International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Assessment of Fish Diversity and Water Quality at Guwardi Dam, Bhilwara.

Muhammad Bello Aliyu[1], Abba Bature Yusuf[2], Umesh Garu[3]

[1,2]MSc. Student Department of Zoology, Mewar University, Gangrar, Chittorgarh, Rajasthan.
[3]Assistant Professor, Department of Zoology, Mewar University, Gangrar, Chittorgarh, Rajasthan.

ABSTRACT

This study examines the relationship between fish diversity and water quality at Guwardi Dam, focusing on physicochemical parameters from July to September 2024. Water samples were collected twice monthly from four sites and analysed, with fish diversity data provided by dam officials. Key water quality metrics included pH (8.35–9.94), temperature (27.3°C–30.7°C), salinity (0.28–0.64 ppt), dissolved oxygen (3.92–4.84 mg/L) and biological oxygen demand (1.8-4.84 mg/L). Other parameters measured were hardness (57.65-176.76 mg/L), carbonate alkalinity (3.4-8 mg/L), bicarbonate alkalinity (75.1-126.2 mg/L), alkalinity (79.7-133.6 mg/L), total dissolved solids (379–877 ppm), and electrical conductivity (551–1,289.7 µS/cm). The dam supported 20 fish species from 9 families and 7 orders, with Cypriniformes (45%) and Siluriformes (30%) being the dominant orders. The alkaline water, while suitable for fish and fisheries, highlights the need for long-term monitoring due to threats from domestic and industrial waste. The study recorded the dam high fish species diversity but also points out the importance of conservation efforts to maintain aquatic health.

Keywords: Fish Diversity, Guwardi Dam, Industrial and Domestic Waste, Physico-Chemical Parameters, Water Quality.

INTRODUCTION

The biodiversity of an aquatic environment encompasses both freshwater ecosystems as well as marine ecosystems (Sanjula *et al.* 2020). The utilization of biodiversity is common as it is an indicator that determines the health of biological diversity. Due to human activities like overfishing, pollution, and developmental activities, manhandling of streams, rivers and dams left the biodiversity of freshwater in a crisis state (Attah et al., 2023). Fish biodiversity in Rajasthan which is in the Northwestern region of India has few rivers (Kumar, 2017) with a diversity of various orders including Cypriniformes, Siluriformes, Perciformes, Osteoglossiformes, Synbranchiformes, Beloniformes and Clupeiformes (Banyal & Kumar, 2019) in Banas River system while (Banyal et al., 2019) found the orders Cypriniformes, Perciformes and Osteoglossiformes in Chambal Basin of West Banas River.

Water quality is the physical, chemical and biological characteristics of water. The chemistry of a water body is largely influenced by its temperature, pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), conductivity, depth and water velocity (Islam et al., 2022). Fish production depends on various factors, including temperature, turbidity, transparency, water colour, carbon dioxide, pH, alkalinity, hardness, ammonia, nitrite, and nitrate, primary productivity, biochemical oxygen demand (BOD), plankton population, and primary productivity (Verma et al., 2022), but the most important to be

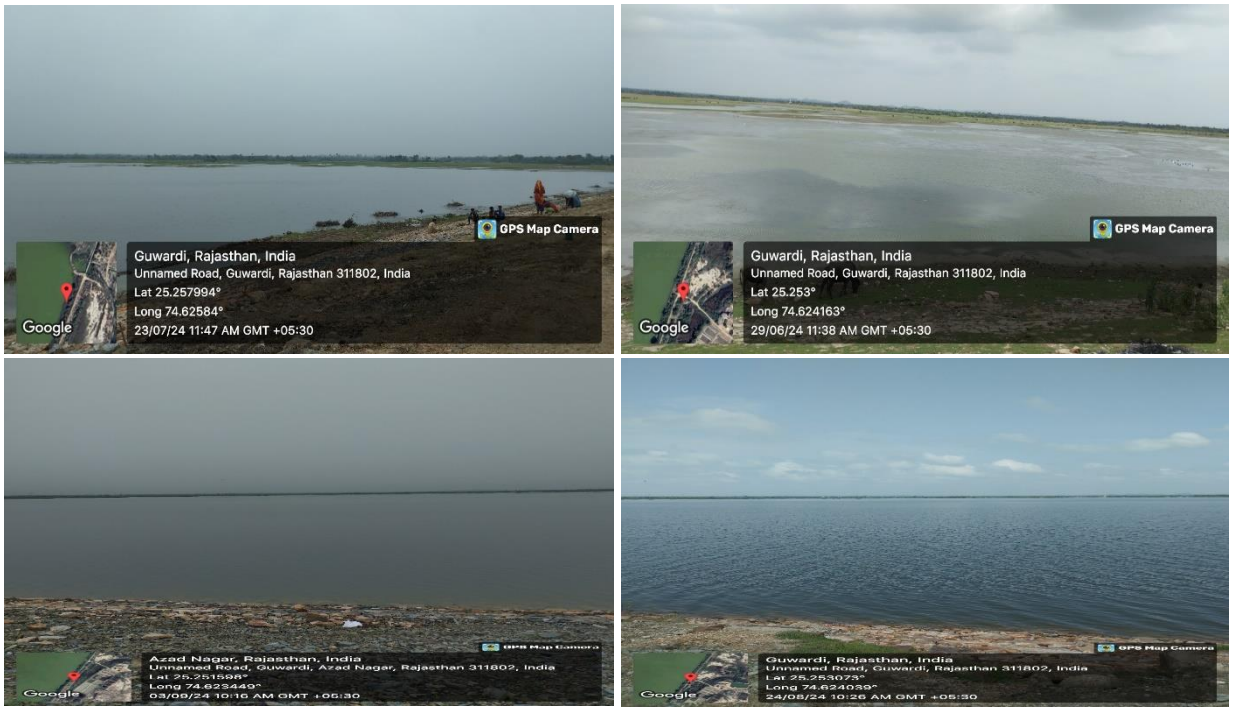
considered are pH, ammonia, nitrite, dissolved oxygen, temperature, total alkalinity, total hardness, and free carbon dioxide (Crosby et al., 2006). (Esteban, 2016) said that "Fish and the aquatic environment are strongly connected, and there is a lot of interest in how they interact. Knowledge on their water medium is necessary for understanding the anatomy of fish. The morphological, physiological, and ecological developments are controlled by water."

MATERIALS AND METHODS

STUDY AREA

The study area is Guwardi dam. It is located in Bhilwara district of Rajasthan. It is 16km from the city of Bhilwara with an approximate latitude of 25.3830°N and a longitude of 274.6410°E. It has a semi-arid climate with an undulating terrain. It was constructed primarily for irrigation, domestic and industrial use, and flood control in the region. The main source of water into the dam is rainfall and runoffs from surrounding areas. The dam is managed by the Office of Fisheries Development Officer, Bhilwara, Rajasthan.

Figure 1: The Study Area.



SAMPLE COLLECTION METHOD

WATER SAMPLE COLLECTION

The Dam was divided into four (4) different sites for collection of sample collection. Water samples were collected early in the morning between 8:00am to 10:30am twice in a month from July to August, 2024. Temperature (air and water) were measured on the field immediately after collection with the aid of a thermometer while the remaining parameters were measured using Standard Methods for the Examination of Water and Wastewater (SMEWW), American Public Health Association (APHA) and Environmental Protection Agency (EPA) in Mewar University Life Science Department.

Figure 2: The Sampling Sites of the Research

The water sample collected was analysed as using the methods in the table below.

Table 1: Methods Used in Sample Analysis

S/N	PARAMETERS (UNIT)	METHOD EMPLOYED
1	Temperature (°C)	Thermometric measurement
2	pH	Electrochemical measurement
3	Electrical Conductivity (µS/cm)	Electrochemical measurement
4	Total Dissolved Solids (TDS) (mg/L)	Electrochemical measurement
5	Carbonate Alkalinity (mg/L)	Titrimetric measurement
6	Bicarbonate Alkalinity (mg/L)	Titrimetric measurement
7	Total Alkalinity (mg/L)	Titrimetric measurement
8	Hardness (mg/L)	Titrimetric measurement
9	Dissolved Oxygen (mg/L)	Titrimetric measurement
10	Biological Oxygen Demand (mg/L)	Titrimetric measurement
11	Salinity (ppt)	Electrochemical measurement
12	Free CO_2 (mg/L)	Titrimetric measurement

FISH DIVERSITY DATA COLLECTION

The study period was from July to September 2024. The schedule for fish harvest on the dam started in mid-August and ended in December, but this year, the water level was too high, so the harvest was postponed to December 2024. The diversity of the fish in the dam was collected using questionnaires from the dam officials regarding previous harvests and their abundance.

RESULTS

Table 2: Water quality parameters from July to September 2024 at the Dam.

S/N	PARAMETERS	MINIMUM VALUE	MAXIMUM VALUE	MEAN VALUE	MEAN VALUE BY SITE			
					SITE A	SITE B	SITE C	SITE D
1	**Air Temperature (°C)**	26.7	34.9	30.4	31.07	30.67	30.53	29.43

2	**Water Temperature (°C)**	27.3	30.7	29.3	29.3	29.5	29.6	28.8
3	**pH**	8.35	9.94	9.0	8.95	9.09	9.12	8.86
4	**Electrical Conductivity (EC) (µS/cm)**	551	1289.7	762.19	808.57	780.73	765.4	718.04
5	**Total Dissolved Solids (TDS) (ppm)**	379	877.2	518.32	551.4	525.67	515.1	481.1
6	**Carbonate Alkalinity (mg/L)**	3.4	8	6.16	6.13	5.8	5.57	7.13
`7	**Bicarbonate Alkalinity (mg/L)**	75.1	126.2	97.16	107.87	92.17	83.2	105.4
8	**Total Alkalinity (mg/L)**	79.7	133.6	103.32	114	97.97	88.77	112.53
9	**Hardness (mg/L)**	57.65	176.76	78.48	104.14	68.18	75.17	66.42
10	**Dissolved Oxygen (mg/L)**	2.69	5.17	3.96	4.25	4.37	3.76	3.46
11	**Biological Oxygen Demand (mg/L)**	1.8	4.84	3.21	3.78	2.83	3.28	2.96
12	**Salinity (ppt)**	0.28	0.64	0.38	0.40	0.39	0.38	0.36
13	**Free CO_2 (mg/L)**	Absent		Absent	Absent	Absent	Absent	Absent

Table 3: Correlation of water quality parameters for July to September months analysed using Pearson Correlation Coefficient.

	AIR	**WATER**	**pH**	**EC**	**TDS**	**CA**	**BA**	**TA**	**TH**	**DO**	**BOD**	**SAL.**
AIR	1.000	0.768^{NS}	0.571^{NS}	0.986^{*}	0.976^{*}	-0.783^{NS}	-0.166^{NS}	-0.203^{NS}	0.696^{NS}	0.848^{NS}	0.599^{NS}	0.994^{**}
WATER	0.768^{NS}	1.000	0.958^{*}	0.654^{NS}	0.608^{NS}	-1.000^{**}	-0.759^{NS}	-0.783^{NS}	0.164^{NS}	0.575^{NS}	0.169^{NS}	0.693^{NS}

pH	0.571^{NS}	0.958*	1.000	0.437^{NS}	0.379^{NS}	-0.951*	-0.891^{NS}	-0.907^{NS}	-0.127^{NS}	0.456^{NS}	-0.113^{NS}	0.483^{NS}
EC	0.986*	0.654^{NS}	0.437^{NS}	1.000	0.998**	-0.672^{NS}	-0.003^{NS}	-0.042^{NS}	0.763^{NS}	0.876^{NS}	0.638^{NS}	0.999**
TDS	0.976*	0.608^{NS}	0.379^{NS}	0.998**	1.000	-0.628^{NS}	0.055^{NS}	0.017^{NS}	0.805^{NS}	0.855^{NS}	0.683^{NS}	0.993**
CA	-0.783^{NS}	-1.000**	-0.951*	-0.672^{NS}	-0.628^{NS}	1.000	0.743^{NS}	0.768^{NS}	-0.186^{NS}	-0.589^{NS}	-0.188^{NS}	-0.711^{NS}
BA	-0.166^{NS}	-0.759^{NS}	-0.891^{NS}	-0.003^{NS}	0.055^{NS}	0.743^{NS}	1.000	0.999**	0.448^{NS}	-0.014^{NS}	0.337^{NS}	-0.057^{NS}
TA	-0.203^{NS}	-0.783^{NS}	-0.907^{NS}	-0.042^{NS}	0.017^{NS}	0.768^{NS}	0.999**	1.000	0.418^{NS}	-0.047^{NS}	0.312^{NS}	-0.095^{NS}
TH	0.696^{NS}	0.164^{NS}	-0.127^{NS}	0.763^{NS}	0.805^{NS}	-0.186^{NS}	0.448^{NS}	0.418^{NS}	1.000	0.440^{NS}	0.960*	0.743^{NS}
DO	0.848^{NS}	0.575^{NS}	0.456^{NS}	0.876^{NS}	0.855^{NS}	-0.589^{NS}	-0.014^{NS}	-0.047^{NS}	0.440^{NS}	1.000	0.222^{NS}	0.870^{NS}
BOD	0.599^{NS}	0.169^{NS}	-0.113^{NS}	0.638^{NS}	0.683^{NS}	-0.188^{NS}	0.337^{NS}	0.312^{NS}	0.960*	0.222^{NS}	1.000	0.626^{NS}
SALINITY	0.994**	0.693^{NS}	0.483^{NS}	0.999**	0.993**	-0.711^{NS}	-0.057^{NS}	-0.095^{NS}	0.743^{NS}	0.870^{NS}	0.626^{NS}	1.000

NS : - Not Statistically Significant
*** :** - Moderately Statistically Significant
**** :** - Highly Statistically Significant

Table 4: Diversity of Fish at Guwardi Dam, Bhilwara.

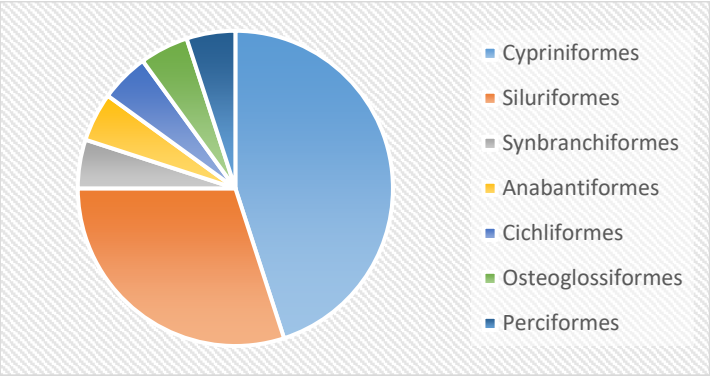
S/N	Scientific Name	Local Name	Family	Order	Feeding Habit	Economic Importance
1	*Labeo rohita* (Hamilton, 1822)	Rohu	Cyprinidae	Cypriniformes	H	F
2	*Cirrhinus mrigala* (Hamilton, 1822)	Mrigala			O	F

3	*Catla catla* (Hamilton, 1822)	Katal			H	F
4	*Hypophthalmichthys molitrix* (Valenciennes, 1844)	Silver Carp			H	F
5	*Rasbora daniconius* (Hamilton, 1822)	Chal			O	Or
6	*Ctenopharyngodon idella* (Valenciennes, 1844)	Grass Carp			H	F
7	*Puntius ticto* (Hamilton, 1822)	Puthi			O	F/Or
8	*Systomus sarana (Puntius sarana)* (Hamilton, 1822)	Sarana Barb/ Kharpata			O	F
9	*Puntius gonionotus* **(***Barbonymus gonionotus)* (Bleeker, 1849)	Silver Barb			O	Or
10	*Ompok bimaculatus* (Bloch, 1794)	Pabda	Siluridae	Siluriformes	C	F/Or
11	*Wallago attu* (Bloch & Schneider, 1801)	Lachi			C	F
12	*Clarias garapienus* (Burchell, 1822)	African Magur	Clariidae		C	F
13	*Clarias batrachus* (Linnaeus, 1758)	Mangur			C	F/Or
14	*Heteropneustes fossilis* (Bloch, 1794)	Shingi	Heteropneustidae		C	F/Or
15	*Mystus seenghala (Sperata seenghala)* (Sykes, 1839)	Shingala	Bagridae		C	F
16	*Mastacembelus armatus* (Lacépède, 1800)	Baam	Mastacembelidae	Synbranchiformes	C	F/Or
17	*Channa marulius* (Hamilton, 1822)	Shawal	Channidae	Anabantiformes	C	F/Or
18	*Oreochromis mossambicus*	Tilapia	Cichlidae	Cichliformes	O	Or

	(Peters, 1852)					
19	*Chitala chitala* (Hamilton, 1822)	Chetal	Notopteridae	Osteoglossiformes	C	F
20	*Chanda nama* (Hamilton, 1822)	Chalputhi	Ambassidae	Perciformes	C	F/Or

H = Herbivores, C = Carnivores, O = Omnivores, F = Food Fish, Or = Ornamental Fish

Figure 2: Abundance Relationship between Orders and Species.



DISCUSSION

The water quality parameters studied in this research were Temperature, pH, Total Dissolved Solids (TDS), Electrical Conductivity (EC), Salinity, Alkalinity, Hardness, Dissolved Oxygen (DO) and Chemical Oxygen Demand (COD). They varied monthly as weather factors like trade winds, periods of sunlight and sunlight absorption by shallow water bodies may be the reason for the monthly fluctuations and significant variations in the parameters observed across seasons (Mustapha, 2008).

Temperature of the water ranges between 27.3°C to 30.7°C which is between the standard acceptable and desirable range for carp culture (Santhosh & Singh, 2007; Bhatnagar & Devi, 2013) and as the water temperature increases, the air temperature 28.7°C – 34.9°C also increases which was presumed to be due to the shallowness of the dam. Similar results were seen in the work of (V. Sharma et al., 2012)(Dangi et al., 2017),(Nakul et al., 2018), (Kavindra et al., 2019), (Choudhary et al., 2021). The temperature of the dam from summer to monsoon is going downward, declining with decrease in air temperature. This shows a positive correlation between air temperature and water temperature.

The degree of hydrogen activity (pH) was from 8.35 – 9.94 which is all alkaline and slightly above the suitable range for fish culture i.e. 6.7 – 9.5 (Santhosh & Singh, 2007) and according to (Bhatnagar & Devi, 2013) the average blood pH of fish is 7.4 so for optimal growth the environment pH should be between 7.0 – 8.5. A pH of less than 4 or greater than 10.5 is lethal to fish while a pH of 9.0 to 10.5 is sub lethal to fish which can hinder its growth and productivity. similar to the study of (Araoye, 2009) (Tiseer et al., 2008) (Sahni & Yadav, 2012) (Majumder & Kumar Dutta, 2014). This can be attributed to low volume of water in the dam leads to reduced buffering capacity and high concentration of dissolved substances.

Electrical Conductivity (EC) ranges from 551-1,289.7µs/cm with the maximum value recorded at beginning of monsoon in July and minimum value at September. It is an indirect indication of pollution as it has close relationship with dissolved salts (Hassan et al., 2017). The acceptable range of electrical conductivity in freshwater according to Boyd 1979 is 50–1500 µs/cm which makes them within the acceptable range for freshwater. The high values at July can be attributed to the fact that the water levels

were low and the dam is surrounded by industries, so industrial effluents, domestic waste as Site D is close to the village discharged into the dam will surely increase the conductivity of the dam. Similar values were recorded by (Hassan et al., 2017), (Sudarshan et al., 2019).

Total Dissolved Solids (TDS) were in the range of 379 – 877 mg/L as $CaCO_3$ with the maximum in July and minimum in September. The acceptable range according to Environmental Protection Agency (EPA) is 500mg/L, it should not be above that but the World Health Organisation (WHO) said the acceptable range for drinking water should be between 300- 600mg/L. The values of the pre-monsoon period were high and not suitable for fish as it will cause stress in fish. (Chennakrishnan et al., 2008), (R. Sharma et al., 2011), (V. Sharma et al., 2012), (Choudhary et al., 2021), (Qureshi & Dube, 2021).

Total Hardness (TH) values ranged from 60.1 to 176.8mg/L with highest hardness in pre-monsoon in July. (Santhosh & Singh, 2007) reported that the ideal range of hardness for freshwater fish is between 30-180mg/L while Bhatnagar said hardness less than 20mg/L will cause stress to fishes, hardness of 75-150mg/L is optimal for fish growth and hardness greater than 300mg/L is lethal to fish because it leads to the non-availability of nutrients as it increases the pH of the water.

Total Alkalinity (TA) was found to be in the range of 79.7-138.6 mg/L as $CaCO_3$ with the highest recorded in July. The acceptable range of alkalinity in fresh water body is between 20-150mg/L according to Boyd and Lichtkoppler as it contains suitable CO_2 for the production of plankton needed by fish. The acceptable alkalinity range for fish culture is between 50-300 mg/L or ppm according to (Santhosh & Singh, 2007). Similar values were recorded by (N. Gupta et al., 2011), (B. K. Gupta et al., 2012), (Rana & Jain, 2017), (Kavindra et al., 2019). The total alkalinity is made up of Carbonate Alkalinity and Bicarbonate Alkalinity. Whenever carbonate alkalinity is present, Free CO_2 is absent (Kavindra et al., 2019).

Dissolved Oxygen (DO) ranged from 2.69 – 5.17mg/L with lowest value in July and highest value in September. According to Bhatnagar, DO value of less than 1mg/L is deadly to fish leading to death, while a DO less than 5mg/L but greater than 1mg/L will lead to fish growing slowly with a sluggish movement but can survive. A DO of greater than 5mg/L is desirable for fish but should not exceed 14mg/L.

Biological Oxygen Demand (BOD) ranged from 1.92-4.84mg/L with maximum value recorded in September and minimum value in July. Bhatnagar 2004, as cited by (Bhatnagar & Devi, 2013) reported that a BOD range of 3.0-6.0mg/L is optimal for fish, 6.0-12.0mg/L is sublethal while above 12.0mg/L is lethal to fishes. (Rana & Jain, 2017) reported similar BOD values.

The species collected from this study are 20 species belonging to 10 families and 7 orders. The dominant order being Cypriniformes with 1 family and seven (7) species followed by Siluriformes with 4 families and 6 species while the rest of are Synbranchiformes, Anabantiformes, Cichliformes, Osteoglossiformes, Perciformes, each with 1 family and 1 species. Out of these, species diversity based on family has the family Cyprinidae to be most dominant with 9 species, Siluridae with 2 species, Clariidae with 2 species, Heteropneustidae with 1 species, Bagridae with 1 species, Mastacembelidae with 1 species, Channidae with 1 species, Cichlidae with 1 species, Notopteridae with 1 species and Ambassidae with 1 species.

The most dominant species in the dam is the *Labeo rohita* (Rohu) as its larvae in millions is deposited every breeding season into the dam. This is followed by the Indian Major Carps (IMC) which are *Catla catla* (Katal) and *Cirrhinus mrigala* (Mrigala). Among the identified fishes are native species of India and exotic species which were introduced into India. According to (Sarkar et al., 2012) *Clarias garapienus, Oreochromis mossambicus*, *Hypophthalmichthys molitrix, Ctenopharyngodon idella* were reported as exotic species. They compete with native species as some are predacious or by competing for same resources.

Similar diversity reports were reported in Rajasthani waters by (R. Sharma et al., 2011), (Sisodiya et al., 2018), (Banyal & Kumar, 2019), (Jain et al., 2019) with the order Cypriniformes being the most dominant and the family Cyprinidae also the most dominant followed by the order Siluriformes. The major carps i.e the cypriniformes are most dominant in India, hence called the Indian Major Carps (IMC). This is evident from study of (Khobragade, 2016), (Ubarhande et al., 2016), (Kumbhar et al., 2018) (Patode et al., 2021) in Maharshtra India, (Muniya et al., 2019) in Gujrat, (Mogalekar et al., 2017) in West Bengal, (Pathak & Lavudya, 2021) in Madhya Pradesh, (Mishra et al., 2021) in UP, (Swarnkar et al., 2020) in Chhattisgarh and many more studies in India. The second most dominant is mostly Siluriformes or Perciformes.

FACTORS THAT AFFECT THE QUALITY OF GUWARDI DAM WATER

The factors affecting the water quality at Guwardi dam are anthropogenic activities which are generally of two (2) types, Domestic and Industrial effluents discharge. Domestic pollution from gutter that left Bhilwara City into the dam that has latrine discharge and also from the college behind the water body. Then secondly industrial pollution from thermal discharge of untreated water from various factories into the dam. These are the main source of water contamination in the dam according to the dam officials. Also they noted that no pollution as a result of agricultural runoffs.

REFRENCES

1. Araoye, P. A. (2009). The seasonal variation of pH and dissolved oxygen (DO) concentration in Asa lake Ilorin, Nigeria. International Journal of Physical Sciences, 4(5), 271–274.
2. Attah, T. C., Isyaku, B. U., Abdul-Azeez, H., & Olem, S. Y. (2023). Fish biodiversity and abundance of Thomas Dam, Danbatta Local Government Area of Kano State, Nigeria. Biological and Environmental Sciences Journal for the Tropics, 20(2), 77–85. https://doi.org/10.4314/bestj.v20i2.10
3. Banyal, H. S., & Kumar, S. (2017). A List of the Fish fauna in Thar Desert of Rajasthan (p. 4).
4. Banyal, H. S., & Kumar, S. (2019). Studies on fish diversity of the Mahi River , Rajasthan State. Records of the Zoological Survey of India, 119(1), 1–8. https://doi.org/10.26515/rzsi/v119/i1/2019/141307
5. Banyal, H. S., Kumar, S., & Raina, R. H. (2019). Exploration of Fish Diversity in the West Banas River , Banaskantha , Gujarat. Records of the Zoological Survey of India, 119(3), 282–288. https://doi.org/10.26515/rzsi/v119/i3/2019/132333
6. Bhatnagar, A., & Devi, P. (2013). Water quality guidelines for the management of pond fish culture. International Journal of Environmental Sciences, 3(6), 1980–2009. https://doi.org/10.6088/ijes.2013030600019
7. Chennakrishnan, C., Stephen, A., Manju, T., & Raveen, R. (2008). Water Quality Status of Three Vulnerable Freshwater Lakes of Suburban Chennai , India. 15(3), 591–596.
8. Choudhary, S., Sharma, S. K., Sharma, B. K., & Upadhyay, B. (2021). Water Quality Analysis of Anasagar Lake, Ajmer, Rajasthan. Asian Journal of Advances in Research, 4(1), 13–20.
9. Crosby, T. C., Hill, J. E., Martinez, C. V., Watson, C. A., & Yanong, R. P. (2006). On-Farm Transport of Ornamental Fish. Edis, 2006(33). https://doi.org/10.32473/edis-fa119-2006
10. Dangi, P. L., Lal, D. P., & Bk, S. (2017). Water quality status of Lake Pichhola, Udaipur, Rajasthan. 181 ~ International Journal of Fisheries and Aquatic Studies, 5(3), 181–187. www.fisheriesjournal.com
11. Esteban, M. A. (2016). Welcome to the new journal Fishes. Fishes, 1(1), 16–17.

https://doi.org/10.3390/fishes1010016
12. Gupta, B. K., Sarkar, U. K., & Bhardwaj, S. K. (2012). Assessment of habitat quality with relation to fish assemblages in an impacted river of the Ganges basin, northern India. Environmentalist, 32(1), 35–47. https://doi.org/10.1007/s10669-011-9363-4
13. Gupta, N., Nafees, S. M., Jain, M. K., & Kalpana, S. (2011). Physico-chemical assessment of water quality of river Chambal in Kota city area of Rajasthan state (India). Rasayan Journal of Chemistry, 4(3), 686–692.
14. Hassan, T., Parveen, S., Bhat, B. N., & Ahmad, U. (2017). Seasonal Variations in Water Quality Parameters of River Yamuna, India. International Journal of Current Microbiology and Applied Sciences, 6(5), 694–712. https://doi.org/10.20546/ijcmas.2017.605.079
15. Islam, M., Hossain, A., & Mandal, S. (2022). Impacts of Water Quality on Finfish and Shellfish Biodiversity in the River Meghna. Dhaka University Journal of Biological Sciences, 31(1), 19–27. https://doi.org/10.3329/dujbs.v31i1.57913
16. Jain, A., Surnar, S., Abhinika Jain, C., Saini, V., & Ojha, M. (2019). Biodiversity of indigenous ornamental fish in Wakl river system of Southern Rajasthan. ~ 293 ~ Journal of Entomology and Zoology Studies, 7(4), 293–298.
17. Kavindra, J., Sharma, S. K., Sharma, B. K., & Ojha, M. L. (2019). Physico-chemical properties and primary productivity of Jawai dam, Pali, Rajasthan. Journal of Entomology and Zoology Studies, 7(4), 865–868.
18. Khobragade, B. (2016). Ichthyofaunal diversity at the confluence of. 4(2), 511–516.
19. Kumbhar, D. S., Shaikh, S. A., & Mhaske, D. K. (2018). FISH FAUNAL DIVERSITY OF BHIMA RIVER AT PEDGAON , SHRIGONDA (AHMEDNAGAR DISTRICT). 6(2), 298–305.
20. Majumder, S., & Kumar Dutta, T. (2014). Studies on seasonal variations in physico-chemical parameters in Bankura segment of the Dwarakeshwar River (W.B.) India. International Journal of Advanced Research, 2(3), 877–881. http://www.journalijar.com
21. Mishra, S. P., Pradesh, U., & Mishra, D. B. (2021). Diversity of Fresh Water Fishes and their Conservation Status in Eastern Uttar Diversity of Fresh Water Fishes and their Conservation Status in Eastern Uttar Pradesh , India. August. https://doi.org/10.46501/IJMTST0708014
22. Mogalekar, H., Canciyal, J., Ansar, C., Bhakta, D., Kumar Gopalgaon, D., Nagar, S., Mogalekar, C. H., Biswas, I., & Kumar, D. (2017). Freshwater fish diversity of West Bengal. Journal of Entomology and Zoology Studies JEZS, 5(52), 37–45.
23. Muniya, T., Kardani, H., Gohel, K., Joshi, A., & Vadher, P. (2019). Ichthyofaunal diversity of the Kadana reservoir in Mahisagar district, Gujarat, India. ~ 20 ~ Journal of Entomology and Zoology Studies, 7(6), 20–25. http://www.entomoljournal.com
24. Mustapha, M. K. (2008). Assessment of the Water Quality of Oyun Reservoir , Offa , Nigeria , Using Selected Physico-Chemical Parameters Assessment of the Water Quality of Oyun Reservoir , Offa , Nigeria , Using Selected Physico-Chemical Parameters. April.
25. Nakul, D. B., Singh, E., & Pr, T. (2018). Studies on the fish and phytoplankton biodiversity with relationship to primary productivity of the. 6(5), 1888–1893.
26. Pathak, S., & Lavudya, N. (2021). Diversity of freshwater fish in Narmada River, Madhya Pradesh. ~ 704 ~ Journal of Entomology and Zoology Studies, 9(2), 704–709. http://www.entomoljournal.com
27. Patode, P. S., Salve, B. S., & Pawar, R. T. (2021). ICHTHYOFAUNAL DIVERSITY AND CONSERVATION STATUS OF SIDDHESHWAR RESERVOIR DISTRICT HINGOLI ,

MAHARASHTRA , INDIA. December. https://doi.org/10.55126/ijzab.2021.v06.i06.031
28. Rana, N., & Jain, S. (2017). Assessment of physico - chemical parameters of freshwater ponds of district Bijnor (U. P), India. Journal of Entomology and Zoology Studies, 5(April), 524–528. https://www.semanticscholar.org/paper/90d64004a72814ccadf14bb56938a8ca202d2151
29. Sahni, K., & Yadav, S. (2012). Seasonal Variations in Physico-Chemical Parameters of Bharawas Pond, Rewari, Haryana. Asian J. Exp. Sci., Vol. 26, No. 1, 2012; 61-64.
30. Santhosh, B., & Singh, G. (2007). Guidelines for water quality management for fish culture in Tripura. Publication No. 27. Santhosh, B. and Singh, N.P. 2007.ICAR Research Complex for NEH Region, Tripura Centre, Lembucherra, West Tripura, 799210, India. 10pp. 27.
31. Sarkar, U. K., Pathak, A. K., Sinha, R. K., Sivakumar, K., Pandian, A. K., Pandey, A., Dubey, V. K., & Lakra, W. S. (2012). Freshwater fish biodiversity in the River Ganga (India): Changing pattern, threats and conservation perspectives. Reviews in Fish Biology and Fisheries, 22(1), 251–272. https://doi.org/10.1007/s11160-011-9218-6
32. Sharma, R., Sharma, V., Sharma, M. S., Verma, B. K., Modi, R., & Gaur, K. S. (2011). Studies on Limnological Characteristic, Planktonic Diversity and Fishes (Species) in Lake Pichhola, Udaipur, Rajasthan (India). Universal Journal of Environmental Research and Technology, 1(3), 274–285.
33. Sharma, V., Verma, B. K., & Sharma, M. S. (2012). Zooplanktonic Fauna in Relation to Physico-Chemical Characteristics in Madar Tank, Udaipur, Rajasthan, India. International Research Journal of Environment Sciences, 1(3), 5–10.
34. Sisodiya, M. K., Choudhary, L., & Bhardhwaj, S. (2018). Fish diversity in relation to physico-chemical characteristics of Haro Reservoir of Ghatol , Banswara (Rajasthan). 6(4), 199–202.
35. Sudarshan, P., K., M. M., & V., R. T. (2019). Assessment of Seasonal Variation in Water Quality and Water Quality Index of Tattekere Lake, Bangalore, India. Environment and Ecology, November. https://doi.org/10.53555/nveo.v8i3.5701
36. Swarnkar, S., Niyazi, A., Sahu, D., & Singh, J. (2020). FISH BIODIVERSITY STUDY OF GHONGHA DAM IN BILASPUR DISTRICT , FISH BIODIVERSITY STUDY OF GHONGHA DAM IN BILASPUR DISTRICT ,. May.`
37. Tiseer, F. A., Tanimu, Y., & Chia, A. M. (2008). Seasonal Occurrence of Algae and Physicochemical Parameters of Samaru Stream, Zaria, Nigeria*. Asian Journal of Earth Sciences, 2(3), 101–107. https://doi.org/10.3923/ajes.2009.101.107
38. Ubarhande, S. B., Barote, R. V, & Adhale, S. B. (2016). Ichthyofaunal diversity from Khadakpurna dam , district Buldhana , Maharashtra , India. 4(3), 362–366.
39. Verma, D. K., Maurya, N. K., & Kumar, P. (2022). Important Water Quality Parameters in Aquaculture : An Overview Important Water Quality Parameters in Aquaculture : An Overview. Agriculture and Environment, 3(March), 24–29.