



(REVIEW ARTICLE)



A brief review on effect of heavy metals in fish fauna

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World Journal of Advanced Research and Reviews, 2024, 24(01), 373–387

Publication history: Received on 20 August 2024; revised on 30 September 2024; accepted on 03 October 2024

Article DOI: <https://doi.org/10.30574/wjarr.2024.24.1.3009>

Abstract

The variety of fish species is essential for the well-being and stability of aquatic environments. Fishes are one of the most important aquatic creatures that are directly or indirectly related to human health and wealth. With thousands of different species inhabiting various water bodies around the world, each fish contributes to the overall biodiversity and sustainability of these environments. Humans have long relied on aquatic resources for food, medicines, and materials. Fish species are adapted to a variety of environments such as freshwater lakes, rivers, reservoirs, oceans, and estuaries. The diversity of habitats available allows a variety of fish species to thrive in different environments. Fish diversity is a vital component of aquatic ecosystems, supporting ecosystem stability, economic value, and cultural significance. India's inland water resources are abundant and diverse, including reservoirs that play an important role in the country's inland fisheries sector. Biodiversity and its conservation are considered one of the key issues to enable sustainable use of natural resources. Protecting ichthyophan diversity in its natural habitat is essential and the need of the hour. By understanding the factors that influence fish diversity and the importance of preserving biodiversity, we can work towards protecting and protecting these priceless resources for upcoming generations.

Keywords: Biodiversity; Heavy metal; Chemical oxygen demand; Exotic species

1. Introduction

One excellent source of protein is fish. Fish is an essential part of a balanced diet, providing numerous health benefits. The fish has been a healthy dietary source for humans. Essential elements like protein, vitamins, minerals, and omega-3 fatty acids are abundant in fish (Supriya Surachita et al., 2023). Fish is recommended for consumption due to its high omega-3 fatty acid content. These fatty acid are needed for maintaining heart health, improving cognitive function, and lowering the body's level of inflammation. High-quality protein, which is needed by the organism for tissue growth and repair, is abundant in fish. Frequent consumption of Fish is connected to better mental health, according to research. Fish rich in omega-3 fatty acids are connected to reduced anxiety, depression, and cognitive decline symptoms (R. Alexandar et al. 2013). Fish, a great source of protein, are often raised in lakes and reservoirs as part of efforts to improve fisheries rather than just for fish culture. Freshwater fish cultivation has been identified by Rao et al. (1998) as a highly profitable venture due to its low input costs and straightforward management practices. Fish, which make up more than half of all vertebrates worldwide, hold the distinction of being ranked tenth around the world for freshwater mega-biodiversity, putting it among the leading mega-biodiversity countries.

India's inland water resources are abundant and diverse, featuring reservoirs that play a pivotal role in the country's inland fishery sector. Reservoirs are primary supply of inland fishery resources in case of production potential. These reservoirs harbor a broad variety of fish species, reflecting the rich variety and plentifulness of fish fauna in India. The existence of different type of fish in Indian reservoirs supports the thriving commercial fisheries sector (Shahnawaz Ahmad et al. 2015). Fish species contribute to the overall biodiversity of aquatic ecosystems by occupying different niches and roles within the food chain. They ensure other species' survival and contribute to the delicate ecosystem's

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equilibrium. Aquatic habitats rely heavily on fish for the cycling of nutrients. Their consumption of organic matter and excretion of waste allow them to contribute to the regulation of nutrient levels in the ecosystem (A.S. Kumar Naik et al. 2013). Aquatic ecosystems' food webs include fish as a crucial link. They provide a dual role in population control as both predators and prey. The entire composition and operation of the food web are impacted by their existence. In aquatic habitats, fish are vital to the health and functioning of the ecosystems and have a significant ecological impact (W. Subadani Devi et al. 2018).

In aquatic ecosystems, maintaining and expanding fish diversity is heavily dependent on chemical oxygen demand. When COD levels are kept at optimal levels, fish can reproduce and grow in a sustainable habitat. Decreased water quality due to high levels of COD can result in the loss of fish populations. The existence of heavy metals in aquatic The ecosystem has attracted prominent headfulness due to their harmful effects on fish species. Heavy metals such as lead, mercury, cadmium, and arsenic can accumulate in fish tissues and harm entire populations by interfering with physiological processes. Pollution from heavy metals can decrease the diversity of fish species. Fish exposed to heavy metals may show alterations in behavior that increase their vulnerability to predators or hinder their ability to obtain food. To keep fish populations in aquatic habitats healthy and sustainable, heavy metal contamination must be monitored and controlled.

2. Review Of Literature

Srinivas Reddy et al. (2005) focused their study on the Nizam Sagar Dam in Nizamabad, Telangana, documenting 67 different species of fish. These are divided into different categories, with the ordinary species in this area being *labeo rohita* and *catla catla* and low-abundant fish species in this area, including *punctius sarana*, *oreochromis mossambicus*, *channa marulias*, *channa straitus*, *trichogaster fasciatus*, and *heteropneustes fossilus*.

A comprehensive study by A. N. Shendge (2007) on fish diversity in the Nira River, Pune. In a recent study conducted in the Nira River, located in Pune district, an important perspective is presented on the diverse fish species that inhabit the region. The study identified a total of 24 different species of fish, classified into eight distinct orders. The analysis revealed that the dominant fish orders in the sangavi region of the Nira River are *cypriniformes*, *siluriformes*, and *perciformes*. Among these orders, Cypriniformes exhibited the highest species diversity, with a total of ten different species recorded. Ten species was the maximum number ever documented within the Cypriniformes order. It was discovered that the fish were widely dispersed throughout the river and had a substantial presence.

A.g. Devi prasad et al. (2009) conducted a study on the biodiversity and conservation status of fish in the primary wetlands of mysore district, karnataka, india, which has been the focus of this comprehensive study. A total of 45 fish species were identified in the eight selected wetlands, including four exotic species. These species belong to 15 families and 31 taxa, with the cyprinidae family exhibiting the highest species richness at 22 species, while the remaining families were represented by one species each. Notable families included bagridae (5 species), channidae (4 species), and other taxa. The other common genera were *aorichthys* (two species), genus *channa* (four species) of the family channidae, and genus *mystus* (three species) of the family bagridae.

A study was conducted by khairul adha et al. (2009) by rahim to assess the fish composition and variety in the brown and black water habitats at batang kerang in balai ringin, sarawak, during both high and low water seasons. A total of 234 individual fish were captured, representing 36 species across 13 families. The fish population in the brown water habitats is comprised of 32 species from 12 families, while the black water environments contain only 12 species from 7 families. The cyprinidae family dominated the fish communities, making up 63.8% of the total catch. Predatory fishes such as *oxyeleotris marmorata*, *hemibagrus nemurus*, *mystus baramensis*, *mystus micracanthus*, *channa lucius*, *clarias batrachus*, *clarias teijsmanni*, *clarias nieuhoffii*, and *clarias macrocephalus* were common.

A study conducted by s.e. shinde et al. (2009) on the diversity of fish genera in the pravara river in 2008. The pravara river in india showcased a diverse array of fish genera. 14 households and 7 orders were observed in the number of captures throughout the year. The order cypriniformes had the most abundant species, followed by siluriformes with 8 species, perciformes with 6 species, osteoglossiformes, and synbranchiformes with 2 species each. There was a total of 14 fish, with each family contributing at least one species. The family cyprinidae was the most influential, comprising 19 variations within the overall assemblage composition. The family bagridae is home to a large population of *mystus tengara*. Less common species were discovered to be *mystus aor* (*aorichthys*), *mystus bleekeri*, *mystus cavasius*, and *mystus seenghala*.

In a study, jiwana shrestha et al. (2009) uncovered there are a total of 30 species of fish in the tamor river and its major tributaries in the eastern himalayan region of nepal. *Psilorhynchoides pseudocheneis*, an endemic fish in nepal, was

found in all seven stations, indicating its prevalence in this area. The study identified a variety of fish species, showcasing the rich biodiversity present in nepal's waters. With 30 different species recorded, the research sheds light on the various aquatic lifeforms that inhabit the region. The sisoridae family comprises 13% of the fish species, while the cyprinidae, balitoridae, and psilorhynchidae families dominate with 61%, 13%, and 103% of the fish species, respectively.

In a study conducted by deependra gautam et al. (2010), gill nets were used to gather fish from jagadispur reservoir in nepal, with a specific emphasis on *mastacembelus armatus* species. The fish collected were carefully counted and kept in formalin (5%) for further study. The study was conducted on jagadispur reservoir, with a total of 42 fish species belonging to 6 orders, 18 families, and 34 genera. Cypriniformes and cyprinidae were found to be the dominant order and family, respectively, underscoring the richness of fish biodiversity present in the reservoir.

The study by k. Bagra and d. N. Das (2010) to analyze the siyom river boasts a diverse range of fish species, with a total of 44 different species identified across 9 families, including the anguilliformes, cypriniformes, siluriformes, and perciformes. In addition to these native species, reports have also surfaced of exotic fish like *cyprinus carpio*, possibly originating from fish ponds. With their limited harvest numbers, these exotic species have made an impact on the river's ecosystem. The presence of different species in different areas of the river adds to its rich biodiversity and underlines the importance of its conservation.

The study was conducted by jogen ch. Kalita et al. (2011) on fish diversity in the koya kujiya beel located in the goalpara district of assam. They recorded the beel has a total of 45 fish species, including *labeo rohita* and *labeo gonius* among the major species. 13 species are categorized as intermediate, including *eutropichthys vacha*, *clupisoma garua*, and *ompok bimaculatus*, and 22 species are classified as minor, including *mystus cavasius*, *mystus bleekeri*, *tetradon cutcutea*, and *chacca chacca*, in very low quantities.

K.v. zeena and k.s. jameela beevi (2011) conducted a survey on the fish found in ithipuzha and murinjapuzha, two tributaries of the river muvattupuzha in kerala, from october 2009 to may 2010. In total, 69 fish species were gathered and categorized, coming from 54 distinct genera, 36 families, and 13 orders. The research showed that perciformes fish were the most prevalent, consisting of 15 families, 20 genera, and 25 species. This was succeeded by the order cypriniformes, which included 1 family, 6 genera, and 14 species. Earch showed that perciformes fish were the most prevalent, consisting of 15 families, 20 genera, and 25 species. This was succeeded by the order cypriniformes, which included 1 family, 6 genera, and 14 species.

Study conducted by shahnawaz ahmad et al. (2011) on fish diversity in sogane and santhekadur tanks, shimoga karnataka, india. There are a combined 17 different types of fish species. Characterized by 4 categories, 11 clans, and 14 various species were observed in the santhekadur and sogane tanks. From a total of 17 fish, there are 8 species in this order. The class cypriniformes includes 5 species. Three species belonging to the order perciformes are categorize as siluriformes, with the remaining species to be ordered. Osteoglossiformes, in respective order. The cyprinidae group was the most dominant among the others. The aquatic life in each tank. The four primary types of carp were discovered, similar to catla, rohu, mrigal, and cyprinus, which is the name given to a type of fish.

In 2012, A. Senthil murugan and C. Prabakaran examined the fish community in nepal's kamala basin reservoir. From june 2010 to may 2011. The kamala basin reservoir is home to 35 different fish species, including families like ophiocephalidae, cobitidae, and cyprinidae. When there was an abundance of food and water during the post-monsoon season, it was obtain that the diversity of fish species was at its highest. Conversely, variety was not as high when it was discovered that the body of water in the kamala basin reservoir was oligotrophic, with a minimal need for biochemical oxygen and high dissolved oxygen levels.

Amal kumar patra et al. (2012) conducted a comprehensive investigation of the karalla river. The main goal of the study was to analyze seasonal variations in physico-chemical parameters and ichthyofaunal diversity. A total of 55 distinct species were discovered; 31 species were classified under the cypriniformes order, while 10 belonged to the perciformes order. Additionally, there were 7 species from the siluriformes order, 3 from the synbranchiformes order, and 1 species categorized under other miscellaneous orders.

A study was conducted by tamboli r.k. . And jha y.n. (2012) on the variety of fish in the rivers kelo and mand in raigarh district. The fish population in the mand and kelo rivers was noted between july 2010 and march 2011, revealing a species inhabiting these waters. A total of 17 species from 12 genera and 6 families were recorded across this extensive research. The study identified various species, including *ompok*, *wallago*, *rita*, *mystus*, *bagropiichthys*, *pseudotropius*,

silonia, neustus, and clago attu; ompok bimaculatus; rita rita; mystus tengara seenghala; mystius, mystus aor, ailia coila, silondia; pseudotropius atherinoides and heteropneustus.

Vipin vyas et al. (2012) conducted a thorough study on the variety of fish of the betwa river in madhya pradesh. the research discovered a vast array species of fish living in the river, with important results regarding the spread and number of different families and genera. The research found sixty different species from 15 different families and thirty-four different genera in total. Interestingly, out of these sixty species, forty-eight were recorded at a sacred ghat along the river. This highlights the importance of specific locations in supporting diverse fish populations within the betwa river. While studying, a total of 5,461 individual fish were seen within the family cyprinidae, with 3,594 individuals accounting for 65.81% of the total population. Additionally, the subdominant family ambassidae was represented by 441 individuals, making up 8.08% of the population.

P.k. Srivastava (2013) study on fish variety and conservation perspectives of gandak river, india. the investigation identified a total of 54 species of fishes, which were divided into 18 different families. The cyprinidae family possessed the greatest quantity of species with a total of 18, followed by bagridae with 6 species families schilbeidae, tetraodontidae, and cobitidae each had three species, while notopteridae, siluridae, ambassidae, and macacembelidae had two species each.

A sampling study conducted by A.S. kumar naiket et al. (2013) on fish variety of the tunga river in karnataka, india. Calta catla emerged as the fish species that is most prevalent, constituting 28% of the observed population. In total, 37 fish species belonging to 4 orders were identified during the study. The study obtained that the order cypriniformes was the most predominant; a total of 23 species have been identified. This was followed by siluriformes, which had 11 species, and perciformes, which had 2 species. Among the recorded species, the family cyprinidae possessed the greatest quantity of fish species, accounting for 51.35% of the total species identified. Bagridae followed with 4 species, making up 10.81% of the total, while claridae had 3 species, accounting for 8.10% of the total species recorded.

In this comprehensive study by sunita bakawale and kanhere r.r. (2013), the focus has been on gathering, categorizing, and recognizing the various fish species present in the western zone of river narmada. Conducted along a 15 km stretch of the river, jangerwa, throughout the period of september 2006 to august 2007. the survey results revealed 51 distinct species of fish in all that reside in this specific zone of the river. Among these, species of fish that were prevalently observed were major carps, minor carps, and catfishes. Additionally, there were several fish species categorized under the orders clupiformes and cypriniformes, cypriniformes, beloniformes, opiocephaliformes, mastacambelliformes.

A comprehensive study conducted by kumar varun and kumar kamad (2013) in the dhaura reservoir identified a total of 25 different fish species. These species belong to various bagridae, channidae, siluridae, notopteridae, heteropneustidae, claridae, belonidae, clupeidae, and mastacembelidae. Among the diverse range of types of fish found in the dhaura reservoir are *labeo rohita, catla-catla, cirrhinus mringla, labeo calbasu, labeo goniis, labeo bata, cyprinus carpio, and ctenodon idella.*

The study by kumar naik a.s. et al. (2013) examined the biodiversity of fish fauna in karanja in the northern region of karnataka. During the research, overall 64 finfish were identified and placed within 37 genera, families, and 5 orders. The order cypriniformes comprised the highest number of fish species with 31, followed by siluriformes with 20 species, perciformes with 10 species, osteoglossiformes with 2 species, and synbranchiformes with 1 species.

A comprehensive study was conducted by gohil mahendrasinh n. And mankodi pradeep c. In 2013 to explore the diversity of fish fauna in the downstream zone of the river mahisagar, gujarat state, india. The researchers visited the downstream zone every month to collect fish samples and analyze the species present in the fresh water. The researchers identified overall 26 fish species belonging to 3–12 families. The most of species (08) were from the cyprinidae family, with rich biodiversity present in river mahisagar. The family cyprinidae contained the maximum quantity of fish (eight), that is a normal characteristic of inland fish diversity. This zone contained only one species that belonged to the genus cynoglossus, or order pleuronectidae, also known as flat fish.

A recent fish survey conducted by r. Alexandar and r. Siva sankar (2013) in ousteri lake, puducherry, identified a total of 15 fish species. Of these species, *catla catla, mystus vittatus, heteropneustes fossilis* and *channa orientalis* are classified as endangered. *channa is*, on the other hand, categorized as low. *Etroplus maculatus*, an endangered fish species, was identified during the fish survey in ousteri lake. This species is in danger of becoming extinct if conservation *vittatus, heteropneustes fossilis, and channa orientalis* are classified as vulnerable based on the survey findings.

Anjanapura reservoir, karnataka is home to a rich aquatic ecology that supports a total of 25 fish species, according to study by d. Basavaraja et al. (2014). There are four orders, nine families, and eighteen genera for these species. A total of 14 fish species, the order cypriniformes is clearly the most prevalent group in the anjanapura reservoir. Six species follow after this. The reservoir also has one fish species of the order osteoglossiformes and four species of the order perciformes. The anjanapura reservoir contributes to the region's general biodiversity in addition to providing habitat for a diverse range of species of fish.

To assess the impacts of pollution on fish habitats and comprehend the distribution among species of fish in the devaha river (up), preeti saxena et al. (2014) conducted research. They discovered that the fish in the river were known as cyprinids. The finding indicates that the river had 16 species at lesser risk, 12 species are vulnerable, and 6 species are endangered. It was discovered that about 52.94% species of fish in the river were in danger.

A comprehensive study was conducted by sunil mondal et al. (2014) to investigate the freshwater fish species at the pakhanjore dam district, kanker, cg, india. Overall 25 species belong to families, during study. In the assemblage structure, it was noted that the cyprinidae family the prominent species included *labeo rohita*, *catla catla*, and *cirrhinus m*, which were present at the sites. The family has the highest diversity with 14 species, followed by 2 species, and bagaridae with 1 species. Other families, such as silidae and mastac, are represented on the study sites. The cyprinidae family of fish in these reports was more.

Samal et al. (2015) examined fish samples collected from the budhabalanga river, odisha, between june and november 2014. A total of 8288 fish belonging to 15 families and 45 species were identified throughout the study session. The species diversity noted throughout the study session ranged from 3.35 to 3.359, with the highest diversity noted in october. This peak in diversity coincided with favorable after-monsoon conditions. In november and august, a total of 2109 individuals belonging to 15 families were recorded.

A study conducted by debasish panditin et al. (2015) in dekhar haor, bangladesh, revealed a diverse range of fish species. 65 species from 23 families were discovered during study. Among the documented species, 26 were classified as moderately available, 18 as rarely available, and 19 as not available. The study revealed that nine species belonged to the carp family and 16 to the catfish family. 10 to the barb family. The study identified a total of 60 fish species, with catfish being the most abundant species at 24. Fishes, 10 barbs and minnows, 1 clupeid, 4 snake eels, 11 perches, 1 featherback, 3 loaches, and 6 miscellaneous species, including 3 species of prawns.

In the study by m. Altaf et al. (2015) aimed to calibrate the range and variety of fish species found in the river chenab (pakistan). The research focused on three main areas of the river: head marala (district sialkot), head khanki (district gujrat), and head qadirabad (district gujranwala). The study used local fishermen to collect data on fish diversity throughout the study area. the findings of the study shed light on the various fish in the chenab river and their distribution in the river. Thirty-four species were identified from the chenab river during the sampling. *Godonidella*, *ctenopharynge*, *cyprinus carpio*, *hypophthalmichthysmolitrix*, *cirrhinus merigala*, *cirrhinus reba*, *labeorohita*, *labeocalbas*, *labeodero*, *catlacatla*, *channapunctata*, *channamarulious*, and *rita rita*.

In the study by md. Abu hanif et al. (2015) examined a total of 98 species of fishes in the southern coastal waters of bangladesh. These species belonged to 81 different genera, 48 families, and 13 orders. The study revealed that perciforms stood out as the greatest diverse fish group. The dominant family noted in the study was cyprinidae, which consisted of 19 species, making up approximately 19.39% of the total species caught. Other families included bagridae, with 5.15% of the species, and clupeidae, among others.

A comprehensive study conducted by G. P. Gadekar (2015) in the bagh river district of gondia (m.s.) india has uncovered a wide range of fish species thriving in the region. Fish from 12 families and 7 orders were noted in the bagh river district during the study session from january to december 2014. Total 29 different species, encompassing 12 families and 7 orders, were identified in the bagh river for this study. - the order cypriniformes emerged as the most dominant group. The common species in this category included *cyprinus carpio*, *puntius ticto*, and *rashora daniconius*. Large numbers of *nemacheilus botia* and *cirrhinus reba* were found.

The Ichthyofaunal ponds of Mahurband and Dandia in the Kanker City district of North Bastar Kanker, Chandigarh, Gujarat, India, are examined in this study by Divya Kumudini Minj and R.K. Agrawal (2015). overall 39 fish species from Mahurband Pond were recorded, representing 5 orders, 20 genera, and 11 families. The main food fish in the water bodies are the rohu and catla populations. Other fish species include *Puntius*, *Chela*, *Mystus*, *Mastacembelus armatus*, *Macrognathus aculeatus*.

A comprehensive study was conducted by Gourishanker Patel et al. (2016) to observe the fish diversity of Raigarh district, Chhattisgarh. A total of 54 fish species were recorded, belonging to 36 genera, 21 families, and 7 orders. Cyprinidae family found to be the most dominant group, comprising 39% of the recorded species. Other prominent families included Bagridae (9%), Channidae (6%), Schibeidae (6%), and Siluridae (6%). The research revealed a diverse array of fish, including *Armatus armatus*, *Parambassis ranga*, *Sperata aor*, *Sperhala*, and *Xenentodon cancila*, emerging as the dominant species. Among these were two endangered species, *Tor tor* and *Tor putitora*, as well as seven vulnerable fishes, including *Bagarius bagialosa manminna*, *Heterop fossilis*, *Ompok pabda*, *Sperata aorropiichthys vacha*, and *System*.

A comprehensive survey was conducted by Phul Kunwar Singh Rana (2016) at Malhaniya Dam bilaspur, resulting in the identification of 25 different species levels. The species identified include *Notopterus not Notoptera chitala*, *Oxygaster*, *Oxygaster gora*, *Rasbora daniconius*, *Rasbora Puntius chola*, *Puntius sarana*, *Sophore*, *Amblypharyngodon mola*, *Cirrhinus mrigala*, *Cirrhinus reba*, *Labeo calbasu*, *Labeo pungusia*, *Clarius batrachus*, *Mystus bleekeri*, *Heteropneustes fossilis*, *Channa punctatus*, and *Channa striatus*. It was found that Cyprinidae are the highest species.

According to D. Samal et al. (2016), among the fish species observed in the Budhabalanga River, Baripada, Mayurbhanj, Odisha, prominent species such as *Labeo bata*, *Crossocheilus latius*, *Garra mullya*, *Puntius ticto*, *Puntius conchoniis*, *Amblypharyngodon mola*, *Puntius pulchellus*, *Puntius stigma*, and *Barilius vagra* were obtain to dominate the ecosystem. Considering the outcomes of the investigation, the Budhabalanga River is swarming with fish, exhibiting a rich ecology with 45 species of fish recognized in 15 genera and families.

A comprehensive study conducted by Jay Narayan Shrestha (2016) revealed fascinating insights into the diverse fish species obtain in the Triyuga River. Overall 48 fish species were recognized, encompassing 35 genera from 6 orders and 17 families, such as *Barilus shacra*, *Garra annandalei*, and *Psilorhynchoides pseudechene*; *Badis badis*; *Lyra longicoudata*; *Tor putitora*; *Labeo dero* and *Anguilla bengalensis*.

A study conducted by Anupama Pandey and Hem Chandra Upadhyay (2016) on fish diversity in the Western Ramganga River of Kumaun Himalaya, Uttarakhand, India. During the current study, a notable seasonal variation was observed in the species of fish inhabiting the Sisoridae, Cyprinidae, Botinae, and Mastacembellidae. Among these families, Cyprinidae emerged as the largest, comprising a total of eight species. The top five species were *Tor putitora* (83.33%), *Botia almorhae* (75%), *Barilius bendelisis* (66.66%), *Schizothorax richardsonii* (66.66%), *Garra gotyla* (58.33%), and others, listed in decreasing order of frequency.

A recent investigation by M.T. Nikam (2016) has revealed the presence of 19 distinct species of fish in the Buldana region. The Cyprinidae family is the most prominent, with a total of 9 species. These include *Puntius sarna*, *Puntius ticto*, *Labeo bata*, *Labeo calbasu*, *Cyprinus carpio* and *Cirrhinus mrigala*. The Bagaridae family is also well represented in the region. The Mastacembelidae family is represented by one species, *Mastocembeluis armatus*. The family *Ophiocephalidae* show only two species, *Channa punctatus*, *Channa orientalis*. The family *Notopteridae* is presented by two species, *Notopterus notopterus* and *Notopterus chitala*.

In our comprehensive study by Neeta Mishra and Devendra N. Pandey (2016), we identified a total of 26 different species of fish across seven orders and eleven families. The most dominant family was Cyprinidae, with a total of nineteen species, followed by Bagridae and ophicephalidae, each having four species. Idae, siluridae, mastacembelidae, and nandidae consisted of two species each, while claridae, saccobianchidae, schlibidae, and anabantidae had one species each. Out of twenty-six species, six have high economic value such as *Walago attu*, *Channa marulius*, and others with moderate economic importance.

Fish fauna of Banganga river was thoroughly studied by Sadguru Prakash (2016), revealing a diverse range of species belonging to seven different orders. The Cypriniformes order in the Banganga River is represented by seven different species. The Perciformes order boasts four distinct species within the Banganga River. Three species were in the Ophiocephaliformes, and 2 species were under the Osteoglossiformes order. The Clupeiformes and Beloniformes each consist of one species in the Banganga River. The common species include *Cirrhinus reba*, *Puntius ticto*, *Amblypharyngodon mola*, *Mystus seenghala*, *Mystus aor*, and *Rita rita*.

Haji Muhammad et al. (2017) conducted a study on the variety and distribution of the species of the fish in Indus River at Taunsa Barrage in Punjab, Pakistan. Seventy various kinds of fish were gathered. A grand total of 2249 fish specimens were collected. The most abundant and diverse family gathered from eight locations in terms of numbers. Cyprinidae includes 27 species, with Bagridae coming next. (eight different kinds of species). Sisoridae was ranked as the third most varied family. Chandidae as well as two families of exotic fish, Cichlidae, were represented by 3 members each for

each type of species. Botiidae was the scarcest family. The families with the lowest level of diversity were Cobiidae and Heteropneustidae.

A comprehensive study conducted by Shiva Narayan Yadav (2017) in the Singhiya River in the Morang district of Nepal between January and August of 2016 revealed the existence of 26 distinct fish species. The research spanned over eight months and covered three distinct locations along the river. The study identified a total of 26 distinct species of fish in the Singhiya River during the specified time frame, in 15 orders, 6 families, and 20 genera, such as *Catla* and *Cirrhinus reba*, *Xenentodon cancila*, *Puntius sophore*, *P. Conchonius*, *Catla*, *Vittatus mystus* etc.

The current study, which aims to provide a comprehensive overview of fish diversity in Narmada, was conducted by Deepika Saini and KK Dube (2017). The study focuses on the abundance of major carp, minor carp, and catfish in the area. Additionally, various species of fish belonging to different phiocephaliformes, perciformes, and siluriformes have been documented. Among the different orders of fish species observed, Cypriniformes emerged as the most dominant group, with a total of 22 recorded species. Some notable species within the Cypriniformes order include *Cirrhinus cirrihosa*.

A study conducted by HS Mogalekar et al. (2017) recognized 267 species of freshwater fish (186 primary freshwater species and 81 secondary freshwater species), belonging to 12 orders, 40 families, and 123 genera. Thirteen species of exotic fish have been introduced to freshwater bodies in the state. The top order has diverse species. The composition was Cypriniformes (117 species, 46 genera, and 4 families). With 84 species and 35 genera, the Cyprinidae family was the most diversified. *Ctenopharyngodon idellus* and *Carassius auratus* are responsible for the imbalance in the aquatic ecosystem.

A recent study by Abhishek Giri and Dr. Shriparna Saxena (2017) revealed fascinating insights about Shahpura Lake, Madhya Pradesh. Shahpura Lake is home to six distinct species from 2 distinct families, including *Cirrhinus rigala*, *Hypophthalmichthys*, *Molitrix* and *Cyprinus carpio*. In these species, *Tilapia mossambica* is known for its remarkable characteristics and adaptability to the environment.

In this study, A. Gunasekar and S. Suthakar Isaac (2017) documented and described 25 freshwater fish species found in the Indrapuri Dam, Rohtas district, Bihar (India). These species belong to 5 different orders, 12 families, and 21 genera. Within the 25 documented fish species, there is a notable distribution across various families. Three species are classified under the family Bagridae, 5 species under Schilbeidae, 2 species each under Siluridae and Cichlidae, and 6 species under Cyprinidae. Additionally, there are species belonging to the Clariidae, Erethistidae, Heteropneustidae, Pangasiidae, Mastacembelidae, Channidae, and Notopteridae families.

A study conducted by Swapnil S. Ghatge et al. (2017) on the freshwater fish diversity of Navegaon Bandh, Gondia district, Maharashtra. 55 fish species from 738 genera and families were documented. Cypriniformes emerged with 27 species; closely behind are Perciformes, and Syn also made their 10 species and 6 genera, respectively. Additionally, Belonossiformes and Ang are one family and one species, respectively. Out of 55, 4 of the species of fish that have been identified are categorized as near-threatened (*Ompok bimaculatus*, *O. Pabda*, *Wallago attu*, and *Anguilla bengalensis*) and one species as endangered (*Clarias magur*).

W. Subadani Devi et al. (2017) reveal a total of 30 fish species belonging to 13 families were reported in the fish diversity of Loktak Lake, Manipur. Among these, 8 species were predominantly found during the rainy season, while the rest were present throughout the year. These species include *Ompok*, *Pabda attu*, and *Osteangeri*, while *Anabas testudineus* is on the verge of lacking sufficient data. *Amblypharyngodon mola* has been identified as the most dominant species throughout all seasons, while *Wallago attu* is least dominant.

A comprehensive study conducted by Jash Hang Limbu and Sandip Kumar Gupta (2018) of fish species in Ratu Various Fishing was conducted in the Damak and lower Terai regions of the Ratuwa River. A total of 27 species of Cypriniformes fish were discovered during the sampling, belonging to two distinct families: Cobitidae (three species) and Cyprinidae (twelve species). Additionally, one species each from the Anguilliformes (*Anguillidae*), Clupeiformes (*Clupeidae*), and Synbranchiformes orders was also identified. Damak and Ratuwa Rivers were home to *Barilius barila*, *Barilius bendelesis*, *Guducia chapra*, *Puntius chola*, *Puntius phutunio*, *Puntius sophore*.

A recent investigation conducted by D.S.Kumbhar et al. (2018) in the Bhima River has identified a total of 26 fish species spanning across 07 different families. Among these families, the Cyprinidae family emerges as the most dominant, with a total of 12 species. Following closely behind are Siluridae with 06 species, Percidae with 04 species, and Notopteridae,

Ambassidae, Clariidae, and Loricariidae each with 01 species. During our investigation, we have documented the existence of an exotic species called *Pteryoplichthys pardalis*, better known as the Amazon sailfin catfish.

A study conducted by Manish Kunwar Sisodiya et al. (2018) focused on the fish community in the Haro reservoir near Ghatol town in Rajasthan. Study revealing a diverse range of 15 fish species from five families, such as *Chanda ranga*, *Chanda nama*, *Mystus seenghala*, *Tilapia mossambica*, *Wallego attu*, *Labeo rohita*, *Puntius ticto*, *Puntius sarana*, *Cirrhinus mrigala*, and *Labeo gonius* were. The reservoirs for electricity generation, fishing, and tourism saw an increase in fish populations following rainstorms and sufficient water and food sources. This study sheds light on the importance of environmental factors in supporting fish populations in the Haro reservoir.

Segun Olayinka Oladipo et al. (2018) conducted study at the Apodu reservoir in Malete, Nigeria, revealed the presence of 3333 fish species over 12 sampling periods. The study identified Mormyridae and Characidae as the most abundant fish families, comprising 34.14% and 29.31% of the total abundance, respectively. Cichlidae was represented by 4 species, while *Tillapia*, *Sarotherodon*, and *Oreochromis* were encountered infrequently. Bagridae accounted for a mere 0.03% of the total population. Other fish families observed in the reservoir included Morchokidae, Clariidae, and Protopteridae.

In a study conducted by Qin et al. (2018), overall 19,355 samples were deposit from the middle and lower reaches of the Ganjiang River in China. These samples were identified to belong to 107 species, 69 genera, and 18 families. Cypriniformes was obtain the dominant group. Siluriformes ranked second with 15.0%. Beloniformes and Synbranchiformes were found to have the lowest presence, accounting for only 9% each. The dominant species recognized were *Aotus*, *Cyprinus carpio*, *Carassius auratus*, and *Silurus asotus*.

A study by Abhisek Saha et al. (2019) examined the seasonal changes in physico-chemical parameters on the Raidak river in the Coochbehar district of west Bengal between January and February 2018. The study identified high water hardness and significant variations in other parameters. A total of 43 ichthyofaunal species were documented in the Raidak River, including 19 food species, 19 ornamental species, and 5 species exclusively for ornamental purposes. Among the species, *Cyprinion semplotum* was classified as vulnerable.

A comprehensive study was directed by Rajini Chandran et al. (2019) on the variety and distribution of fish variety in the Ib River India, where overall 3923 individuals were sampled and examined. Overall 55 species were identified, belonging to 42 genera, 21 families, and 9 orders. Cypriniformes emerged as the most dominant order, representing 41.8% of species with 23 different species. Siluriformes and Perciformes are right behind it, each with 12 species (21.8%). Cyprinidae was identified as the richest family with 21 species, followed by Bagridae with 5 species and Schilbeidae with 4 species.

A study was conducted by Jian Huang et al. (2019) to analyze fish variety and abundance in a overall 2968 fish recognized during this study, which was related to the total species richness. The dominant species identified were *Astromys* (0.0%), *Acrossocheilus parallens* (12.8%), and *Aeromyzon sinensis* (10.5%). These species accounted for 10% of the total fish abundance in the study. Habitat type varied among the dominant species. Generalists, such as *Z. Platypus*, *P. Fangi*, and *A. Parallens*, were the dominant species in most habitats. In addition, *Rhinogobius leaveli* and *Rhinogobius similis* were the dominant species in the Riffle and Cascade.

In a recent investigation by Kamal Narve et al. (2019) in Kotwal Reservoir (Madhya Pradesh), overall 29 different species were discovered. There are 21 genera and 7 orders in total. Cypriniformes was the largest group, consisting of 1 family, 9 genera and 15 species. Several fish species commonly observed in Kotwal Reservoir are *Labeo gonius*, *Labeo calbasu*, *Ctenopharyngodon idella*, *Cyprinus carpio*, *Hypophthalmichthrix*, *Wallago atun*, *Notopterus species*, *Xenentodon cancella* and *Parambesis ranga*.

A study conducted by Harinder Singh Banyal and Sanjeev Kumar (2019) revealed that the Mahi River in Banswara and Dungarpur districts of Rajasthan is home to a diverse range of fish species. The order Cypriniformes comes out with the highest of species (17) in the Mahi River. Close behind are Siluriformes and Perciformes, each with five species. *Osteoglossiformes*, *Symbranchiformes* and *Clupes* each have two species.

A study conducted by Ashok Kumar Verma (2019) reveals that explore the fish species in Balapur pond through a comprehensive study. Overall 12 fish belonging to 4 orders, 7 families and 11 genera were observed during the research period. The fish fauna observed in the pond includes species from four different orders: Siluriformes, Cypriniformes and Ophiocephaliformes. In the present investigation, the Cyprinidae family was the most dominant group with 5

species, followed by the Bagaridae family with 2 species. The Siluridae, Cleridae, Clupeidae, Saccobranchidae and Ophiocephalidae families were represented by one species each.

Toral Munia et al. (2019) The present study is based on the Ichthyofaunal Gallery of Kadana Faizabad, Gujarat. During the investigation, overall 32 genera were recognized from 6 different investigations and 13 families. The dominant species with 12 species were Siluriformes Studio, Pharcyphus Formation with 6 species, *Osteognathus*, and *Belonidea* with 1 species each. *Heteropneustidae*, *Schilbeidae*, *Cichlidae*, *Abacidae*, *Gobiidae*, *Belonidae*, and *Notopteridae* families; then *Siluridae* and *Chanidae* had 3 species each, *Mastacembelidae* had 2 species, and Cleridae had 1 species each.

A recent study was conducted by Rabinarayan Kar and Sitaram Swain (2020) at the Paradip coast of Odisha. The study revealed the presence of 22 fish species. The study revealed various species of fish, including *Dorosoma petenense*, *Xenentodon cancella*, *Nuchekula nuchalis*, *Trichiurus lepturus*, *Cynoglossus macrolepidotus*, *Achirus achirus*, solo fish, and terpedo, with *M. Cephalus* being the most abundant species. These findings indicate that the Paradip coast is polluted.

According to a study conducted by Samina Ahtun et al. (2020), seventy fish were found in the Korotoa River in Bangladesh. The fish were carefully counted and classified. The study included ten species from genera representing seven families and five orders. In terms of both diversity and number of species obtain, Cypriniformes emerged as the dominant order. Siluriformes and perciformes followed closely, in second and third place, respectively. Distribution of species Four distinct species belonging to the Cypriniformes order have been identified, which make up a large portion of the total fish population. Within the Cypriniformes order, these 4 genera responsible for 40% of the species diversity and 29% of all fish individuals.

In a study conducted by archana tiwari et al (2020) on fish growth and productivity were analysed with reference to chemical. Fishes were obtained from the ton's river at satna with the help of local fishermen. The study concluded that the limnological condition of the river was suitable for fish growth and survival. Cyprinidae leads with 44% of the total species, followed by siluridae and bagridae with 13% each. Chanidae accounts for 9%, while cleridae makes up 5% of the species count. Schilbeidae, notopteridae, belonidae and mastacembelidae contribute 4% each.

Sanjula swarnkar et al. (2020) reported that overall 38 species have been recognized recently at snail dam. Some of the notable species recorded in the cyprinidae family at snail dam include *cirrhinus mrigala*, *catrohu*, *hyphalmichthys molitrix*, *ctenophryne godonidella*, *puntius ticto*, *puntius chola*, *puntius cochonius*, *oxygaster clupeoides* and *salmo stomabachella*. The bagridae family provided five species, of which 3 species come from both the channidae and siluridae families. Notopteridae, mastasemelidae, cobitidae, centromeridae, nandidae, belonidae, cichlidae, pangolididae and anabantidae were the taxa attributed to each species, listed in sequential order.

A study was conducted by sachin sahu and subhendu dattain (2020) in kawardha to look into the biodiversity of species in the area. Overall 54 species belonging to 20 families under seven orders and 39 genera were recorded in kawardha, including 4 ponds and 1 river. Among these species, it was obtain that 3 species (5.5%) had ornamental value, while 19 species (35.18%) had both ornamental and food value. The family cyprinidae emerged as the dominant group among the ornamental and food fish categories. Such as Tilapia, catfish, exotic carp, and indian carp are the main fish species found there.

Manoj Kumar et al. (2021) in their survey found that Chirpani and Sarodha reservoirs, Kawardha CG, are known for abundant population of Indian major carps such as *Mystus sp.*, *Wallago attu*, *Common carp*, *Mystus sp.*, *Notopterus sp.*, *Channa sp.* Etc. These reservoirs provide a rich ecosystem for these fish species.

Many different aquatic species can be obtain in the Kharung reservoir located in the Bilaspur district of Chhattisgarh. To document this reservoir, Atiya Niazi et al. (2020) conducted a comprehensive study. Forty-three species are spread across 29 genera and are members of thirteen different families and nine orders. The Cypriniformes order was the most notable among them, with 24 species and 56% of all species in the reservoir. Currently, *Channa striata*, *Oreochromis mossambicus*, *Labeo calbasu*, *Cirrhinus reba* are among the economically important food fishes that the lake supports. The food chain includes predatory fishes, including *Macrognathus panicle*, *Wallago attu*, *Mastacembelus armatus*, *Channa sp.*, and *Mystus*.

At Dheer Beel in Dhubri district of Assam, Arup Nam Das et al. (2021) discovered a total of 83 species, belonging to 56 different genera and representing 29 families and 10 orders. The common species at this time were Siluriformes and Cypriniformes. Apart from reflecting the vast biodiversity of Dheer Beel, the predominance of Cypriniformes and Siluriformes in its fish population also highlights the health of the aquatic ecosystem.

A recent study on fish species diversity by Manoj Kumar Shukla (2021) had a focus on the Yamuna River, particularly Kalpi. The study revealed a total of 29 different fish species present in this particular region. Apart from Kalpi, the study also reported a total of 58 taxa in the Yamuna River at Chilla, Banda, UP. *Channa marulius*, *C. Punctatus*, *Serinus mrigala*, *Eutropichthys vacha*, *Labeo bata*, *Mastacembelus armatus*, *Mystus senghala*, *Notopterus cheetala*, *N. Notopterus*, *Oxygaster baccala*, *Rita rita*, and *Wallago attu* are some of the common fish species found at these locations.

Supriya Surachitha and Sharat Kumar Palita (2022) conducted an in-depth study on freshwater fish diversity and physico-chemical parameters analysis of Jagannath Sagar, Odisha. A total of twenty-six fish species, divided into eight orders, thirteen families and nineteen genera were found. The highest variety was obtained in the Cyprinidae family of fishes. Fishes of different orders have different chemical parameters and resistance levels. Anabantiforms and Cichliforms are least affected by these parameters. On the other hand, Symbranchiforms show a strong affinity for water temperature.

The study conducted by A.V. Dorlikar and M.R. et al. Aimed to inspect the ichthyofaunal variety in the Wainganga River at Wadsa in Gadchiroli. The research, spanning from November 2022 to March 2023, revealed a total of 28 fish species belonging to different orders 15, 22 genera. Notably, the Cypriniformes order came out as the most dominant, while Siluriformes showed the most. Different orders, 15 families were recognized. Of these, the Cypriniformes order came out with 10 species, while Siluriformes also showed prominence with 8 species. This indicates the rich biodiversity of the region, with Cypriniformes and Siluriformes being the dominant orders.

This study conducted by Amit Singh Kshatriya et al. (2022) focuses on the ichthyo-faunal diversity of the Khutaghat reservoir in Bilaspur district of Chhattisgarh. 34 fish species representing 13 families and 8 orders were obtained in the Khutaghat reservoir. According to a study on fish species diversity, the *Labeo* genus led the Cyprinidae family with four species, which had the highest number of species (16). The following families were also mentioned: Notopteridae (2 species), Siluridae (2 species), *Channidae* (3 species), and Bagridae (3 species). *Wallago attu*, *Notopterus chitala*, *Chanda nama*, *Labeo catla*.

Rishabh Shukla et al. (2023) revealed that the Kolar River is home to a wide variety of fish species from 7 orders and 11 families. Among the various orders observed, most fish species belong to the Cypriniformes order, accounting for 63% of the total species identified. The most prevalent fish orders in recent research were Beloniformes, Symbranchiformes, Perciformes, Siluriformes (4%), Cypriniformes (63%), Osteoglossiformes (17%), and Clupeiformes (8%).

A recent study by Shrestha et al. (2023) explored fish species in the Dudhkoshi River in eastern Nepal in two different seasons. The study revealed a total of 21 fish species present in the Dudhkoshi River, with the Cypriniformes order being the most prevalent. The study recorded 21 fish species from 3 orders, 6 families and 12 genera. Among the identified fish families, Cyprinidae emerged as the dominant Sisoridae. Apart from assessing the fish population, various water analyzing parameters such as temperature, conductivity, acidity, alkalinity, salinity and total dissolved solids (TDS) were carefully measured and analyzed.

A recent survey conducted by Jean-Jacques Albaret et al. (2023) in the Gambia Estuary in West Africa has documented a total of 70 species of fish belonging to 32 families. The survey families only had one species, leading to an interestingly, the month of November had the lowest species ratio, while the dry season in April recorded the highest diversity. Notably, Carangidae and Sciaenidae had each species; Mugilidae had 5 species; and Clupeidae and Haemulidae had 4 species each. Among the diverse range of fish species, *Sciaenolithus elongatus* emerged as the dominant species in the Gambia Estuary.

The study by Shahid Mehmood et al. (2023) to analyze physico-chemical parameters and freshwater variety of fish of the Sip River Madhya Pradesh, India, revealed that seasonal changes had a direct impact on fish diversity, with certain periods experiencing lower diversity levels. The abundance of fish species was found to be closely correlated with the stream gradient and overall water conditions. Among the various fish families observed, Cyprinidae emerged as the dominant group, including both food and ornamental fish varieties. These findings shed light on the significant role played by this particular fish family in the ecosystem of the Sip River.

A study conducted by Satinder Kaur et al. (2024) on the fish variety and Distribution of Chromatophores in Some fish are inhabiting Manawar. Tawi, Rajouri (J&K), India. In a recent total of six fish species from 5 genera, 5 species, and 2 families, fish species included *Puntius conchonus*, *Gara gotyla*, *Tor putitora*, *Onocorhynchus vagra*, and *Labeo boga*. Among the identified fish species, *Onocorhynchus mykiss* was classified under the Salmonidae family, while the remaining species belonged to the Cyprinidae family and the Cypriniformes order.

Triparna Chakraborty et al. (2024) found in their survey that water quality parameters played a crucial role in influencing the ichthyofaunal diversity in Ray Pukur. A total of 22 self-recruiting fish species were noted, with Cypriniformes being the dominant group among the catch composition. The results of the study highlighted the significance of water temperature, DO levels, and pH in determining the ecological health of the lake.

A study conducted by Sanjay Thiske et al. (2024) Based on our field observations in Rajnandgaon District, Chhattisgarh (India), a total of 43 fish species have been identified. These species belong to 31 different taxa and 17 families. The table and local names of the identified species. It is noteworthy that the order Cypriniformes and the family Cyprinidae stand out as the dominant groups, comprising a total of 17 species. On the other hand, the orders Osteoglossiformes, Beloniformes, and Characiformes have lower fish populations, with each order having only one species. Furthermore, mentioned are the species that are prevalent in this area, such as *Labeo rohita*, *Catla catla*, *Wallage attu*, *puntius*, *Mastcembelus sp.*, *Clarius batrichus*, *Channa punctatus*, silver carp, grass carp, and Piranha.

This field studies were conducted by Chiranjeev Pandey et al. (2024) in various habitats from the source of the river to the Mongra Dam between June 2023 and May 2024. Samples were collected, classified and their physical characteristics were recorded. In addition, elements such as feeding patterns and environmental preferences were assessed to understand how fish distribution is influenced by ecological variables. The results show that 46 species from 15 families spread across 9 orders are present, including a wide variety of native ornamental fish species, highlighting the ecological importance of the Shivrath River and emphasizing the need for conservation activities.

3. Conclusion

In conclusion, the present review shows that the most common fish species are *Labeo rohita*, *Katla catla*, Indian carp, which have economic importance in local and foreign market. And the most common order is Cypriniformes. It is suggested that fisheries authorities should investigate and practice proper management of fisheries resources according to ecological principle.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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