

Seasonal variations in the physio-chemical analysis of water from the Khadkpurna reservoir of Maharashtra, India

Nagmote SR^{1*}, Tandale MR² and Nikam MT³

¹Department of Zoology, Late B. S. Arts, Prof. N. G. Science & A. G. Commerce College, Sakharkherda, Tq. Shindkhed Raja, Dist. Buldhana, Maharashtra, India.

²Department of Zoology, Shri Vyankatesh Arts, Commerce & Science College, Deulgaon Raja, Maharashtra, India.

³Head Department of Zoology, Shri Shivaji Science and Arts College, Chikhli, Dist. Buldhana, Maharashtra, India.

*Corresponding author: Mr. S. R. Nagmote,

Email: [1sr.nagmote@gmail.com](mailto:sr.nagmote@gmail.com) | [2tandalemahesh4@gmail.com](mailto:tandalemahesh4@gmail.com) | [3meenanikam66@gmail.com](mailto:meenanikam66@gmail.com)

Manuscript Details

Received :09.09.2024

Accepted: 19.10.2024

Published: 30.10.2024

Available online on <https://www.irjse.in>

ISSN: 2322-0015

Cite this article as:

Nagmote SR, Tandale MR and Nikam MT. Seasonal variations in the physio-chemical analysis of water from the Khadkpurna reservoir of Maharashtra, India, *Int. Res. Journal of Science & Engineering*, 2024, Volume 12(5): 251-258.

<https://doi.org/10.5281/zenodo.14456922>



Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit <http://creativecommons.org/licenses/by/4.0/>

Abstract

The Khadakpurna river, which is close to Chikhali, had its physical and chemical parameters evaluated in order to identify seasonal fluctuations in the water quality. The study focused on physicochemical characteristics, such as color, pH, turbidity, total dissolved solid, conductivity and temperature. To find the correlation between temperature and hardness, chemical characteristics such as Dissolved Oxygen, Free Carbon dioxide, Alkalinity, CO₃ (Carbonate Phenolphthalein alkalinity), HCO₃ (Bicarbonate or Methyl Orange alkalinity), hardness (Calcium, magnesium), Chloride, Salinity, Phosphate, and Nitrate were examined.

Keywords: Khadakpurna, Alkalinity, physicochemical, fluctuations,

1. Introduction

Khadakpurna is one of the three major dams of the Buldana district (Latitude: 20° 4' 10.79" N, Longitude: 76° 10' 4.73" E, Altitude: 445 meters above sea level) with storage capacity of 160.66 m cm water, has registered 276 mm rainfall in its catchment area. Khadakpurna Reservoir which rises from Gautala forest and upon which the dam lies, is now receiving good amount of water.

The physico-chemical characteristics hold great significance in the study of environments, particularly those that are aquatic. The generation of phytoplankton depends on the pH and dissolved nutrients. Important variables that affect how nutrients are exchanged between water and sediment include temperature, pH, and dissolved oxygen [1].

The physico-chemical characteristics of pond water, plankton production, and their link to the monthly fluctuation of zooplankton are all very important and fundamental to the care of fish culture. For growth and development, fish are more reliant on the temperature, pH, dissolved oxygen, free CO₂, alkalinity, and certain other minerals of the water. The biological diversity and the physical-chemical characteristics of the water are essential for the upkeep of a healthy aquatic ecosystem. In India, several streams and rivers have been dammed up to conserve water for various useful purposes, including irrigation, fishing, electricity production, and drinking water provision.

Pollutants, which are substances found in water and include dissolved oxygen, ammonia, and nitrates, also have an impact on the quality of the water. A thorough understanding of biological events requires an understanding of the ecosystem that is water chemistry. The biotic community-structure, which includes species pattern, distribution, and diversity, reflects changes in the trophic conditions of the water and can be used to determine the effects of pollution on water quality.

2. Methodology

Physico-chemical parameters analyzed as per the standard methods recommended by APHA [2] and with the help of systronics digital portable water analysis kit of DO meter, PH meter, and CST METER. The parameters are viz., Turbidity, Temperature, Conductivity, Dissolved Oxygen, Carbon Dioxide, Alkalinity (Carbonate and Bicarbonate), Total Hardness (Calcium, Magnesium), Chloride, Salinity, Phosphate and Nitrate.

3. Results and Discussion

Water samples were collected for analysis from Six different sites S1, S2, S3, S4, S5 and S6 located at six directions of the reservoir. Water samples were collected during season for a period i.e., January 2021 to December 2021.

Physical parameters:

To determine water color, "Visual Comparison Method" APHA, [2] was used. From the months of January through May, the water's colour seems to fluctuate. From June to September, it takes on a yellowish green hue, which might be attributed to the monsoon season, when water drains organic compounds and sand particles.

There was a noticeable rise in plankton populations from September to December, which might explain the light green colour. More phytoplankton and zooplankton mean that reservoir water looks green [3]. Sing *et al.* [4] observed color of water was yellow brown in monsoon season, green in winter and dark green in summer season.

Temperature:

Temperature was measured with a thermometer. Temperature of water fluctuates seasonally. Mean Temperature of reservoir recorded monthly from January 2021 to December 2021. The mean value of annual water temperatures were ranged between 19.17 ± 1.9408 to $29.67^\circ\text{C} \pm 0.5164$ in 2021. By taking the mean temperature from all sampling sites and comparing the all six different sites the highest was 25.79167 ± 2.840121 and lowest mean were 24.45833 ± 3.24024 on sampling site S2 in 2021. The water temperature shows seasonal variation in change in atmospheric temperature, but during the study, water temperature found higher in the month of May and June and lower in November and December. This trend supported by the observation of Pandey and *et al.*, [5]; Tayade [6]. The rise in temperature in monsoon due to intake of rain water. These variation of temperature in different season like decreases temperature in winter and increases in summer was reported by Kumbhar *et al.* [7], Bade *et al.* [8], Patel and Puttiah, [9].

Water Temperature shows positive correlation with pH, turbidity, T.D.S. Conductivity, Carbonate, Total hardness and magnesium hardness but it shows negative correlation with dissolved oxygen, CO₂, bicarbonate, calcium hardness in 2021.

Table 1: Mean and SD of water temperature, pH, Turbidity, Total Dissolved Solid (TDS) and Electrical conductivity at Six collection site.

Months	Water temperature (°c)		pH		Turbidity		TDS mg/l		EC S/m	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
January	24.17	1.3292	7.70	0.4980	6.38	0.4906	275.88	15.3389	370.33	15.1614
Feb	24.50	0.5477	7.63	0.2338	7.75	0.3674	284.40	14.9469	377.00	19.0578
March	26.00	1.5492	7.93	0.3204	8.21	0.7251	259.09	28.2477	283.25	27.0724
April	26.00	1.3784	8.00	0.1414	8.37	0.4388	242.00	31.1820	273.67	41.3409
May	29.67	0.5164	7.90	0.3742	8.72	0.5928	256.88	40.6265	276.33	18.2282
June	29.67	0.5164	7.40	0.2530	8.86	0.4517	380.30	29.0358	365.33	21.9241
July	27.33	0.8165	7.65	0.3937	8.68	0.8225	356.68	35.3224	358.83	22.6929
Aug	26.67	0.5164	7.38	0.2229	8.31	0.7581	286.44	17.2971	327.33	26.7930
Sept	24.50	1.0488	7.45	0.2168	6.93	0.2717	260.04	9.3871	343.50	32.4207
Oct	22.33	0.8165	7.42	0.3430	6.45	0.5587	242.36	22.8305	294.83	15.6258
Nov	21.50	2.2583	7.32	0.3710	6.27	0.5074	239.99	8.1064	269.83	24.9753
Dec	19.17	1.9408	7.18	0.1602	5.63	0.8044	234.75	11.1422	216.67	9.0921

pH:

The pH of the water was measured directly using a digital electrode pH meter (Systronics, model no. Sys - 335). During the study period pH value ranged from 7.18 ± 0.1602 to 8.00 ± 0.1414 in January to December 2021. The pH value are found more in April, June in 2021 during the study period and less in the November, December in the year. The pH from all six sampling site during 2021, highest mean was observed on sampling site S2 7.72 ± 0.455 , and lowest was 7.48 ± 0.34 on S6. The result found during the study period it indicate the pH was alkaline. Most of the biological and biochemical are depends upon the fluctuations of pH, therefore pH is consider as an indicator of overall productivity that causes habitat diversity.

In present investigation pH value increases in summer and pre monsoon and decreases in winter, [10] there were found somewhat fluctuation in all results that in some reservoir the pH found to be maximum in summer ad minimum in winter reported by Shinde *et al.*, [11], Manjare *et al.*, [12]. Mushatq *et al.*, [13] studied on variations of physico-chemical properties of Dal lake.

But in some reservoir pH increases in monsoon reported by Jayabhaye *et al.*, [14].

Turbidity:

In January to December 2021, the turbidity of the water was 5.63 ± 0.8044 to 8.86 ± 0.4517 NTU. The month of June and the whole monsoon season saw the most turbidity, whereas December of both years saw the lowest. In the first year of the study, the mean maximum turbidity was measured on the sampling side at S4 at 7.7075 ± 1.713556 NTU. The mean lowest turbidity was measured on S1 at 7.371667 ± 1.290559 NTU. Clay, organic matter, planktons slit and other microscopic organisms are increases turbidity of water. Turbidity was found different i.e. maximum turbidity found in month of February, due to human activity and decrease in water level reported by Manjare *et al.*, [12].

Total Dissolved Solids:

Total dissolved solids, which includes nitrates, calcium, magnesium, sodium, potassium, iron, carbonates, and bicarbonate, is a measurement of the quantity of particles dissolved in water. In 2021, it varied from

234.75 \pm 11.1422 to 356.68 \pm 35.3224 mg/L. It was discovered that the months of June and July had the highest total dissolved solids, while April had the lowest. Throughout the research years, do not demonstrate a discernible change. Owing to the abundant runoff from the agricultural land surrounding the reservoir, which raises the levels of fertilizers, organic matter, and salts in the aquatic water, 392.18 mg/L TDS is observed in June, which is comparable to the results of the Charghad dam in Amravati, Maharashtra, as reported by Makode [15]. According to some contentious findings by Verma et al. [16], rainwater dilution causes TDS to rise over the summer and fall. TDS was displayed in Table No. 1, none of which showed a significant difference.

Conductivity:

Conductivity was measured with a conductivity meter calibrated with potassium chloride solution. On the basis of Conductivity we know the quality of water. The mean values of conductivity ranged between 216.67 \pm 9.0921 μ mho/cm to 377.00 \pm 19.0578 mho/cm in year 2021. Highest mean value from sites wise was observed on sampling site S1 was 317.75 \pm 67.72689, and lowest was observed on sampling site S6 was 296.0208 \pm 54.28005 in 2021. Conductivity was lower in winter season was reported by Sing et al. [4].

Certain controversial results obtained, that was higher during winter, and the level was highest due to heavy load from all side into lake [6, 17, 18]. All water body of Khadkpurna reservoir is maximum covered with the field area therefore organic matter influence the water conductivity, in rainy season organic soil are artificially drained, it increases the cation concentration of ponds.

Chemical Parameters

Dissolved oxygen (DO) Dissolved oxygen is one of the most important parameter for assessing the quality of water, directly affecting survival and distribution of fauna in an ecosystem. It is very interesting to note that the level of dissolved oxygen content greatly fluctuated during different months of the year (Table 2). During year the mean highest value of dissolved oxygen found on sampling site S1 it was 6.425 \pm 1.648 mg/l, while

lowest was on S6 it was 4.7167 \pm 1.080. The months of December and January had the highest levels of dissolved oxygen, whereas September and October had the lowest levels. Similar results were recorded by Khan et al. [19]. Dissolved oxygen is play vital role in aquatic fauna, it is an important parameter for aquatic life mainly fish culture, it found lower in summer by Rani et al., [20], Medudhula et al. [21], Prabhakar et al. [22].

Free Carbon dioxide:

CO₂ is found in three forms i.e. free CO₂, CO₃, or HCO₃ depends upon the pH and biological condition. The Carbon dioxide found 0.67 \pm 0.5317 to 2.22 \pm 1.0926 mg/L in 2021. It found maximum in monsoon and minimum in March month in the study year but presence of free CO₂ is also depends upon the time of sampling and seasonal fluctuations in water body. Also sometimes free CO₂ also found in most of the sites, and less no. of sites resulted absences of free CO₂. The total CO₂ concentration in water depend upon pH Which is governed by the buffering effect of carbonic acid, carbonate and bicarbonate [23]. Free CO₂ was recorded negligible at Kagal tank, high at Kanerwadi and moderate at kandalgaon tank by Pailwan et al. [24]; Sharma et al., [25] also pointed that, absence of free carbon dioxide in unpolluted water bodies. CO₂ is essential for respiratory metabolism of phytoplankton and aquatic vegetation, increased carbon dioxide level might be due to uptake from autotroph, assimilation by algae and aerobic bacteria of decay add CO₂. [26].

CO₃ (Carbonate Phenolphthalein alkalinity):

During the study period Carbonate was found 24.5 \pm 4.5935 mg/L to 63.5 \pm 21.2108 mg/L in first year of study period and 25.67 \pm 7.0048 mg/L 64.67 \pm 17.0607 mg/L in 2021. The carbonate value from all sampling sites of both years was 0.6929. which was not show any significant difference during study period. Carbonate value increases in summer and minimized in monsoon season, shown in Table no.2

HCO₃ (Bicarbonate or Methyl Orange alkalinity):

Annual changes found in bicarbonate value are ranged from 101.92 \pm 6.0201 mg/L to 148.33 \pm 29.8641 mg/L in 2021. Bicarbonate value found to be minimum in June month and maximum bicarbonate alkalinity found in

Table 2: Mean and S.D. monthly range of Dissolved O₂, Free CO₂, Carbonate and Bicarbonate of khadkpurna reservoir.

Months	DO mg/l		Free CO ₂ mg/l		Carbonate mg/l		Bicarbonate mg/l	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
January	6.60	2.4405	1.43	0.4926	41	13.1909	148.33	29.8641
Feb	6.75	1.2243	1.52	0.5811	63.5	21.2108	136.5	17.9972
March	4.47	0.3777	1.13	0.432	57.5	21.5291	171.67	38.7694
April	4.87	0.8359	1.77	0.5164	41.83	23.8865	101.92	6.0201
May	4.70	1.1367	0.67	0.5317	50.17	30.7208	110.23	7.9804
June	5.58	0.7910	1.37	0.6947	35.5	8.9387	111.22	16.7559
July	7.07	0.7554	1.63	0.6377	29.83	9.1742	114.67	7.2296
Aug	6.22	0.7960	2.22	1.0926	25.33	6.1536	130.5	20.0915
Sept	4.57	0.4274	1.97	1.1325	24.5	6.3166	139.17	14.3167
Oct	3.93	0.3077	2.17	1.1413	31.17	6.4627	126.33	9.048
Nov	4.87	1.2176	1.93	0.7967	26.17	8.5421	126.67	4.9666
Dec	6.40	1.6346	2.1	1.0789	24.5	4.5935	122.5	13.2023

March of the year depicted in Table no.2. The total carbonate and bicarbonate values rise throughout the summer and fall during the monsoon. This might be because water is diluted during the rainy season, which raises the water's alkalinity percentage, and because there is less water available in the summer. The controversial results obtained by Verma *et al.*, [16] they found maximum value of alkalinity in monsoon and minimum during summer.

Total Hardness:

The overall water hardness values for 2021 were 142.33 ± 15.6034 to 314.33 ± 51.0124 mg/L. As can be seen in Table No. 3, the greatest hardness of the reservoir water rises in February of each year, while the lowest hardness is discovered during the winter study period. Mean total hardness from all sampling sites was observed, during the first year of observation the highest was observed on sampling site S5 it was 270.167 ± 63.66, while lowest was on sampling site S4 it was 182.9167 ± 33.33. The total harness was recorded higher in summer, it might be due to decrease in water level and rate of evaporation of water. Similar result observed by Hujare [27]; Manjare *et al.* [12]. Total hardness of water increases mainly due to the presence of (Ca²⁺) and magnesium (Mg²⁺) ions in every water body which may increases due the human washing clothes, bathing activities in Khadkpurna reservoir.

Calcium Hardness:

Calcium is major cation found in water. During year of study period calcium Hardness found 17.76 ± 4.145 to 45.85 ± 7.8341 mg/L. The maximum Calcium hardness found in January month and minimum in Monsoon in the year, shown in **Table no.3** Site wise mean of calcium harness value, during first year of analysis the mean highest value was observed on the sampling site S5 it was 37.479 ± 12.59 while lowest was observed on S4 sampling site it was 29.57 ± 8.80. The maximum desirable limit of calcium in drinking water is 75mg/l (W.H.O), therefore above recorded value of calcium, it indicate water is use for drinking purpose. Maximum value of calcium in winter season, controversial result obtained by Harney *et al.*, [28] recorded calcium hardness minimum in winter season.

Magnesium Hardness:

Magnesium Hardness was calculated from removing calcium hardness from total hardness. The magnesium hardness found in this reservoir was 20.6 ± 4.1218 mg/L to 66.11 ± 10.5452 mg/L in the year 2021 shown in Table no.3 Mean Magnesium hardness from the 2021 highest was observe on sampling site S5 it was 56.77 ± 14.72 while lowest was on S4 it was 37.41 ± 7.57. Maximum hardness of magnesium was found in the month of February and minimum in winter season of both the year of study period. Similar result found by Patil [29]

about magnesium. The permissible limit of magnesium of drinking water is 50mg/l (W.H.O) but our result about magnesium was above 66mg/l, so it may hazardous for drinking purpose.

Chloride:

The chloride value of Khadkpurna reservoir was ranged from 70.08 ± 5.7947 mg/L to 143.32 ± 5.9064 mg/l in 2021, shown in Table no. 4 During the first year of analysis the mean highest chloride value was observed on sampling site S5 it was 103.60 ± 21.5176 , lowest was

observed on S2 it was 92.52 ± 23.51 . The chloride value was higher in summer and minimum during winter season in both the year of study period. Similar result obtained by Shinde *et al.* [11], according to them Higher level of chlorides in natural water is indication of pollution and domestic sewage. Likewise, in Morna reservoir there may be certain anthropogenic activities increases chloride concentration in water. The result obtained by Pulugandi [31] that chlorides was minimum at winter and shows maximum in monsoon season.

Table 3: Mean and S.D. monthly range of Total Hardness, Calcium Hardness, Magnesium Hardness and Chloride of khadkpurna reservoir.

Months	Total Hardness mg/l		Calcium mg/l		Magnesium mg/l		Chloride mg/l	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
January	270.67	66.5693	45.85	7.8341	54.86	14.6600	80.51	15.867
Feb	314.33	51.0124	43.38	9.2884	66.11	10.5452	70.08	5.7947
March	256.5	46.4575	43.48	7.6645	51.98	10.5825	92.15	11.6129
April	292.67	60.5662	40.46	5.8539	61.54	14.0244	129.1	14.4134
May	230	17.2743	35.19	3.5005	47.43	4.259	143.32	5.9064
June	276.33	29.4596	27.09	3.9953	60.82	0.6	104.11	7.7056
July	210.67	32.0167	18.02	8.7746	47.01	7.426	96.37	10.8
Aug	198	18.8892	35.19	3.5005	39.73	4.9256	96.47	11.2687
Sept	189.83	29.137	22.33	10.6708	40.87	8.3028	82.46	13.5487
Oct	184.17	49.5718	17.76	4.145	40.6	12.3651	94.1	10.5975
Nov	218.33	72.6214	26.52	4.5713	46.8	17.7758	91.32	9.8934
Dec	142.33	15.6034	37.45	6.6863	20.6	4.1218	76.49	8.3539

Table 4: Mean and S.D. monthly range of Magnesium Hardness, Chloride, Salinity, and Phosphate of khadkpurna reservoir.

Months	Salinity mg/l		Phosphate mg/l		Nitrate mg/l	
	Mean	SD	Mean	SD	Mean	SD
January	145.35	28.6400	0.16	0.0465	2.18	0.1285
Feb	126.53	10.4594	0.25	0.0619	2.52	0.476
March	166.35	20.9614	0.31	0.0607	3.17	0.1742
April	233.05	26.0162	0.44	0.0894	2.15	0.6626
May	258.72	10.6611	0.52	0.0308	2.7	0.4
June	187.94	13.9086	0.61	0.0733	2.78	0.7333
July	173.98	19.4937	1.2	0.2188	3.55	0.8191
Aug	174.15	20.3401	2.15	0.3683	2.6	0.5967
Sept	148.88	24.4553	1.03	0.1721	2.05	0.345
Oct	169.88	19.1285	0.82	0.0225	3.15	0.5296
Nov	164.87	17.8577	0.65	0.0524	3.77	0.7376
Dec	138.09	15.0788	7.29	17.0028	3.1	0.802

Salinity:

The salinity value ranges from 126.53 ± 10.4594 mg/l to 258.72 ± 10.6611 mg/l in 2021. shown in Table no. 4 During years, mean salinity highest was observed on the sampling site S5, it was 187.031 ± 38.83927 , the lowest value was observed on the sampling site S2 it was 167.0421 ± 42.43989 . In years under observation, the month of February had the lowest water salinity and the month of March the highest.

Phosphate:

As the Khadkpurna reservoir is totally surrounded from all sides by field area and totally water in reservoir is used for irrigation purpose, therefore it also necessary to study the phosphate level in water. The phosphate level during the year of study was found 0.16 ± 0.0465 to 7.29 ± 17.0028 mg/l in 2021, shown in Table no. 4. From the sampling site S5 the highest value recorded it was 4.233 ± 11.909 while lowest was on the sampling site S3 it was 0.64083 ± 0.4489 in 2021. The phosphate value was not much more significant from all sampling site during years. It shows 0.05 level of significance difference in month of October and December due changed phosphate level in water during the year. The phosphate level was higher in Monsoon season and lower in summer and winter season. Similar result obtained by Manjare, [12] and Makode [15] that the maximum value of phosphate recoded in August and minimum in October i.e.in winter season.

Nitrate:

Nitrates is highly oxidized form of nitrogen, in natural water due to runoff fertilizers, decayed vegetable and domestic waste are increases the amount of nitrogen in water. Nitrate value ranged from 2.05 ± 0.345 to 3.77 ± 0.7376 mg/l in 2021, shown in Table no. 4. In 2021 highest Nitrate was observed on sampling sit S2 it was 2.982 ± 0.9842 , while lowest was on S5 it was 2.643 ± 0.5708 . The nitrates value was higher in monsoon season and recorded lower in late winter and summer season. Nitrates is act as nutrient for growth of plants, excess amount of nitrogen helps for rapid growth of algae and other plants in water. Nitrates is found very small amount in nature because ongoing process of growth and decaying. Most stable form of nitrogen is nitrates

which enhances the growth of plankton density and primary production [31-32].

References

1. Bais VS and Agrawal NC. Comparative study of the zooplanktonic spectrum in the Sagar lake and Military Engineering lake. *J. Environ. Biol.*, 1995; 16 (1): 27-32.
2. APHA (1998) Standard Method for the examination of water and wastewater, 20th edition. American Public Health Association New York, ISBN-O-87553-235-7.
3. Chalinda A, Reungchai T, Pimpan T and Angsupanick S. Phytoplankton diversity and its relationships to the physico-chemical environment in the Banglang Reservoir, Yala Province. *Songklamakar J. Sci.TechnoL.*, 2004; 26(5): 595-607.
4. Singh SM, Panday SC, Pani S and Malhosia A. Limnology : A case study of highly polluted Laharpur reservoir, Bhopal, (M.P.) India. *J. of Chemical, Biological and Physical Sciences.* , 2012; Vol.2(3),1560-1566, e-ISSN: 2249-1929.
5. Pandey SC, Singh SM, Pani S and Malhosia A. Limnology: A case study of highly polluted Laharpur reservoir, Bhopal, (M.P.). *Journal of Chemical, Biological and Physical Sciences.*, 2012; Vol.2 (3), 1560-1566.
6. Tayade. Studies on Zooplankton communities of Rotarians in Relation to water Chemistry of Ephemeral Ponds in Washim Region of Maharashtra. Ph.D. Thesis submitted to SGB Amravati University, Amravati, 2012.
7. Kumbhar AC, Kulkarni DA, Bade BB. Seasonal Variation in Physico-chemical parameters of VJANI Reservoir of Madha Tahashil, Dist- Solapur, 2009. ISSN - 0974 - 2832, Vol. II, Issue - 9.
8. Bade BB, Kulkarni DA and Kumbhar AC. Studies on physico-chemical parameters in Sai reservoir, Latur dist, Maharashtra. *Shodh, Samoksha aur Mulankan (International Research Journal)* , 2009; Vol.II Issue-7. ISSN-0974-2832
9. Patel AN and Puttiah ET. Analysis of water quality using physico-chemical parameters Hosahalli tank in Shimoga district, Karnataka, India. *Global J. Of Science frontier research*, 2011; Vol 11 (3) ISSN: 0975-5896.
10. Nagmote SR, Nikam MT and Tandale MR. Diversity of Fresh Water Fishes from the Khadkpurna Reservoir of Maharashtra, India *Acta Scientific Microbiology*, 2023; Volume 6 Issue 4.
11. Shinde SE, Pathan TS, Raut KS and Sonawane DL. Studies on the physico-chemical parameters and correlation coefficient of Harsool-savangi dam, district Aurangabad, India. *Middle-East Journal of Scientific Research*, 2011; 8(3): 544-554.
12. Manjare SA, Vhanalakar SA and Muley DV. Analysis of water quality using physico-chemical parameters

- tamdalge tank in Kolhapur district, Maharashtra. *International Journal of advanced biotechnology and research*, 2010; Vol. 1, Issue 2; Dec – 2010 PP. 115-119.
13. Mushatq B, Raina R, Yaseen T, Wanganeo A and Yousuf AR. Variations in the physico-chemical properties of Dal Lake, Srinagar, Kashmir. *African Journal of Environmental Science and Technology*, 2013; Vol. 7(7); pp 624-633.
 14. Jayabhaye UM, Saive BS and Pentewar MS. Some physico-chemical aspects of Kayadhu river, Hingoli district, Maharashtra. *J.Aqua.Biol.*, 2008; 23(1); 64-68.
 15. Makode PM. Physico-Chemical parameters Charghad Dam district Amravati, Maharashtra, 2012.
 16. Verma PU, Chandawat DK and Solanki HA. Seasonal variation in physic-chemical and Phytoplankton analysis of Kankaria Lake, Gujrat University, Ahmedabad _Gujrat, *Life science Leaflets*, 2011; 19:842, ISSN 0976-1098.
 17. Koshy and Nayar. Water quality of river Pamba at Kozhencherry. *Poll.Res.*, 2000; 19(4):665-668.
 18. Karadkhede SV, Lokhande MV, Rathod DS, Shembekar VS and Patil SM. Studies on physico-chemical characteristics of recreational water body in Nana-Nani Park, Latur, Maharashtra. *J.Aqua.Biol.*, 2008; 23(1): 55-58.
 19. Khan RM, Jadhav MJ and Ustad IR. Physicochemical analysis of Triveni Lake water of Amravati district in (MS) India., *Bioscience discovery*, 2012; 3(1): 64-66.
 20. Rani R, Gupta BK and Srivastav KBL. Studies on water quality assessment in Satna city (M.P.): Seasonal parametric variation, *Nature Environment and Pollution Technology*, 2004; 3(4). pp 563-565.
 21. Medudhula T. Ch. Samatha, Ch. Sammaiah (2012): Analysis of water quality using physico-chemical parameters in lower manair reservoir of Karimnagar district, Andhra Pradesh.
 22. Prabhakar C, Saleshrani K and Tharmaraj K. Hydrobiological investigation on the planktonic diversity of Vellar River, Vellar Estuary and Portonovo coastal waters, south-east coast of India. *Int. J. Pharm. Biol. Arch.*, 2012, 2 (6): 1699-1704.
 23. Hutchinson GE. A treatise on limnology vol. I. and II Geography, physics and chemistry, John Wiley and Sons, New York, 1957; pp :1015.
 24. Pailwan IF, Muley DV and Maske S. Limnological features, Plankton Diversity and Fishery Status of Three Fresh Water Perennial Tanks of Kolhapur District (M. S.) India, Proceedings of Taal: The 12th World Lake Conference, 2008; pp 1643-1649.
 25. Sharma KP, Goel PK and Gopal B. Limnological studies of Polluted fresh water I "physico-chemical characteristics" *Ind J. Ecil. Environ Sci.*, 1978; 4 pp-88-105.
 26. Sivakumar K and Karuppasamy R. Factors affecting productivity of phytoplankton in a Reservoir of Tamilnadu, India. *American – Euroasian Journal of Botany*, 2008; 1(3): 99 – 103, 200.
 27. Hujare MS. Seasonal variation of physico-chemical parameters in the perennial tank of Talsande, Maharashtra. *Ecotoxicol, Environ. Biol.*, 2008; 11(3), 335-343.
 28. Harney NV, Dhamani AA and Andrew RJ. Seasonal Variation in The Physico-chemical Parameters of Pindavani pond of Central India. *J.* 2013, DOI: 10.9780/2321-7871/162013/18, vol.I Issue_6 ISSN:2321-7871.
 29. Patil AA. Limnological and Correlation studies of Birnal water body of Sangali, Maharashtra. *International Research Journal of Environment Sciences*, 2014; 3(9), 43-49, September.
 30. Pulugandi C. Analysis of water quality parameters in Vembakotti water reservoir, Virudhunagar district, Tamil Nadu – A report. *Res.J. Recent Sci.* 2014, ISSN 2277-2502.
 31. Parida RN, Nanda S and Rath RK. Physico-chemical features of water and soil in rural fish ponds and its relationship with pond productivity. *J. of Aquaculture.*, 1999; 7: 17-23.
 32. Thorat DR and Patil SS. Physico-Chemical Assessment of Kham River Water at Aurangabad, Maharashtra (India) *International Journal for Scientific Research & Development.*, 2020; Vol. 8, Issue 4, pp-27.

© 2024 | Published by IRJSE

Conflicts of interest: The authors stated that no conflicts of interest.

Publisher's Note

IJLSCI remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Correspondence and requests for materials should be addressed to Nagmote SR.

Peer review information

IRJSE thanks the anonymous reviewers for their contribution to the peer review of this work. A peer review file is available.

Reprints and permissions information is available at <https://www.irjse.in/reprints>