

AN ASSESSMENT OF WATER QUALITY AND PLANKTON DIVERSITY IN BAUR RESERVOIR GULARBHOJ, U.S NAGAR UTTARAKHAND (INDIA)

Original research Article

Abstract

The current investigation was conducted between January and December of 2022. During the study period water quality was studied in Baur reservoirs two spot, one spot is a barrage area, and the second one is four kilometers away from the first one. The present study is done in Baur Reservoir, which is switched to Gularbhoj in Udham Singh district. Reservoir water is used for irrigation and domestic purposes. Many villages are located near the reservoir, so due to human interaction, water quality may be affected. For this reason, the present study finds parameters of water so we can identify the present water quality status, as we know many similar work done all over India but in this study we find present condition which may be change from past condition and as we know climatic condition are change now days so we can find rainfall in every month and other parameters of reservoir. Various quality parameters are measured, including P^H, water temperature, DO, CO₂, total alkalinity, total solid, turbidity, total suspended solids and total dissolved solids. All the parameters are within the permissible limit and suitable for domestic use, pisciculture, and agriculture. Water quality parameters have been observed to vary and, with the exception of temperature, all show a positive correlation with the production of phytoplankton and zooplankton in the chosen reservoirs. These parameters include temperature, pH, dissolved oxygen, carbon dioxide, and total dissolved solids. The temperature varies from 24⁰c± 6⁰c, the pH varies from 7.0 ± 2, the dissolved oxygen range varies from 7± 3, range of carbon dioxide varies from 6± 5, the humidity range is 50±25, and rainfall throughout varying the all study period. All the physico-chemical parameters are the relation to plankton diversity. In this study, we also find plankton diversity status in Baur reservoir. Plankton diversity can also help to find out the water quality; healthy plankton growth may relate to water quality as well as fish diversity. In the following study, we find the groups Copepoda, Clyadocera, and Rotifera, each containing 6, 6 and 2 respectively. The groups Bacillariophyceae and Chlorophyceae each contain 29 and 23, respectively, phytoplankton taxa. The study looked at the association between group variation in physico-chemical parameters for the Cyanophyceae, Dinophyceae, and Euglenophyceae. With the help of this study, we can find the pollutant status and water quality level in the Baur reservoir. All the water quality parameters are under safety level and are good for irrigation purposes and for domestic use. They can filtrate, and may relevant department may take action for tourist activity that causes pollution in reservoir water.

Key words: Parameters, Baur, Pisciculture, Water quality and Turbidity.

1. Introduction

Water is essential for life; we cannot expect life without it. Approximately 97% of the water on Earth is saltwater, while less than 3% is fresh water. The majority of the freshwater on Earth is frozen in ice caps, glaciers, or aquifers deep below the surface in the shape of lakes, ponds, rivers, and reservoirs. There are several different types of freshwater resources in India. Testing the water for physico-chemical properties is crucial before using it for home, industrial, agricultural, or drinking purposes. It is necessary to examine water using

many physico-chemical characteristics [1, 2, 3, and 4]. Because they facilitate the growth of the industrial, agricultural, and urban sectors, provide electricity, and supply water for irrigation and human use, reservoirs are important for human societies on both a social and economic level [5]. In Uttarakhand State, the experimental reservoirs constructed for irrigation during the post-independence era are a significant source of fish production [6,7and8]. Biological diversity and the physical-chemical characteristics of the water are critical to the upkeep of a healthy aquatic ecosystem. The biotic community structure, which includes species pattern, distribution, and diversity, reflects changes in the tropical conditions of the water and can be used to determine the effects of pollution on water quality. Primary and secondary production are directly correlated with the physico-chemical properties, specifically water temperature, pH, dissolved oxygen, clarity, and total dissolved solids [9and 10]. The primary uses of these reservoirs are for fishing, agriculture, and the production of hydroelectric power. [11, 41-44].The present study is about the physico-chemical and plankton diversity of the Baur reservoir. Baur reservoir is situated in Gularbhoj village in the Gadarpur Block of Udham Singh Nagar district and is fed by the Baur and Kakarata rivers. The total catchment of the reservoirs is 605 square kilometers. The water holding capacity of these reservoirs is 3650 million cubic feet. The total volume content of the dam (TCM) is 8252. Work on this reservoir began in year 1966-67. Its catchment area mainly comprises Tarai and Bhabar, which are spread over an area of 307.2km².The dam morphometry, comprises a length of 9.50km and a maximum height of 17.98meters, with a vast expanse of 1271.00 hectares. The reservoir receives an average annual precipitation of 1645mm, with normal monsoons accounting for 1500mm, which could sometimes go as low as 547mm (Uttarakhand irrigation department). The average water level in the reservoir from October to May is approximately 786.5ft. There are approximately nine villages located around the periphery of this reservoir. The dam is an irrigation dam, and its water irrigates the Tarai area of Uttarakhand.

Due to their brief life cycles, plankton, which is minute organisms that float with water currents, respond swiftly to environmental changes. The diversity and biomass of the plankton population may be impacted by any unfavorable changes in aquatic habitats. Plankton, based on their capacity to perform certain tasks, phytoplankton and zooplankton are separated into two types' synthesis of photons. The minuscule, free-swimming, microscopic consumers of the aquatic ecosystem are called zooplankton. Zooplankton plays an important role in secondary production and takes up an in-between space. By moving energy from lower trophic levels to higher trophic levels, an organism can reach a position in the food chain. In freshwater ecosystems, zooplankton serves as a crucial link in the aquatic food chain [12]. According to Pravin and Archana [13], physico-chemical factors play an important role in maintaining plankton levels in aquatic systems.

2. MATERIAL AND METHODS

The water samples have been collected from two selected sampling stations (spot1 and spot 2), where spot 1 is four kilometers away from spot 2. Monthly and seasonal samples have been collected from selected stations of the dam for one year, January to December 2022. The samples from surface water were taken directly in polyethylene bottles, while the bottom samples were collected using a Nansen bottle. The temperature was recorded at the time of sampling on the spot using a centigrade thermometer. The water transparency was measured by a secchi disk, pH was measured with a standard pH meter, and DO, free CO₂, alkalinity, and hardness were determined by the procedures of APHA 1995 [14]. Some of the parameters were recorded at sampling sites, and other was analyzed in the laboratory. 50 liters of water from each of the investigation's two habitats—fluvial and stagnant—were used to filter the plankton samples. Before being analyzed in the lab, the concentration was transferred using a plankton net made of bolting silk number 25 to microscopic specimen tubes, where it was kept in 4% Lugol's iodine solution for phytoplankton and 5% formalin for zooplankton, respectively. For each sample, the measurements were made in triplicate.

To measure zooplankton, the Sedgwick Rafter counting cell was employed, and the population size was calculated using the given methodology after being counted in accordance with industry standards [16]. Under a powerful digital microscope, plankton samples were examined (Motic, China).

3. Result

The rainfall in Baur Reservoir recorded during study time varied from 5 mm to 54mm. In November and December, there was no rainfall recorded. The maximum rainfall was recorded at 54mm in month of July, and minimum rainfall was recorded in May, which is 5 mm (fig.1). The humidity value was 45% to 80% higher humidity was recorded in summer and monsoon seasons and lower value of humidity was observed during the winter seasons (fig 1). The water temperature varies from 18^oc to 32^oc in spot 1 and 20^oc to 34^oc in spot 2 respectively. The maximum water temperature was recorded in the month of August, which is 32^oc and minimum water temperature was recorded in the month of January, which is 18^oc in spot 1 and 20^oc spot 2. The study's findings support those of [17, 18] who discovered that summertime temperatures were greater than wintertime ones. Low temperatures throughout the winter may be brought on by chilly air, greater water levels, and less solar radiation, but consistent temperature rises during the summer may be brought on by a clear sky, lower water levels, a longer photoperiod, and more solar radiation. According to research by Verma [19], reservoirs in the Tarai region of Uttarakhand State often see average water temperatures above 20^oc, providing a favorable habitat for the development and survival of tropical fish. During the study period the p^H range varied from 6.8 to 9.0 in spot 1 and 6.8 to 8.4 in spot 2, respectively shown in fig 1. The lowest p^H range was recorded at 6.6 and 6.8 in the months of July and November in spots 1 and 2 respectively. The highest p^H was recorded in the months of January and March, which were 8.2 and 8.4 in spot 1 and 2 respectively. The reservoir water remains Alkaline during most part of the year. The value of alkalinity was varied from recorded during the month of May, June, July and August in spot 1 and 2, which is varied from 100 ± 10 mg/l and 94 ± 10 mg/l in spots 1 and 2, respectively . The highest alkalinity was recorded in the summer month. According to Sharma et.al. [20 and 21] the lowest value of alkalinity was recorded in summer month, and the highest value of alkalinity was recorded in winter month. The minimum value of hardness was recorded in February at 78mg/l and 74mg/l in spots 1 and 2 respectively and the maximum value of hardness was observed in May at 120mg/l and 115mg/l in spots 1 and 2, respectively denoted in. According to [22, 23 and 24], the increased value observed in summer and monsoon may be due to higher temperatures which may increase the concentration of salt by excess evaporation. The surface water of the reservoir is oxygenated for the majority of the year.

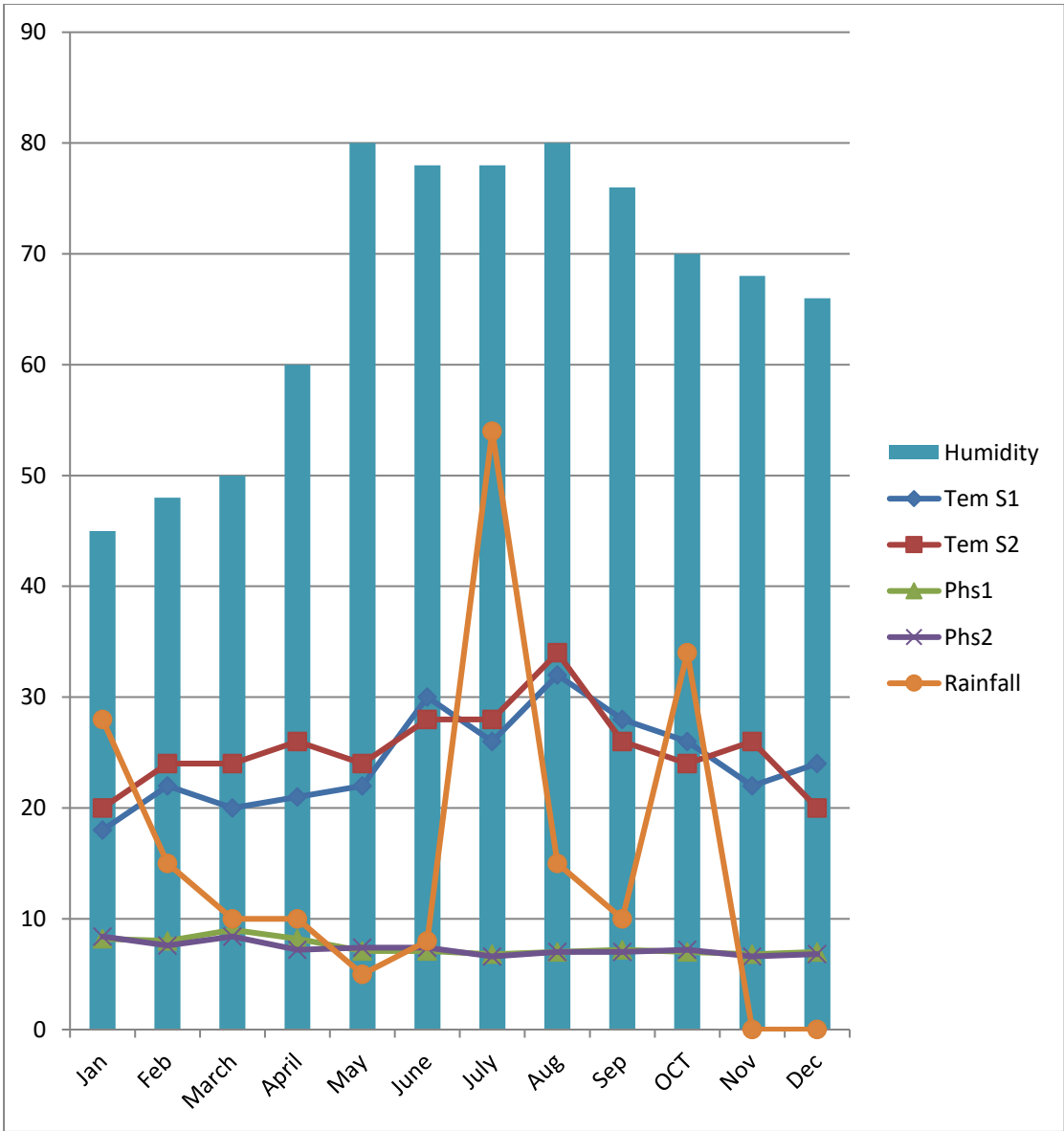


Fig 1. Monthly variation in physico-chemical parameter in spot 1 and 2 in Baur Reservoir (January 2022 – December 2022)

Table1 Monthly variation of Physico-chemical parameters of Baur Reservoir (January to December 2022).

Months	Temp.		Ph		DO		Co ₂		T.D. Solid		Humidity	Rainfall	Hardness		Alkalinity	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2			S1	S2	S1	S2
Jan	18	20	8.2	8.4	9.2	9.0	10.0	9.6	120	130	45	28	88	84	150	160
Feb	22	24	8.0	7.6	8.8	9.2	12.0	12.2	140	110	48	15	86	82	130	140
March	20	24	9	8.4	6.2	7.1	7.2	9.0	122	130	50	10	96	88	130	120
April	21	26	8.2	7.2	7.8	8.4	6.1	7.0	120	125	60	10	100	94	118	110
May	22	24	7.1	7.4	8.2	8.6	7.0	7.2	132	136	80	5	120	115	110	115
June	30	28	7.1	7.4	8.1	7.8	8.4	7.2	140	140	78	8	115	120	100	96
July	26	28	6.8	6.6	9.8	9.6	8.4	8.2	132	135	78	54	110	115	105	100
Aug	32	34	7.0	7.0	8.4	7.2	7.1	6.8	145	146	80	15	100	98	100	94
Sep	28	26	7.2	7.0	7.8	7.2	6.1	7.0	114	128	76	10	98	96	110	100
Oct	26	24	7.0	7.2	7.0	7.4	6.2	7.4	116	126	70	34	105	98	115	105
Nov	22	26	6.8	6.6	8.0	7.8	7.6	6.8	112	122	68	-----	98	104	115	110
Dec	24	20	7.0	6.8	7.6	7.4	6.0	6.2	106	110	66	-----	96	98	120	115

	Temp.	pH	DO	Co ₂	T.D. Solid	Humidity	Rainfall	Hardness	Alkalinity
SD	3.94	0.64	0.89	1.70	11.58	12.92	17.22	11.0006	16.38
Mean	24.79	6.94	8.05	7.88	126.54	66.58	9.65	99.33	115.78

3.1 Phytoplankton population

The phytoplanktonic community composition of the research period's Baur reservoirs is shown in Table 2. In Baur Reservoir, phytoplankton belonging to 29 different taxa was discovered, with Bacillariophyceae and Chlorophyceae accounting for the majority of these taxa. Among these genera are Bacillariophyceae, which includes Dinophyceae, 10, Cyanophyceae, 2, Euglenophyceae 1, and 15, Chlorophyceae. The observed phytoplankton was depicted by class, and the Bacillariophyceae (49%) were dominating in terms of phytoplankton diversity. Chlorophyceae (32%), Euglenophyceae (11%), Cyanophyceae (10%), and Dinophyceae (21%), in that sequence. The eutrophic status of the ecosystem was demonstrated in the current study by the presence of *Nitzschia* sp., *Naviculla* sp., *Euglena* sp., *Chymbella* sp., *Gomphonima* sp., and *Oscillatoria* sp. at both reservoir sites [7, 25, and 26]. The Chlorophyceae were the next important group, and according to Kadam et al. [27], they can live in situations with high temperatures, pH levels, and DO. The Baur Reservoir was discovered to have a higher concentration of green algae, which may be related to the reservoir's higher temperature and dissolved oxygen levels. Karthi et al. [28] found 32 phytoplankton species in Lake Vaduvar, including 15 species from each of the families Bacillariophyceae, Chlorophyceae, and Cyanophyceae. According to Sharma [15] research, diatoms comprised 40.31% of the phytoplankton in the Tighra Reservoir near Gwalior. Gadag et al. [29] claim that *Oscillatoria* sp. is a biological contaminant and an indicator of nutrient excess in water bodies [30]. In cold settings, diatoms have been seen to flourish [31 and 32]. However, it has been seen that blue-green algae diversity increases as temperature and DO rise [33], demonstrating the biological burden that all aquatic systems bear. The phytoplankton density in the Baur Reservoir peaked in April (29,000 cells l-1) and declined in September (12,000 cells l-1), based on the usual pattern. At 23,775 x 7,982.436 cells l-1, Site S2 had the highest average phytoplankton density, followed by Site S1(20,125 x 7,019.107 cells l-1). Site S1 had a lower concentration of phytoplankton. With regard to pH, TDS, DO, and zooplankton, there was a positive correlation in the density of phytoplankton. Researchers found a negative correlation between air pressure and water temperature.

Table2. Qualitative composition of phytoplankton (January to December2022).

Class	Species	Spot-1	Spot-2
Bacillariophyceae	<i>Nitzschia</i> sp.	++	+
	<i>Achnanthes</i> sp.	+	++
	<i>Navicula</i> sp.	+++	-
	<i>Amphora</i> sp.	-	+
	<i>Gomphonema</i> sp.	++	+
	<i>Synedra</i> sp.	+	++
	<i>Gyrosigma</i> sp.	-	+
	<i>Fragillaria</i> sp.	+++	-
	<i>Caloneis</i> sp.	++	++
	<i>Epithemia</i> sp.	-	++
	<i>Pinnularia</i> sp.	+	+
	<i>Rhopalodia</i> sp.	++	+++
	<i>Denticula</i> sp.	-	++
	<i>Cymbella</i> sp.	+	+
	<i>Amphipleura</i> sp.	+	++
Chlorophyceae	<i>Chlorococcus</i> sp.	+++	+
	<i>Cosmarium</i> sp.	++	-
	<i>Spirogyra</i> sp.	+	++
	<i>Hyalotheca</i> sp.	-	++
	<i>Mougeotia</i> sp.	+	-
	<i>Zygnema</i> sp.	++	++
	<i>Scenedesmus</i> sp.	-	+

	<i>Rhizoclonium sp.</i>	++	-
	<i>Ulothrix sp.</i>	++	+
	<i>Ankistrodesmus sp.</i>	+++	+
<i>Cyanophyceae</i>	<i>Oscillatoria sp.</i>	++	+
	<i>Microcystis sp.</i>	+++	+
<i>Euglenophyceae</i>	<i>Euglena sp.</i>	++	++
<i>Dinoophyceae</i>	<i>Ceratium sp.</i>	++	++

(-, +, ++, +++ as mentioned in Table 3)

3.2 Zooplankton population

Table 3 displays the zooplankton composition of the Baur reservoir during the course of the investigation. 14 genera of zooplankton from three distinct families, including Clyadocera (7 genera), Copepoda (5 genera), and Rotifera (2 genera), are found in the Baur Reservoir. When the observed zooplankton composition was represented by class, Cladocera (52%) and Copepoda (34%) made up the majority of the donors, followed by Rotifera (14%), in terms of diversity. The reservoir frequently contained members of the zooplankton genera *Moina sp.*, *Ceriodaphnia sp.*, *Brachionus sp.*, *Chydorus sp.*, and *Mesocyclops sp.* Cladocerans make roughly 36% of the Kaliasote Reservoir's makeup, according to [33and8]. The reservoir frequently contained members of the zooplankton genera *Moina sp.*, *Ceriodaphnia sp.*, *Brachionus sp.*, *Chydorus sp.*, and *Mesocyclops sp.* In the Madhya Pradesh Lony Dam, [16] found 29 species of zooplankton at a moderate density. Cladocerans make roughly 36% of the Kaliasote Reservoir's makeup, according to Dubey et al. [34]. A related investigation into some biotic elements in the Nanak Sagar reservoir was done by Joshi and Tripathi [35].

Over the course of the two-year investigation, they detected 14 distinct genera and species of zooplankton (rotifera and crustaceans), but no genera/species of protozoa. *Mesocyclops sp.* and *Diaptomus sp.* are indicators of organic contamination in the streams, according to Rajagopal et al. [35]. Rotifers prefer alkaline settings, and Ana et al. [37] claim that this abundance indicates eutrophication. This pattern was also observed in the Baur Reservoir, where the zooplankton population increased (3,400 individuals l-1) in November but fell (1,500 individuals l-1) throughout the month. The average density of zooplankton at sites S1 and S2 was 2,575677.706 and 2,325575.077 individual's l-1, respectively. It was discovered that zooplankton negatively correlated with temperature and positively correlated with phytoplankton, pH, DO, and TDS. The results of the ANOVA (p 0.05) indicated that there were significant differences in zooplankton density between the chosen sites. According to Manickam et al. [38], the zooplankton population rose during the summer and fell during the monsoon season. Researchers [39,40] report that there was a lot of turbidity, little light, and a black sky. all result in a decrease in zooplankton diversity. The overall zooplankton density may have increased over the summer, according to Manickam et al. [38], because of steady limnological conditions and high primary producer standing crops that improve the availability of food.

Table3 .Qualitative composition of zooplankton in year January.2022- December2022

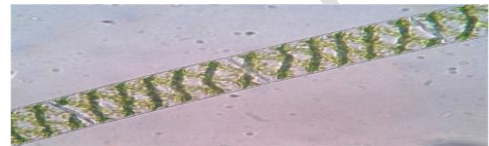
Class	Species	Spot-1	Spot- 2
Copepoda	<i>Cyclops sp.</i>	++	++
	<i>Eucyclops sp.</i>	++	-
	<i>Mesocyclops sp.</i>	++	+
	<i>Diaptomus sp.</i>	++	+
	<i>Nauplius larva</i>	++	+
Clyadocera	<i>Daphnia sp.</i>	++	-
	<i>Chydorus sp.</i>	++	-
	<i>Alona sp</i>	++	++
	<i>Bosmina sp</i>	++	-

	<i>Diaphanosoma sp.</i>	-	+
	<i>Ceriodaphania sp.</i>	++	++
	<i>Monia sp.</i>	++	+
Rotifer	<i>Brachionus sp.</i>	++	+
	<i>Notholca sp.</i>	++	-

- = Absence, + = Rare, ++ = Presence, +++ = Abundance.



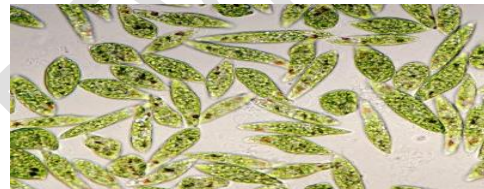
Gyrosigma sp.



Spirogyra sp.



Nitzschia sp.



Euglina sp.

Fig 2. Microscopic image of some Phytoplankton



Cyclops sp.



Diaptomus sp.

Fig 3. Microscopic image of Zooplankton

4. Discussion

The results of this investigation demonstrated that these water bodies' limnological features are favorable for the greatest development of phytoplankton and zooplankton. These two spot of this reservoir are highly interfered by human, so we can say the parameters of these spot with respect to reservoir. It has been shown that the limnological features influence the architectures of phytoplankton and zooplankton. There is some variation in the zooplankton and phytoplankton population structure depending on the limnological features of the chosen environments. In April, the Barrage area site had the highest phytoplankton concentration, whereas in November, the same site had the highest zooplankton density. Numerous phytoplankton and zooplankton

pollution indicator species, along with the limnological characteristics of these water bodies, show that organic pollution has an impact on the water in the Baur reservoir. This impact can be lessened by employing appropriate management practices, such as balancing food webs. All the physico-chemical parameters shows that reservoir water can be used for irrigation purposes and with only two spots we can say this because these areas of this reservoir are mostly interrupted by humans, especially spot 1. With the help of this study, we can find the present status of reservoir water.

5 . Conclusion

The investigation conducted between January 2022 to December 2022 assessed the water quality of the Baur Reservoir, which is used for irrigation and domestic purposes, in Udham Singh District. Water quality was evaluated at two spots, one near a barrage and the other four kilometers away. Various parameters, including pH, temperature, dissolved oxygen (DO), carbon dioxide (CO₂), total alkalinity, total solids, turbidity, total suspended solids, and total dissolved solids, were measured. The study found all parameters within permissible limits, suitable for domestic use, pisciculture, and agriculture. The study also observed a positive correlation between these parameters and the production of phytoplankton and zooplankton. Additionally, the diversity of plankton species was assessed, indicating a healthy ecosystem. The study highlights a positive correlation between physico-chemical parameters and plankton diversity, indicating a healthy water ecosystem. Continuous monitoring and potential measures to mitigate pollution, especially from tourism, are recommended to sustain water quality.

REFERENCES

- [1] Chaudhari, S. & Banerji .T. Arsenic removal from drinking water by electrocoagulation using iron electrodes-an understanding of the process parameters. *Journal of Environmental Chemical Engineering*, vol. 4 (4), pp- 3990-4000, 2016, doi:10.1016/j.jece.2016.09.007.
- [2] Gulumbe, B. H., Aliyu, B., & Manga, S. S., Bacteriological and physico-chemical analyses of aliero dam water. *PARAMETERS*, vol.2, pp. 30-34, 2016. <http://www.researchgate.net/publication/340464631>.
- [3] Mora, A., Mahlknecht, J., Rosales-Lagarde, L., & Hernández-Antonio, A., Assessment of major ions and trace elements in groundwater supplied to the Monterrey metropolitan area, Nuevo León, Mexico. *Environmental monitoring and assessment*, 189(8), pp.1-15, 2017, Doi:10.1007/s10661-017-6096-y.
- [4] Reddy, G. & Swamy .T. (2024), limnological studies Related to physicochemical parameter of Nizam Sagar Reservoir, Kamareddy District, Telangana, India 2024 . *Uttarpradesh journal of zoology* -2024;45-(6), 11-21. DOI- 10.56557/ipjz/2024/v45i63947
- [5] Deepak T, Padmavathy P, Rani V, Manimekalai D, Samudrala Devasena. Water quality parameters and nutrient status of selected reservoirs in Tamil Nadu, India. *Indian Journal of Fisheries*; 2022. DOI: 10.21077/ijf.2022.69.4.125726-03
- [6] Desai, V. R. , Reservoir fisheries. In: Handbook of fisheries and aquaculture. Directorate of Information and Publications of Agriculture, Indian Council of Agricultural Research, New Delhi, India, pp. 173-195, 2006.

- [7] Mishra, A. 2007. Study of biodiversity of selected reservoirs of Uttaranachal. Ph. D. thesis, ICAR-Central Institute of Fisheries Education, Mumbai, India, pp.1-169,2007.
- [8] S.S.Pathani and Promod Joshi.,Ichthyo- fauna and fishery in the Nanak sagar reservoir of Uttarakhand , India.Aquacult vol.8(2), pp.191,2007.
- [9] Joshi. Studies of Primary and secondary productivity in Nanak sagar reservoir Thesis submitted to K.U. University Nainital pp. 1 to 336,2006. <http://hdl.handle.net/10603/171019>
- [10] Mishra, A., Srivastava, A. and Singh, U. P., Limnological studies of fish ponds in Tarai region of Uttar Pradesh. Environ. Ecol., 21(3): pp.623- 627,2003. Doi:<http://dx.doi.org/10.18782/2320-7051.7695>
- [11] Bepler, G., Sharma, S., Cantor, A., Gautam, A., Haura, E., Simon, G., & Robinson, L. RRM1 and PTEN as prognostic parameters for overall and disease-free survival in patients with non-small-cell lung cancer. Journal of Clinical Oncology, 22(10), pp- 1878-1885, 2004, Doi: 10.1200/JCO.2004.12.002.
- [12] Bala, m., Sheela,P., A study on the diversity and community structure of freshwater zooplankton and Ichthyofaunal in kumaraswamy lake, Coimbatore district, Tamil Nadu. J. Mater.Environ.Sci.,pp-1327-1338,2022. <http://www.jmaterenvironsci.com>
- [13] Pravin M, Archana., Physico-chemical condition and plankton diversity of Godavari river in city area of Maharashtra. International j.Ecology and Environmental Sciences, pp., 373-379, 2020. <https://www.researchgate.net/publication/348916076>.
- [14] Adoni, A.D., Work book on limnology prativa publishing sager, 1995 pp. 209.
- [15] Das, S.M., 1989. Hand book of limnology and water pollution with practical methodology South Asian publication New Delhi pp-174 ,1989.
- [16] Sharma, D. K. , An assessment of phytoplankton diversity of Tighra Reservoir, Gwalior (Madhya Pradesh). Int. J. Sci. Res., 2(12): pp.568-571,2013.Doi:10.1537/22778179/DEC2013/180
- [17] Garg, R. K., Rao, R. J., Uchhariya, D., Shukala, G. and Saxena, D. N. ,Seasonal variation in water quality and major threats to Ramsagar Reservoir, India. Afr. J. Environ. Sci. Technol., 4(2):pp. 61-76,2010. <http://www.academicjournals.org/AJEST>.
- [18] Jawale, A. K. and Patil, S. A. ,Physico-chemical characteristics and phytoplankton abundance of Mangrul Dam, Dist - Jalgaon, Maharashtra. J. Aqua. Biol., 24(1): pp.7-12,2009.

- [19] Verma. R., Water and fishery resources of Kumaun Central Himalaya, India. *Discovery*, 8(19):pp. 7-12,2013. www.discoveryjournals.org
- [20] Sharma A, Sharma R.C, Anthwal A. Monitoring phytoplanktonic diversity in the hill stream Chandrabhaga og Garhwal Himalaya. *Life Sci. J* ; 4(1):pp.80-84,2007. <http://life.zzu.edu.cn>
- [21] Tidame, S. K., & Shinde, S. S., Studies on seasonal variations in physico-chemical parameters of the Temple pond Nasik District (MS), India. *International Multidisciplinary Research Journal*, 2(5),2012. <http://irjs.info/>
- [22] Joshi,P., Some physico-chemical factors of Nanak Sagar Dam Uttarakhand (India). *J.Global Biosciences*, Vol. 11 pp.9238-9243,2022. www.mutagens.co.in/jgb/vol.11/110302.pdf
- [23] Majare SA, Vhanalakar SA, Muley DV. Analysis of water quality using physico-chemical parameters Tamdalge tank in Kolhapur District, Maharashtra. *Intl. J of Adv. Biotec. And Res.* 1(2):pp.115-119,2010. <http://www.bipublication.com>
- [24] Mehta, M.B. Drinking water quality of ground water from selected sample points around Thane district of Maharashtra. *J. industrial pollution control.* 19(2): pp.153-157,2003.
- [25] Nandan, S. N. and Aher, A. H. , Algal community used for assessment of water quality of Haranbaree Dam and Mosam River of Maharastra. *J. Environ. Biol.*, 26:pp. 223-227,2005.PMID:16161977.
- [26] Shekhar, T. R., Kiran, B. R., Puttaiah, E. T., Shivaraj, Y. and Mahadevan, K. M. ,Phytoplankton as index of water quality with reference to industrial pollution. *J. Environ. Biol.*, 29(2):pp. 233-236,2008. www.jeb.co.in
- [27] Kadam, S. U., Kadam, S. S. and Md. Babar.Phytoplankton diversity of reservoirs in Parbhani District, Maharashtra, India. *Int. J. Curr. Microbiol. App. Sci.*,vol. 3,no.8: pp.459-466,2014. <http://www.ijcmas.com/vol-3-8/S.U.Kad...>
- [28] Karthi, N., Vachanth, M. C. and Sridharan, G., Studies on phytoplankton diversity in Vaduvur Lake at Thiruvavur District, Tamil Nadu, India. *Int. J. Pharm. Biol. Sci.*, 3(1): pp.227-230, 2013. www.ijpbsonline.com
- [29] Gadag, S. S., Kodashetter, M. S., Birasal, N. R. and Sambrani M. I.The microphytes and macrophytes in and around Heggeri Lake (Haveri District). *Proceedings of the State level UGC sponsored Seminar on Biodiversity and its Conservation*, 28-29 July 2005, Haveri, Karnataka, India, pp.91 ,2005.
- [30] Zargar, S. and Ghosh, T. K. , Influence of cooling water discharges from Kaiga Nuclear Power Plant on selected indices applied to plankton population of Kadra Reservoir. *J Environ. Biol.*, 27:pp. 191-198,2006.www.jeb.co.in

- [31] Ganai, A. H., Parveen, S., Khan, A. A. and Maryam, H. , Phytoplankton diversity at WatlabGhat in Wular Lake, Kashmir. *J. Ecol. Nat. Environ.*, 2:pp. 140-146,2010.<http://www.academicjournals.org/jene>.
- [32] Gurung, L., Buragohain, A. K., Borah, S. P. and Tanti, B., Freshwater diatom diversity in DeeporBeel – A Ramsar site. *J. Res. Plant Sci.*, 2(2): pp.182-191,2013. <http://www.plantscience.info> documents/PS0055.pdf.
- [33] Sedamkar, E. and Angadi, S. B., Physico-chemical parameters of two fresh waterbodies of Gulbarga, India, with special reference to phytoplankton. *Pollut. Res.*, 22: pp.411-422,2003.
- [34] Dubey, M., Tiwari, A. K., Manohar, S. and Ujjania, N. C. , Plankton diversity in Kaliasote Reservoir, Bhopal (India). *Eco.Env. Cons.*, 20(4): pp.458-462, 2014.<http://www.researchgate.net/publication/283118868>.
- [35] Joshi, P. and Tripathi, P., A Case study of some biotic factors of Nanak-Sagar Reservoir, Nanak Matha (U.K.) India. *J. Env. Bio-Sci*, Vol. 24(1) : pp.121-125,2010.
- [36] Rajagopal, T., Thangamani, A., Sevarkodiyone, S. P., Sekar, M. and Archunan, G., Zooplankton diversity and physico-chemical conditions in three perennial ponds of Virudhunagar District, Tamil Nadu. *J. Environ. Biol.*, 31: pp.265-272,2010.www.jeb.co.in
- [37] Ana, X. P., Dub, Z. H., Zhang, J. H., Li, Y. P. and Qi, J. W., Structure of the zooplankton community in Hulun Lake, China. *Proc. Environ. Sci.*, 13: 1099-1109, 2012, DOI:10.1016/J.PROENV.2012.01.103.
- [38] Manickam, N., Bhavan, P. S. and Santhanam, P. , Seasonal variations in species composition and community structure of zooplankton in two perennial lakes of Coimbatore, Tamil Nadu, Southern India. *J. Aquat. Res. Mar. Sci.*, 1(1):pp. 1-12,2017, Doi:10.29199/ARMS.101013.
- [39] Dede, A. N. and Deshmukh, A. L. , Study on zooplankton composition and seasonal variation in Bhima River near Ramwadi village, Solapur District (Maharashtra), India. *Int. J. Curr. Microbiol. Appl. Sci.*, vol. 4: pp.297-306, 2015. <http://www.ijcmas.com>
- [40] Patel, V., Shukla, S. N. and Patel, V. K., Studies on the diversity of zooplankton and their seasonal variation in Govindgarh Lake at Rewa, Madhya Pradesh, India. *Indian J. Appl. Res.*, 3:pp. 544-546, 2013, Doi:10.15373/2249555X/NOV2013/170.
- [41] Wafa MFN, Hasan Z, Gumilar I, Sahidin A. Plankton Community Structure and Its Relationship with Minerals Profiles in Minapadi Area, Talagasari Village, Kadungora Garut Regency. *Asian J. Fish. Aqu. Res.* [Internet]. 2019 Aug. 28 [cited 2024 Jun. 4];4(2):1-13. Available from: <https://journalajfar.com/index.php/AJFAR/article/view/71>
- [42] Idam OA, Yousif RA, Mohamed FA, Elobied AA, Ibrahim NS, Ibrahim SM, Mollah SA. Spatial Distribution and Diversity of Phytoplankton and Zooplankton and Status of Physico-chemical Parameters in White Nile, Blue Nile

and River Nile . J. Adv. Biol. Biotechnol. [Internet]. 2023 Sep. 12 [cited 2024 Jun. 4];26(8):1-13. Available from: <https://journaljabb.com/index.php/JABB/article/view/647>

- [43] Stockwell JD, Doubek JP, Adrian R, Anneville O, Carey CC, Carvalho L, De Senerpont Domis LN, Dur G, Frassl MA, Grossart HP, Ibelings BW. Storm impacts on phytoplankton community dynamics in lakes. *Global change biology*. 2020 May;26(5):2756-84.
- [44] Jonkers L, Hillebrand H, Kucera M. Global change drives modern plankton communities away from the pre-industrial state. *Nature*. 2019 Jun 20;570(7761):372-5.

UNDER PEER REVIEW