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Physico-chemical characteristics of the water of the Nandeshwar Dam, Udaipur, Rajasthan

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Abstract

Nandeshwar Dam is located between the arawali ranges of Udaipur, Rajasthan. It provide of water to meet demands of the city. Thus, study on water quality bears high importance further, the study of lake trophic status may help in the optimum utilization and conservation considering this an upstream water body. On the basis of the relationship of physico-chemical parameters of water and qualitative and quantitative analysis of plankton Nandeshwar dam is moderate productive with proper monitoring of water quality and fisheries management practices, fish production potential can be increased in the Nandeshwar dam of Udaipur.

Keywords: Water quality, characteristics of the water, Dam water, Udaipur lake

Introduction

Udaipur is blessed with a good number of lakes and known as 'The city of lakes'. Every year, a large number of tourists come from all over the world to visit Udaipur city. The lakes provide bulk of water to meet demands of the city. Thus, study on water quality of lake bears high importance further, the study of lake trophic status may help in the optimum utilization and conservation considering this an upstream water body namely Nandeshwar dam has been selected for the present study.

Nandeshwar dam is situated in the South-West region of Udaipur and it is about 13 km west to Udaipur city. In Nandeshwar Lord Shiva's temple is situated in the vicinity, because of which, the place is more commonly known as Nandeshwar ji. The place has a beautiful pond and is full of amazing flora and fauna. The dam is totally rain fed by Sisarma river and retains water throughout the year.

Materials and Methods

Observation for of the present study was carried out during July, 2015 to July, 2016 with a view to investigate the phytoplankton, zooplankton and primary productivity of Nandeshwar dam for assessing aquacultural possibilities with reference to prevailing limnological conditions.

Water quality parameters such as temperature of water and air around dam, water colour, water clarity, pH, alkalinity (carbonates and bicarbonates), dissolved oxygen, free carbon dioxide, electrical conductivity (EC) and primary productivity were determined in the field itself, while for the analysis of nitrate-nitrogen and orthophosphate the samples were brought to the laboratory in plastic bottles of one liter capacity and analyzed as soon as possible using standard methods of [2, 34].

Results and discussion

Result of physic-chemical attributes of water and a few climate parameters are presented in table 1

Air temperature

Physical and chemical parameters of Nandeshwar dam were found to be suitable for fisheries development as evident from this study. The maximum air temperature was 42.10 °C in May. The observations of air temperature had a positive significant relationship with water temperature, pH, bicarbonate, alkalinity, electric conductivity, Nitrate-nitrogen. Similar results have been reported by [12, 29, 24].

Water temperature

In the present study the surface water temperature variation was between 16.30 to 30.60 °C. The observations on water temperature had a positive significant relationship with air temperature, pH, electric conductivity and negative

correlation with dissolved oxygen. Similar results were observed by [19]. Temperature of water showed the maximum value in summer and minimum in winter. Low temperature during the winter season was assigned to the shorter photoperiod and decreased atmospheric temperature [15, 20].

Table 1: Seasonal variation in physic-chemical characteristics of surface water of Nandeshwer dam from 2015-2016.

Sr. No.	Air. Temp	Water temp	pH	Depth of visib.	DO	CO ₂	Carb. Alk.	Bic. Alk.	Total. Alk.	EC	TDS	Nitrate	OP
1	32.20	22.20	7.40	32.47	6.9	-	33.37	53.60	86.97	0.410	264.53	0.069	0.083
2	31.50	23.10	7.20	33.53	7.0	-	32.37	51.63	84.00	0.420	268.80	0.058	0.073
3	30.20	21.50	7.10	33.57	7.2	-	30.43	53.40	83.83	0.430	273.07	0.054	0.066
4	33.30	23.70	7.00	34.23	7.4	-	30.17	51.67	81.83	0.470	302.93	0.047	0.069
5	28.40	19.70	7.10	34.87	7.4	-	29.43	50.43	79.87	0.490	296.53	0.053	0.078
6	36.30	26.30	7.20	37.33	7.6	-	31.43	51.73	83.17	0.390	238.93	0.049	0.085
7	35.50	25.80	7.10	40.00	7.7	-	33.13	52.60	85.73	0.340	209.07	0.052	0.090
8	31.40	24.70	7.20	45.53	7.9	-	32.90	53.63	86.53	0.290	177.07	0.056	0.088
9	29.10	22.90	7.20	56.90	8.2	-	35.20	56.37	91.57	0.230	140.80	0.054	0.098
10	27.40	20.80	7.10	57.43	8.1	-	36.10	57.50	93.60	0.190	121.40	0.056	0.102
11	22.60	17.10	7.20	60.03	8.4	-	40.37	56.80	97.17	0.180	113.07	0.059	0.109
12	27.10	17.90	7.20	61.73	8.5	-	41.63	53.60	95.23	0.170	113.07	0.068	0.110
13	23.40	16.10	7.30	62.23	8.7	-	42.40	56.40	98.80	0.180	119.47	0.073	112.000
14	26.60	17.80	7.10	61.93	8.8	-	40.07	55.77	95.80	0.190	128.00	0.080	0.118
15	24.50	19.10	7.20	62.57	8.8	-	43.40	56.53	99.93	0.210	138.67	0.084	0.129
16	34.30	20.70	7.50	63.27	8.6	-	43.58	57.60	101.21	0.230	102.47	0.086	149.000
17	34.70	21.10	7.60	61.60	8.2	-	43.43	55.80	99.23	0.300	196.27	0.084	0.160
18	38.30	24.20	7.80	60.50	8.2	-	43.43	58.73	102.17	0.310	202.67	0.089	0.137
19	36.40	22.70	7.90	58.27	8.1	-	43.50	58.87	102.37	0.330	211.20	0.092	0.129
20	41.20	29.20	8.10	58.50	7.8	-	44.40	58.60	103.00	0.320	209.07	0.097	0.117
21	42.10	29.60	8.20	57.50	7.7	-	45.53	60.53	106.07	0.340	219.73	0.099	0.118
22	40.30	28.40	8.00	57.63	7.5	-	47.63	60.30	107.93	0.350	226.00	0.100	0.119
23	37.80	27.30	7.90	55.37	7.2	-	41.30	58.27	99.57	0.360	238.93	0.104	0.108
24	34.60	24.50	7.80	45.30	7.1	-	39.47	57.80	97.27	0.390	256.00	0.098	0.105
25	28.50	22.10	7.40	39.77	7.0	-	37.40	56.73	94.13	0.400	230.67	0.087	0.103
Mean	32.31	22.77	7.41	51.35	7.86	-	38.52	55.76	94.28	0.32	198.65	0.07	0.11
Min	22.60	16.10	7.03	32.47	6.87	-	29.43	50.43	79.87	0.17	102.47	0.05	0.07
Max	42.10	29.60	8.17	63.27	8.80	-	47.63	60.53	107.93	0.49	302.93	0.10	0.16
SD	5.51	3.72	0.37	11.57	0.06	-	5.55	2.87	8.16	0.97	62.22	0.02	0.02
CV (%)	17.05	16.40	5.00	22.50	7.70	-	14.43	5.20	8.70	30.80	31.30	25.90	22.60

pH

pH value is very important for plankton growth [5] According to [37] pH range 6.5 to 8.5 is best for plankton growth. Similar pH range was observed by [23]. The present study finds the value of surface water pH variations between 7.13 to 8.53. The observations on pH had a positive significant relationship with air temperature, water temperature, depth of visibility, carbonate alkalinity, bicarbonate alkalinity, total alkalinity, total dissolved solid, nitrate-nitrogen and orthophosphate.

Depth of visibility

According to [40] the secchi disc transparency (depth of visibility) is a reflection of light from the water surface. The intensity of light penetration decreases with increasing average depth of water and suspended materials. Factors affecting the transparency of water are siltation, microscopic organisms and organic matter [17]. In the present investigation value of depth of visibility were between 34.47 to 63.27 Cm during the study period. The observations on the depth of visibility had positive significant relationship with pH, dissolved oxygen, carbonate alkalinity, bicarbonate alkalinity, total alkalinity, nitrate-nitrogen, orthophosphate and negative correlation with electric conductivity.

Dissolved oxygen

The dissolved oxygen of surface water showed variations between 7.07 to 9.07 mg/l during the study period. Similar observations have been made by [13, 39, 4, 26] the observations on dissolved oxygen had a positive significant relationship with depth of visibility, carbonate alkalinity, orthophosphate, community respiration and total phytoplankton but negative correlation was found with water temperature, electric conductivity, total dissolved solid and net primary productivity.

Carbon di-oxide

As per [8] the main source of free CO₂ is mainly decomposition of organic matter and respiration of plants and animals. In the present investigation, however, free CO₂ was found absent throughout the study period. Similar results were also reported by [13, 36] also found the absence of free CO₂ in the three water bodies in southern Rajasthan [18]. observed absence of free carbondioxide for most of the time during his studies in Pangdam reservoir in Himanchal Pradesh. In the present investigation over the study period, free carbon dioxide was discernible by its absence in surface in surface and sub-surface water of all the sampling stations.

Carbonate alkanity

A change in alkalinity thus indicates either an addition or precipitation of carbonates [1]. stated that in highly productive waters, the alkalinity ought to be over 100 ppm. According to [33] such waters are suitable for fish culture. Ranged of surface water carbonate alkalinity variations was between 26.77 to 44.23 mg/l during the study period. The regular presence of carbonates in the water bodies of arid and semi-arid region was also reported by [16, 27, 28, 26]. The observations on carbonate alkalinity had a positive significant relationship with pH, depth of visibility, dissolved oxygen, bicarbonate alkalinity, total alkalinity, total dissolved solid, nitrate-nitrogen and orthophosphate, but negative correlation was evident with electric conductivity.

Bicarbonate alkalinity

Bicarbonate alkalinity remained slightly high in winter and low in summer at all the stations. [7] found maximum alkalinity in March and minimum in September whereas, [11, 30] found maximum alkalinity during summer which declined subsequently in the monsoon. [38, 28, 4] The value of surface water bicarbonate alkalinity variations were between 47.83 to 57.30 mg/l during the study period. While in the sub-surface water bicarbonate alkalinity variations were between 50.43 to 60.53 mg/l during the study period. The observations on bicarbonate alkalinity had a positive significant relationship with air temperature, pH, depth of visibility, carbonate alkalinity, total alkalinity, total dissolved solid, nitrate-nitrogen, orthophosphate,

Total alkanity

As evident from the results of this study total alkalinity of surface water indicated variations between 75.13 to 101.27 mg/l. A range of 4 to over 1000 ppm alkalinity has been encountered in natural waters [14] In the present study, total alkalinity ranged from 32 to 152 mg/l [35] observed total alkalinity of 65 to 199 mg/l in three water bodies of southern Rajasthan [20,3] also reported higher alkalinity in the different water bodies in Udaipur region. The values of total alkalinity above 60 mg/l are indicative of nutrient rich condition of a water body. According to [33] such water is suitable for fish culture. The total alkalinity of water is an important factor in pond productivity. The total alkalinity had a positive significant relationship with pH, depth of visibility, carbonate alkalinity, bicarbonate alkalinity, total dissolved solid, nitrate-nitrogen and ortho-phosphate.

Electric conductivity

The electrical conductivity represents the total ionic load in water due to dissolved substances and sometimes considered as an index of productivity. In Nagarjuna sagar and Govind Sagar the recorded EC value ranged from 212.4 to 338.0 [29], has reported the EC values of 391.87 μ mho cm^{-1} in Rameshwer anicut [13]. observed EC of 412 to 850 μ mho cm^{-1} in the Amarchand reservoir, Southern Rajasthan. In the present investigation the average value of electrical conductivity in the surface water between 0.133 to 0.480 mScm^{-1} during the study period. Further the observations on electric conductivity with having a positive significant relationship with air temperature, water temperature and total dissolved solid but negative correlation was evident with a depth of visibility, dissolved oxygen, carbonate alkalinity, orthophosphate.

Total dissolved solid

In the present study the mean value of total dissolved solids in the surface water ranged between 85.33 to 309.33 mg/l during the study period. In selected micro-water sheds the waters are soft to slightly hard. Such hard water has also been reported earlier by [25, 22] from waters of Southern Rajasthan. The observations on total dissolved solids had a positive significant relationship with air temperature, water temperature and electric conductivity and negative correlation with depth of visibility, dissolved oxygen, carbonate alkalinity and total alkalinity.

Nitrate-nitrogen

In natural aquatic systems the major source of nitrate-nitrogen is allochthonous i.e. through runoff, beside this it is also contributed by the decomposition of nitrogenous matter and its further oxidation [10] Nitrate generally occurs in the trace quantities which is essential for aquatic life. In the present investigation the average value of Nitrate-nitrogen in the surface water ranged between 0.043 to 0.099 mg/l during the study period. These values are fairly comparable to those reported by [6, 9, 32] different lentic waters. The observations on nitrate-nitrogen had a positive significant relationship with air temperature, pH, depth of visibility, carbonate alkalinity, bicarbonate alkalinity, total alkalinity, total dissolved solid and ortho-phosphate.

Ortho phosphate

The most critical single element in maintaining aquatic productivity is phosphorous, through it is one of the most limiting factors of production in Indian reservoir [6] According to [31] normal range of phosphate concentration in water is 0.1 to 0.2 mg/l. In present study the mean value of orthophosphate in the surface water of the Nandeshwar dam in surface water varied between 0.055 to 0.0150 mg/l during the study period [21]. recorded orthophosphate variations between 0.06 to 0.52 m/l in the Rangasagar Udaipur. [20] also found the same result in Daya reservoir. The observations on orthophosphate showed a positive significant relationship with pH, depth of visibility, dissolved oxygen, carbonate alkalinity, bicarbonate alkalinity, total alkalinity, total dissolved solid and nitrate-nitrogen but negative correlation was found electric conductivity.

Conclusion

In any aquatic ecosystem limnological characteristic can affect both fauna and flora. On the basis of the physico chemical parameters of lake and diversity of fish species and plankton Nandeshwar Dam is eutrophic and the status becoming more and more eutrophic day by day and need to be conserved in the future.

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