river are the glaciers besides seasonal springs and monsoon rains. The elevation of this watershed varies between 274 and 8042 m-above-the-mean-sea-level (masl) representing the bioclimatic zones from subtropical (1000–2000 m) to alpine (4000–5000m) (Shrestha, 2008). After 153 kilometers, the Marshyangdi River enters the Trishuli River in Muglin Bazaar. This river has an average slope of 0.0417 meters and has its source in the Himalayas at an elevation of 6400 meters (Shrestha, 1999).

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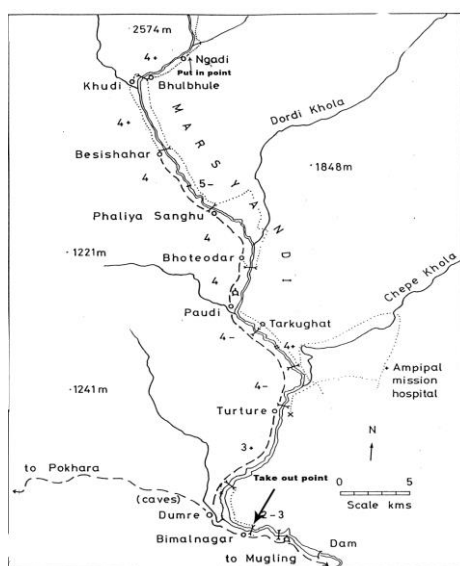
The study of fish diversity is essential for the discovery of new species, which will increase the total number of species in the nation's diversity profile. This is the second study that attempts to explore the fish diversity of Lamjung district's Marsyangdi River in order to close information gaps and so broaden Nepal's fish diversity profile. Habitat degradation, climate change, overfishing, pollution, and poor understanding of fish ecology are major threats to native fish conservation (Gurung, 2013). Additionally, inadequate technological implementation, insufficient budgets, and lack of proper management strategies hinder the development of sustainable aquaculture practices (Gautam, 2015). Environmental factors, such as water quality parameters and river characteristics, significantly influence fish assemblage structures (Pokharel et al., 2018).

The diversity of fish in the Marsyangdi River in Lamjung district has not been the subject of most comprehensive research. There hasn't been any more research on the diversity of fish in the area since (Mandal and Jha, 2013). The number of fish in the river is getting fewer every day. It is important to study the current state of the fish species there, identify common and rare species, and protect the latter.

Fish diversity studies are important for accurate recording of species counts. Fisheries in Nepal are primarily subsistence-based, with a mix of capture fisheries and aquaculture (Gautam, 2015). Major threats to fish populations include damming and pollution (Khatri et al., 2020). Improving aquaculture practices, implementing long-term sustainable plans, and focusing on scientific research could help mitigate the decline of freshwater fish populations in Nepal (Gautam, 2015). Very little research has been done on the fish that inhabit the Marsyangdi River in Lamjung district. It is important to understand the present scenario of the fish diversity there, identify common and rare species, and protect the latter. Along with the diversity, assessments of the different water quality parameters are also vital. Therefore, the purpose of this study is to determine the existing fish diversity, fish distribution patterns along the different sites, and water quality characteristics in the Marsyangdi River in Lamjung district.

2. MATERIALS AND METHOD

This research was done in Marsyangdi River, the major river bewildering in Lamjung District. The Marsyangdi is a mountain river in Nepal. Its length is about 150 kilometers (Adhikari et al., 2022). The Marsyangdi begins at the confluence of two mountain rivers, the Khangsar Khola and the Jharsang Khola, northwest of the Annapurna massif at an altitude of 3,600 meters near Manang village (Adhikari et al., 2022). The study was confined in four permanent sites. These were Bhulbhule- I, Gairi- II, Bhotewodar- III and Paudi- IV. Site I was chosen in north-eastern bank of Marsyangdi river at Bhulbhule, which was quite undisturbed area and it had got big boulders. Site II was chosen in Gairi at the confluence of Gaikhuire waterfall and Marsyangdi river. Site III was selected in Bhotewodar, which was highly affected by human activities. Similarly, Site IV was selected at the confluence spot where another Paudi River joins with Marsyangdi river.



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Figure 1: Sampling stations of Marsyangdi river

Fish samples were collected from October 2023 to June 2024, covering two seasons (Winter 2023 and summer 2024) assuming that more fish

could be captured in low water levels in those seasons. Five sub-samples collected at each site generated a total of 20 samples in each season. A cast net (mesh size: 2- 4cm) and a gill net (3- 5cm) were used for fish sampling with the help of local fishermen (Shrestha et al., 2023). Each site was sampled for 30- 45 minutes, using cast nets from downstream to upstream in the daytime and covering about 150- 200m of river length (Edds, 1993). However, gill nets were set across the bank of the river in the evening, left overnight, and removed the next morning. Fish number was counted after the catchment from different nets. Throughout the collection, the fish species' colors and the ecological characteristics of their habitat were noted. Every sampling was done between the hours of 8:00 and 11:00 a.m. in the morning or 13:00 and 16:00 p.m. in the afternoon (Khatri et al., 2020).

Fish were photographed and their identities were confirmed to the species level using taxonomic literature. In order to identify the species, measurements of the body and counts of fin rays and lateral line scales were done using the methods proposed by (Shrestha, 2008) as done by (Jha and Bhujel, 2014).

River fish that were caught was preserved in a solution containing 10% formalin solution as done by (Mandal and Jha, 2014) with its proper identification in the Laboratory of Lamjung Campus. While the smaller specimens were placed straight into the formalin, the larger specimens had their abdomens cut lengthwise. In order to prevent injury to the caudal fin within the container, the fish were maintained inverted (Jha and Bhujel, 2014).

Waters were collected from four sites in the Marsyangdi River during two seasons; winter and summer. Sampling sites included superficial waters from main stems tributaries at the outlets of different watersheds and cold and hot springs. For water sampling, a plastic sampling bucket of 10 L volume was used. Water was collected from 30 cm below the water surface and then transferred into sterilized sampling bottles (Bista et al., 2022). Water temperature (°C) was measured with a digital thermometer by placing it in the water at a depth of 1 feet (Limbu V Prasad, 2020). DO (mg/L) was measured by the DO meter (Model PDO - 520). pH was measured by using a pH meter (Model ME - 963P).

Species diversity of the Marsyangdi River was evaluated from four diversity indices, such as Shannon-Wiener's diversity, Margalef's richness, Pielou's evenness and Simpson's diversity.

Shannon-Wiener's diversity

It was calculated using the following formula:

$$H' = - \sum_{i=1}^S p_i * \ln p_i \quad (\text{Shannon, 1949})$$

Where, H'= diversity index; pi= relative abundance (ratio of the number of ith individuals

And the total number of individuals), and S= the total number of species.

Margalef's richness index

It was performed based on the following formula:

$$d = S-1/\ln N \quad (\text{Margalef, 1968})$$

Where, d= Margalef's richness index; S= the number of species, and N= the total number of individuals of all species.

Pielou's evenness index

It was applied based on the following formula:

$$E = H'/\ln S \quad (\text{Pielou, 1966})$$

Where, E= Pielou's evenness index; H'= Shannon-Wiener's diversity index, and S= the total number of species.

Simpson's index of diversity (1-D)

It was implemented based on the succeeding following formula:

$$1-D = 1 - \sum n(n-1)/N(N-1) \quad (\text{Simpson, 1949})$$

Where, 1-D= Simpson's index of diversity; n= the number of individuals of a particular species, and N= total number of individuals of all species.

The catch compositions of individual fishes were determined using the following formula:

$$\text{Catch composition (\%)} = \frac{\text{Total catch of an individual species} \times 100}{\text{Total catch of all species}}$$

The data of collected fish were tabulated and the values of all the diversity indices were calculated in MS Excel version 2016. For water quality parameters, the means were compared by using one-way ANOVA and the differences were evaluated according to the Duncan test using R-studio, Version 1.4.4.

3. RESULT AND DISCUSSION

A total of 946 individuals representing 23 fish species (17 in the winter season and 23 in the summer season) were collected during the study. They belong to 5 orders, 6 families and 15 genera. The order with the greatest number of species, Cypriniformes, had 74%, followed by Siluriformes (8.6%) and Perciformes (8.6%) while Anguilliformes and Synbranchiformes only had one species each as represented in (Table 1,

Figure 2). Out of all the families, Cyprinidae had the most species (48%) followed by Cobitidae (26%), Sisoridae (8.6%), Channidae (8.6%), Anguillidae (4.3%) and Synbranchidae (4.3%) (Table 1, Figure 3).

Cypriniformes and Cyprinidae were the dominant order and family with 74% and 48% fish species during the study. (Mandal and Jha, 2014) had also reported Cypriniformes as a dominant order and Cyprinidae as a dominant family holding a maximum number of species and contributing a maximum catch in percentage in the Marsyangdi River. Of the total species collected, 14 were listed as least concern (LC), three species as near threatened (NT), one species as endangered (E) and one species as vulnerable (VU), one species as common (C), and one species as data deficient (DD) (IUCN, 2021) as shown in (Table 1).

Table 1: List of fish species recorded from the Marsyangdi River with their IUCN status

Order	Family	Scientific name	Local name	IUCN Status	Abundance
	Cyprinidae	<i>Tor tor</i>	Sahar	NT	Common in II to IV
	Cyprinidae	<i>Tor putitora</i>	Sahar	E	Common in II to IV
	Cyprinidae	<i>Schizothorax molesworthi</i>	Chuche Asla	DD	Common in I to III
	Cyprinidae	<i>Schizothorax richardsoni</i>	Buche Asla	VU	Common in I to III
	Cyprinidae	<i>Schizothorachthys progastus</i>	Chuche Asla	LC	Common in I to II
	Cyprinidae	<i>Barillius barna</i>	Tite	LC	Common in III to IV
	Cyprinidae	<i>Barillius bendelisis</i>	Fageta	C	Common in IV
Cypriniformes	Cyprinidae	<i>Barillius vagra</i>	Fageta	LC	Common in IV
	Cyprinidae	<i>Neolissochilus hexagonolepis</i>	Kate	NT	Common in IV
	Cyprinidae	<i>Chaganius chagunio</i>	Pathar chati	LC	Common in IV
	Cyprinidae	<i>Labeo boga</i>	Thike	LC	Common in IV
	Cobitidae	<i>Schistura beavani</i>	Gadela	LC	Common in III to IV
	Cobitidae	<i>Schictura rupecula</i>	Gadela	LC	Common in III to IV
	Cobitidae	<i>Acanthocobotis botia</i>	Gadela	LC	Common in III to IV
	Cobitidae	<i>Garra gotyla</i>	Buduna	LC	Common in III to IV
	Cobitidae	<i>Garra anandalei</i>	Buduna	LC	Common in III to IV
	Cobitidae	<i>Crossochelus latius</i>	Besuro	LC	Common in IV
Perciformes	Channidae	<i>Channa punctatus</i>	Hile	C	Common in III to IV
	Channidae	<i>Channa orientalis</i>	Hile	C	Common in III to IV
Siluriformes	Sisoridae	<i>Glyptothorax pectinopterus</i>	Nakato	LC	Common in III to IV
	Sisoridae	<i>Pseudocheneis sulactus</i>	Kabre	LC	Common in IV
Anguilliformes	Anguillidae	<i>Anguila bengalensis</i>	Rajbam	NT	Rare in IV
Synbranchiformes	Synbranchidae	<i>Mastacembelus scropoli</i>	Chuche baam	LC	Rare in IV

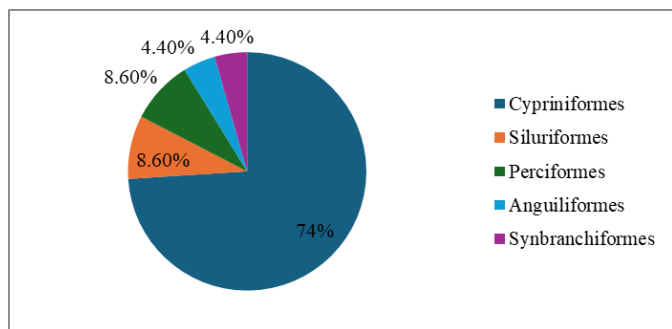


Figure 2: Fish species according to order of total ichthyo-faunal diversity in Marsyangdi River.

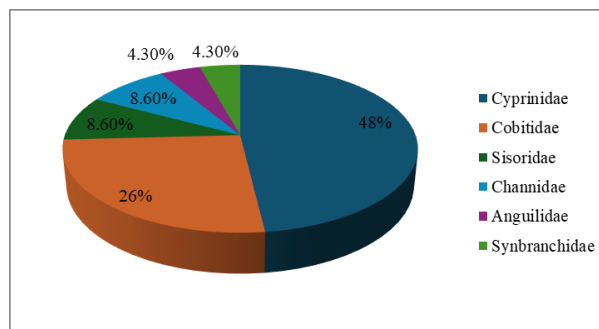


Figure 3: Fish species according to family of total fish diversity in Marsyangdi River

The catch composition (CC) of each fish collected in the Marsyangdi River in the Winter and Summer season are shown in Fig. (4). A total of 21 species were considered for the analysis; rare species like *Anguila bengalensis* and *Mastacembelus scropoli* were not included in the analysis of catch composition since their CC was represented below one percent. *Schizothorax Molesworthi* was the most common and abundant species, which was collected from all the sites and accounted for 13.7% of the total number of specimens collected. The next abundant species was *S. richardsoni*, which accounted for 11.33% of the total number of specimens, followed by *S. progastus* (9.39%), *Schistura beavani* (6.15%) and *Tor tor* (5.72%). *Chaganianus chaganio* (1.73%), *Labeo boga* (1.83%) and *Neolissochinulus hexagonolepis* (2.16%) were the least abundant species recorded in the Marsyangdi River in Lamjung district.

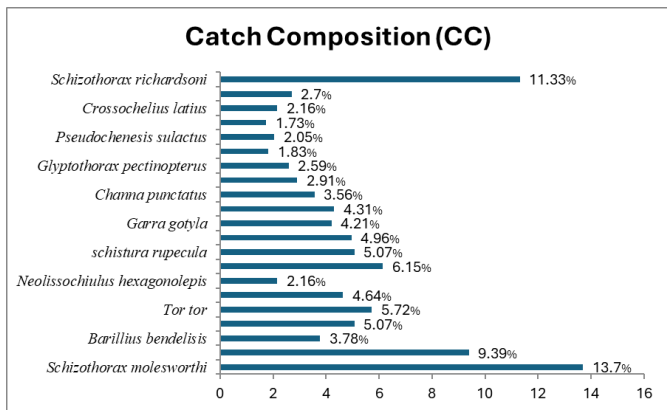


Figure 4: Total catch composition of fish species collected in the Marsyangdi River during two seasons

The highest value of Shannon-Wiener’s diversity (H') (3.07) was recorded at site IV, while the lowest (1.85) was at Site I in summer season. In winter season, H' was high (2.68) at Site IV and low (1.95) at Site I. The highest Simpson’s diversity (1-D) (0.97) was recorded at Site IV, and the lowest

(0.79) was recorded at Site I in summer season. In winter season, 1-D was high (0.94) at Site IV and low (0.81) at Site I. In summer season, the value of Margalef’s index (d) was high (4.34) at Site III and low (2.77) at Site I. In winter season, the value of d was high (3.4) at Site II and low (2.89) at Site I. Pielou’s evenness (E) was high (0.97) at Site IV and low (0.66) at Site II in summer season. In winter season, the value of E was high (0.95) at Site III and low (0.76) at Site I.

Similarly, the season wise value of all the diversity indices i.e. H' , 1-D, d and E were higher in summer season (2.97, 0.94, 3.48, 0.947) than in winter season (2.67, 0.92, 2.68, 0.944) respectively.

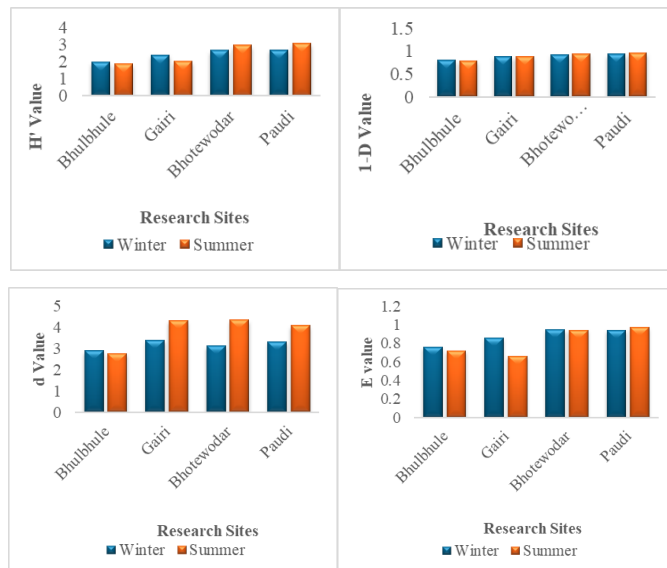


Figure 5: Shannon, Simpson, Margalef’s richness and Pielou’s evenness indices of the Marsyangdi River in two seasons

Table 2: Observed water quality parameters of the Marsyangdi River at winter seasons.

Site	Water quality parameters in winter season in different sites		
	Dissolved oxygen (mg/L)	pH	Water Temperature (°C)
Bhulbhule	7.88± 0.1	7.67 ± 0.03	6.98 ± 0.16
Gairi	7.84 ± 0.13	7.66 ± 0.04	6.9 ± 0.15
Bhotewodar	7.84 ± 0.09	7.73± 0.02	7.02 ± 0.15
Paudi	7.98 ± 0.16	7.65 ± 0.03	6.86 ± 0.14
LSD	0.38	0.11	0.45
Probability	NS	NS	NS
CV	3.61	1.11	4.95

The water quality parameters in the winter season were evaluated across four distinct sites, namely Bhulbhule, Gairi, Bhotewodar, and Paudi. Statistical analysis revealed that the differences between sites were not

significant for any of the parameters, as indicated by the probability values of "NS" (not significant) as shown in (Table 2).

Table 3: Observed water quality parameters of the Marsyangdi River at summer season.

Site	Water quality parameters in Summer season in different sites		
	Dissolved oxygen (mg/L)	pH	Water Temperature (°C)
Bhulbhule	6.51± 0.09	7.71 ± 0.04	18.44± 0.18
Gairi	6.58 ± 0.09	7.66 ± 0.02	18.24 ± 0.13
Bhotewodar	6.53 ± 0.06	7.72± 0.03	18.65± 0.05
Paudi	6.61 ± 0.06	7.69 ± 0.03	18.63 ± 0.08

Table 3(Cont.): Observed water quality parameters of the Marsyangdi River at summer season.

LSD	0.25	0.1	0.36
Probability	NS	NS	NS
CV	2.85	0.98	1.45

The data showed that the water quality parameters in the summer season are also relatively consistent across the four sites, with no statistically significant differences observed. The results showed that the sites exhibit similar water quality characteristics during the summer season.

The findings of fish diversity were quite similar with the findings of (Mandal and Jha, 2013) in which they found 26 species of fish belonging to 5 orders, 6 families and 18 genera. The Gandaki river system of Nepal harbors 171 species (Khatrri et al., 2021) out of 252 freshwater fishes of Nepal (Shrestha, 2019). The fishes collected in this study attributed for 13.45% of the fishes of Gandaki river system. *S. molesworthi* was the most common species which was recorded from all the sites. This might be due to favorable conditions like cold water with the high volume of water in the Marsyangdi River. Species like *A. bengalensis* and *M. scropoli* were rare species. *B. bendelisis*, *B. barna*, *S. beavani*, *S. rupecula*, *A. botia*, *G. gotyla*, *G. anandalei*, *C. latius*, *C. punctatus*, *C. orientalis*, *G. pectinopterus*, *P. sulcatus*, and other. were recorded mainly from lower sites, and may be favored by the moderate water temperature. *A. bengalensis* and *M. scropoli* were occasionally recorded species in this study. Gear choice (e.g. cast net, gill net) in fish sampling might have caused their occasional capture because they are generally attached to the lower surface of rocks.

This study is in line with who reported Cypriniformes as the dominant order. Generally, Cypriniformes is the dominant order in rivers (Rajbanshi, 2012; Shrestha et al., 2009; Mandal and Jha, 2013; Shrestha, 2016).

The value of Shannon-Wiener's diversity (H') ranged from 1.85 to 3.07 during the study period, indicating low to moderate species diversity. They were comparatively higher in summer than winter season. The number of fish collected, location dissimilarity with various physicochemical parameters, nutrition availability and season were some of the elements that are thought to be contributed to the fluctuation in diversity indices (Huh and Kitting, 1985; Hossain et al., 2012). The higher value of H' found in the summer or pre-monsoon may be related to good water levels supporting higher fish catch. The higher the catch, the higher the H' value will be, so gear selectivity also plays a vital role in this regard (Hossain et al., 2012). Our results are similar to those of (Ogamba et al., 2017; Tumbahangfe et al., 2021). The higher value of 1-D is associated with higher fish diversity. We also found higher fish diversity in the pre-monsoon or summer season. This might be due to the mixing of feeder streams with the Marsyangdi River at that time as the water levels are good at those time. Margalef's index (d) is concerned with species richness. It is dependent on sampling effort such that, the greater the sampling effort, the higher the Margalef's index. The value of d also found to be in line with (Ogamba et al., 2017). The value of E ranges from 0 to 1, and its value closer to 1 indicates an evenly distribution. Site III and Site IV showed evenly distribution trends in the Marsyangdi River.

The DO requirements for different fish species vary. For example, Salmonids need more (8-10 mg/L) DO than Cyprinids (6-8 mg/L), and DO below 5mg/L is detrimental to fish (Svobodova et al., 1993). In general, DO greater than 6mg/l is in the favor of the growth of fish (Ravindra et al., 2003). High DO levels measured in this study indicated the good quality of water in the Marsyangdi River. The value of DO was recorded high in winter season ranging from 7.84 to 7.98mg/L than in summer (6.51 to 6.61mg/L). Dissolved oxygen of snow-fed rivers is comparatively higher and is suitable for cold-water fish (Shrestha et al., 2009). And our findings supported this. The pH levels, however, remained relatively consistent across both seasons, ranging from 7.65 to 7.73, indicating that the water bodies tended to be slightly alkaline with minimal seasonal variations. Similar results have been postulated in the works of (Singh et al., 2021). The water temperature, as expected, showed a significant difference between winter and summer, with average temperatures of 6.9°C in winter and 18.6°C in summer. In this context, (Bhatt et al., 2012) elucidated a significant association between fish diversity and water temperature. Because warm water and cold-water species can tolerate (22-32) °C and (10-18) °C respectively, (Yildiz et al., 2017), the Marsyangdi River was found to be suitable, especially for the latter species.

The LSD values indicated that there are no significant differences between the sites for each parameter in both seasons. The probability values also suggested that the differences between sites were not significant. The CV values indicated that the data has moderate to high variability. Overall, the study showed the seasonal variations in water quality parameters, with dissolved oxygen levels being higher in winter and water temperatures being higher in summer, while pH levels remained relatively consistent. And, all the water quality parameters were in desirable range as stated by (Ghanbari et al., 2010; Singh et al., 2021; Wagle et al., 2016).

Fish diversity in sites III and IV of the Marshyandi River were found to be greater than those in the dam-affected areas of sections I and II (Fig. 3). Which implied that the construction of dam has affected badly in number of fishes. Long distance migratory fishes like *Anguilla bengalensis*, *Mastacembelus scropoli* were rarely found in the Marsyangdi River.

The local fishermen claimed that a few fish populations in the Marsyangdi River have been waning. It was caused by overcrowding, overfishing, illicit electrofishing, the usage of fry nets, stupefied toxic plants, and overpopulation. The fish species of the Marsyangdi River were declining, and there may be more causes. This was a result of people not understanding the negative consequences of discarding non-biodegradable items into the river. Various plastic bags, bottles, garments, and water bottles had been thrown by the locals. Additionally, a disposal site was located next beside the Marsyangdi River flowing below the Besisahar area. Thus, People should refrain from using various stupefied poison herbs, engaging in illegal electrofishing, and using fry nets in order to conserve fish. Additionally, various awareness campaigns about the value of fish, the dangers of discarding various non-biodegradable items into the water, and their repercussions should be carried out.

4. SUMMARY AND CONCLUSION

This research aimed to assess the fish diversity, species richness, evenness, and abundance fish distribution patterns across different sites and water quality parameters in the Marsyangdi River in Lamjung district. Research was conducted in winter and summer seasons from November, 2023 to June, 2024. The study was confined in four permanent sites namely Bhulbhule (I), Gairi (II), Bhotewodar (III) and Paudi (IV). Fish were collected by using variety of nets. The fish species' colors and ecological characteristics of their habitat were noted throughout the collection. Collected fish were photographed and their identities were confirmed to the species level using taxonomic literature. Then the river fish that were preserved in a solution containing 10% formalin solution with its proper identification in the laboratory of Lamjung campus.

Altogether 23 species (17 in winter and 23 in summer) of fish comprising of 6 families, 5 orders, and 15 generas were found in the Marsyangdi River. With 74% of all species, Cypriniformes was the order with the most, followed by Siluriformes (8.6%), Perciformes (8.6%) and with only one species each in Anguilliformes and Synbranchiformes. Cyprinidae was the family with the greatest number of species (48%) among all the families, followed by Cobitidae (26%), Sisoridae (8.6%), Channidae (8.6%), Anguilidae (4.3%) and Synbranchidae (4.3%). *Schizothorax molesworthi* was the dominant fish species with 13 % catch composition whereas *A. bengalensis* and *M. scropoli* were the rare ones with catch composition lower than 1 %. For fish diversity analysis, the value of different diversity indices such as Shannon Weiner's diversity (H'), Simpsons diversity index (1-D), Margalef's index (d) and Pielou's evenness (E) were calculated for each site and seasons. Season-wise, the value of all diversity indices found to be more at summer than in winter season. Whereas site wise, in winter season the values for H' , 1-D, d and E were higher in sites IV, IV, II and III and lower in Sites I, I, I and I respectively. Similarly, in summer season, the values for H' , 1-D, d and E were higher in sites IV, IV, III and IV and lower in Sites I, I, I and II respectively.

In the study, 14 fish species belonging to least concern, three fish belonging to near threatened, one species belonging to common, one species belonging to endangered, one species belonging to vulnerable and

one species belonging to data deficient categories were found according to IUCN red list status for Nepal.

Water quality parameters (Dissolved oxygen, pH and water temperature) of different sites were measured of both winter and summer seasons in which no significant difference on any other parameters were found between the sites in same season. Whereas seasonal variations were observed in water quality parameters with dissolved oxygen levels being higher in winter and water temperatures being higher in summer, while pH levels remained relatively consistent.

Thus, the findings recommended that the unlawful exploitation of the Marsyangdi River system, habitat degradation, and dam development have been assessed to have caused an impact on fish diversity. To substantiate fishermen's claims of a fall in fish populations, data on fish catches should be documented and gathered, and the appropriate measures should be taken to conserve species.

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