

A Study of Seasonal Changes in Water Quality of Lake Rankala

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ABSTRACT

The water samples from different sites of Lake Rankala were studied for physico-chemical characteristics for two different seasons. The temperature of water samples ranges from 27.2°C to 28.5°C in post monsoon season and it ranges in between 29°C to 30.5°C in postsummer season. The total solids ranges from 226 mg/l to 460 mg/l in post monsoon season and the same was found in between 350 mg/l to 534.7 mg/l in postsummer season. The D.O. level ranges from 4.0 to 9.59 mg/l in postmonsoon season and it ranges in between 9.0 to 9.6 mg/l in postsummer season. The B.O.D. values are found less in postmonsoon season and it increases in postsummer season where C.O.D. level ranges from 8.8 to 24.8 mg/l in postmonsoon season and it increases in postsummer season which ranges in between 48.0 to 192.0 mg/l. The level of phosphorus ranges from 1.74 to 3.12 mg/l in postmonsoon season and it was found in between 0.56 to 1.89 mg/l in postsummer season. But at the same time the level of nitrogen from all the sites in postmonsoon season ranges from 0.56 to 4.48 mg/l and it ranges in between 5.60 to 47.60 mg/l in postsummer season.

Keywords:

Water pollution, Sewage, Solids, D.O., B.O.D., C.O.D., Nitrogen.

Introduction

Present work was undertaken on Rankala lake water pollution which is one of the oldest lake in this region, situated in well known city, Kolhapur. Kolhapur city is situated on 15° to 17° N latitude and 73° to 74° E longitude. It also enjoys a moderate climate with temperature rarely dropping below 15°C and occasionally rising above 38°C. Kolhapur city receives fairly good rainfall about 135 cm/annum. This is a city of great antiquity and distinction.

Kolhapur city is surrounded by plenty of water tanks and out of it many of filled up and same was brought under land development for human settlement colonies. This city is flanked by Sahyadri hills on north-western side which add another beauty and charm in Kolhapur environment. Because of this beauty and healthy environment, Kolhapur city is growing very fast and at present having about six lakh population.

From the beginning Rankala lake was famous for fresh good water quality and its unique beauty, which is about 500m away from great Mahalaxmi temple at the western side. On the other side one big historical palace known as Salini Palace which adds more beauty in Rankala scenery. To make more popular and beautiful Rankala, municipal corporation has developed children park, which is heavily crowded from morning to evening. Municipal Corporation has also started boating for tourists and at last all the people enjoy with Bhelpuri, and other fast food product and remaining food, paper, flower and other gods pooja material thrown into lake. At present most of the Rankala sites are used for early morning activity by surrounding local peoples and then for bathing, swimming, washing of cloths, cattle's and vehicles, which adds soaps, detergents and oils in Rankala water which leads to increase the organic pollutant in water body. Even though some sites of this

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The Article Is Published On March
2015 Issue & Available At

www.scienceparks.in

DOI:10.9780/23218045/1202013/49



lake directly connected with municipal sanitary channels which adds huge load of organically rich pollutants in lake water body. Because of all above activities lake water is heavily polluted and it shows huge growth of phytoplankton which alters in monsoon season and get thin film on water surface; and it is the indication of eutrophication. For judging the status of this historical lake water present work was undertaken to understand the causes of pollution and the level of physical, chemical and biological characteristics of Rankala water and find out its control measures.

Material and Methods :

For achieving the objectives of this study in respect to status of lake Rankala water, various sampling sites were selected. Sampling site selection was made mainly on the basis of human activity, animal activity and mixing of city sewage in the lake water. The sampling sites were selected as follows -

R1 - Near to R. K. Kapoor statue (Timber market site).

R2 - At the bathing and cloth washing ghat.

R3 - Along the Rankala garden site.

R4 - Vicinity of Sane Guruji and Fulewadi Vasahat.

R5 - The centre of lake Rankala.

From the above five sites water sampling was made for two different seasons i.e. postmonsoon and postsummer season. Lake water samples were collected in different plastic cans which was already cleaned and rinsed with distilled water. At the same time water samples separately collected in sterilised glass bottles for microbial study. The temperature of water measured at site with the help of standard thermometer. The collected lake water samples brought to laboratory immediately and analysed for physical, chemical and biological parameters. Turbidity of water sample was determined by turbidity meter and Electric conductivity (E.C.) by conductivity bridge. pH of water sample was measured with the help of pH meter where solids were determined using evaporation method. D.O. and BOD were determined by Winkler's idometric method and COD was determined by titrimetry method which described by Trivedy & Goel (1984). The total nitrogen, chloride, hardness and alkalinity was determined by titrometrically and total phosphorous was determined by H_2SO_4 - HNO_3 digestion method. The fecal coliforms determined by MPN technique, which described by APHA (1992).

Results and Discussion :

The physico-chemical characteristics from different water sampling sites were stated in Table 1 & 2 and the colour of water sample from R1 site found greenish colour in postmonsoon season and it changes blakish in the postsummer season. Remaining other four sites sample (R2, R3, R4 and R5) was seen colourless. It was the indication of heavy pollution load at site R1 than the other four sites. Temperature of lake water ranges inbetween 27.2°C to 28.0°C in the postmonsoon season where site R4 shows lowest (27.2°C) temperature and remaining all four sites shows 28.0°C temperature. These range of water temperature increased in postsummer season and lowest temperature 29.0°C was found at site R1 and highest temperature was recorded at site R4 and it was 30.50°C . Kumar (1996) has reported the range of pond water temperature from 24.0°C to 29.0°C in monsoon and 28.0°C to 31.0°C in summer season of Lakhikundi pond (Bihar). Agarkar (1998) has also reported 26.20°C temperature in monsoon and 33.0°C temperature in summer season of the Chandai Reservoir. The turbidity in water samples found high in postsummer season and it ranges inbetween 3.40 NTU to 23.80 NTU. The highest turbidity (23.80 NTU) was noted from site R1 and lowest (3.40 NTU) was noted from site R4 and it was ranges inbetween 4.20 NTU to 6.0 NTU in postmonsoon season. The lowest turbidity was noted from site R5 and it was found highest at site R2 in postmonsoon.

Sampling site R1 found algal odour and remaining four sites don't have any smell in the postmonsoon season where the site R1 shows noxious smell and site R2 shows marshy smell in the postsummer season and remaining sites R3, R4 and R5 don't have any smell. In the present study Lake water found alkaline in condition and its pH ranged from 8.2 to 8.9 in postmonsoon season and it slightly changes in postsummer season and it ranges inbetween 8.1 to 8.8. The minimum pH was noted as 8.1 from the site R1 and maximum at site R5 (8.8). Lake water samples shows high solids (460.0 mg/l) at site R1 and it was found less (224.9 mg/l) at site R3 in the postmonsoon season. This level of solids in water goes to rise in postsummer season and it was found highest (534.7 mg/l) at the site R2 where it was

found very low (350.1 mg/l) at site R5. The dissolved solids were ranges from 162.30 mg/l to 256.20 mg/l. in the postmonsoon season, where it was ranges inbetween 215.40 to 292.8 mg/l in postsummer season. The high load of dissolved solids was found at site R5 and it was 292.8 mg/l and 215.4 mg/l at site R3 which was low in postsummer season.

Electric conductivity in water sample ranges inbetween 304.0 to 710.0 \square Mhos/cm in the postmonsoon season and the lowest conductivity was observed at site R4 where highest E.C. noted from site R1. The range of conductivity was again going on increases in the postsummer season except site R1 and it was ranges inbetween 371.0 to 417.0 \square Mhos/cm. The lowest conductivity in lake water was noted from the site R4 and it was found highest at site R1. From these observations it is clear that the site R1 was highly influenced with pollution load due to mixing of sewage in postmonsoon season and continuous activities of peoples like, cattle washing, clothe washing, vehicle cleaning and washing, bathing and swimming in postsummer season, because site R1 do not have protective wall and shallow water condition which is easy access to people and animal for completing various activities. It is evident from the table 1 and 2 the level of D.O. 4.08 mg/l was found at site R1 and it was found 9.59 mg/l at site R4 in the postmonsoon season. The remaining site R2, R3 and R5 found 6.32, 8.57, and 8.99 mg/l of D.O. respectively. Kadam (1990) has reported 6.12 mg/l of D.O. from Lake Rankala. And these level of D.O. was going on increasing in postsummer season and it ranges inbetween 9.0 to 9.60 mg/l. The lowest level 9.0 mg/l of D.O. was found at site R2 and R3 where site R1, R4 and R5 showed 9.20, 9.40 and 9.60 mg/l of D.O. respectively. In the present investigation the B.O.D. values in lake water ranged from 2.46 to 12.24 mg/l in postmonsoon season. The low (2.46 mg/l) of B.O.D. was found at site R5 and it was found high (12.94 mg/l) at site R1 and R2. Remaining sites R3 and R4 was observed 4.08 and 6.12 mg/l of B.O.D. respectively. The B.O.D. level slightly fluctuate in postsummer season and it ranges inbetween 8.10 to 13.78 mg/l. The minimum B.O.D. was found at site R3 where maximum B.O.D. observed at site R2. The remaining site R1, R4 and R5 observed 10.94, 9.32 and 9.72 mg/l of B.O.D. respectively.

To decide the water quality, chemical oxygen demand (C.O.D.) is a most important parameter. In the present study C.O.D. values were vary from site to site and ranged from 8.80 to 24.80 mg/l in lake water whee low (8.80 mg/l) of C.O.D. was found at site R4 and it was found high (24.8 mg/l) at site R1 in postmonsoon season. The remaining site R2, R3 and R5 found 16.80, 12.80 and 10.40 mg/l of C.O.D. respectively. These C.O.D. values increases in postsummer season and it was found 48.0 mg/l at site R3 and 192.0 mg/l at site R2 and R5. At the same time site R1, R3 and R4 showed 68.0, 48.0 and 100.0 mg/l of C.O.D. respectively. From the table 1 and 2 it clears that the phosphorus level in water increases in postmonsoon and it decreases in postsummer season. In the postmonsoon the level of phosphorus ranges inbetween 1.74 to 3.12 mg/l and it was ranges inbetween 0.56 to 1.89 mg/l in postsummer season. the highest level of phosphorus found at site R1 and it was 3.12 mg/l, whereas lowest was noted from site R2 and it was 1.74 mg/l. Remaining site R3, R4, and R5 observed 3.04, 2.20 and 2.0 mg/l of phosphorus respectively.

In the postsummer season phosphorus level was declined at all the sampling sites and the lowest was found at site R4 and it was 0.56 mg/l. where highest was observed at site R2 and it was 1.89 mg/l. The remaining site R1, R3 and R5 found 1.69, 0.81 and 1.45 mg/l of phosphorus respectively.

It was very interesting to note that the nitrogen level in all water sampling sites exactly shown opposite trend in respect of phosphorus level. The level of nitrogen was found in the range of 0.56 to 4.48 mg/l in postmonsoon season and it was significantly increases in postsummer season and it was ranged inbetween 5.6 to 47.6 mg/l. In the postmonsoon season the lowest nitrogen level was found at site R5 (0.56 mg/l) and highest was noted from site R1 (4.48 mg/l). The same was increases in postsummer season and the low level of nitrogen content was found at site R5 and it was 5.6 mg/l while it found very high at site R2 and it was 47.60 mg/l. Even though the level of nitrogen at all the sampling sites increased by many folds in postsummer season where the phosphorus level was successively decreases. As like nitrongen level the same trend was observed for chloride level in all the water sampling sites for two different season. The level of chloride was ranges inbetween 42.60 to 48.28 mg/l in postmonsoon season and it increases in postsummer season and it ranges inbetween 53.96 to 63.90 mg/l. In the postmonsoon the lowest was noted from site R2 and it was highest at site R1 where the remaining site R3, R4 and R5 observed the same level of chloride and it was 45.44 mg/l. In the postsummer season the

highest level of chloride was found at site R1 (i.e. 63.90 mg/l) and lowest was noted from site R4 and it was 53.96 mg/l where remaining site R2, R3 and R5 found 55.38 mg/l of chlorides. Agarkar (1998) has reported 36.2 mg/l of chloride in summer season and 33.90 mg/l in monsoon season from Chandai reservoir water. Rao and Mahamood (1995) have also reported chloride content in the month of May and September as 560.0 ppm and 320.0 ppm respectively from the Hubsiguda Pond (A.P.) Kumar and Singh (1996) have reported 34 to 52 mg/l of chlorides in the summer season and 31 to 45 mg/l of chlorides in monsoon season from the lake of Sauthal Pargana (Bihar).

Present study shows low hardness in postmonsoon water sample and it increased in postsummer water sample. The hardness of lake water sample in postmonsoon season ranged inbetween 76.0 to 92.0 mg/l and it was found lowest at site R4 and highest at site R1 where remaining site R2, R3 and R5 shown 84.0, 80.0 and 88.0 mg/l of hardness respectively. This level of hardness increased in postsummer season and it ranged inbetween 120.0 to 134.0 mg/l and lowest was found at site R1 and highest was found at site R2 where remaining sites R3, R4 and R5 observes 126.0 and 128.0 mg/l of hardness respectively.

Rankala lake water study showed lowest alkalinity in postmonsoon season and it increases in postsummer season. In the postmonsoon season low alkalinity was found at site R4 and it was 70.65 mg/l and it was found high at site R1 i.e. 120 mg/l where remaining site R2, R3 and site R5 observed 112.0, 96.50 and 85.25 mg/l of alkalinity, respectively. These range of alkalinity were increase in postsummer season and it found low as 150 mg/l at site R4 and as high at site R1, R2 and R3 and it was 300.0 mg/l where site R5 shows 200.0 mg/l of alkalinity.

The pathogenic organisms present in aquatic environment can be of natural origin or discharged by man and other warm blooded animals. Hence, it is very important to know the MPN of coliform bacteria per 100 ml. of sample. The number of organisms present is not absolute but it is statistical estimate. It is also essential to know the probability of human fecal pollution before final conclusions can be drawn or legal restrictions placed before on the use of a water supply. In these interaction present investigation observed that water samples from R1 to R5 sites shows positive results for the MPN test. The most probable number from all the samples of both the seasons i.e. postmonsoon and postsummer season was found >2400/100 ml of MPN (Table 1 and 2). From these observation it clears that the lake Rankala water was highly contaminated with various types of pathogenic organisms.

Present study on seasonal water quality of Lake Rankala revealed that there was significant variation in physico-chemical characteristics. The colour of water sample from site R1 was greenish in postmonsoon and it turns blackish in postsummer season where other water sampling sites as R2, R3, R4 and R5 remains colourless in both season. Even water sampling site R1 found algal odour in postmonsoon and it was changed into noxious in postsummer season. Total solids was also found high at site R1 in both the seasons and it reduced in postsummer season. Maximum E.C. was found in postmonsoon season and it declined in postsummer season from site R1, it may be due to mixing of sewage at site R1 which do not have any protective wall and it may loaded with inorganic ingredients which may precipitate upto postsummer season and it reduces E.C. (Table 1 and 2). The D.O. level was significantly increases in water samples of postsummer season and it was very low in postmonsoon season at site R1. Low D.O. level at site R1 in postmonsoon it may due to mixing of organically rich wastewater and its level increases in postsummer may because of drying of wastewater ways. Exactly opposite trend was found in case of B.O.D. which found more in postmonsoon at site R1 and reduces in postsummer at site R1 where remaining sites found increased level of B.O.D. in postsummer season. It clears that the site R1 charged with fresh organic wastewater load in postmonsoon and the organic matter may fastely go under degradation processes and due to water current, wave action and water movement it reach at all sites as well as it may possibly increase in B.O.D. at site R2, R3, R4 and R5 due to disposal of organic material by the tourist and visitors in postsummer season.

C.O.D. level were also increases in postsummer season at all the sites and it clears that the peoples activities reach at top like, cloth washing, bathing, cattle and vehicle washing, boating and swimming through which it adds soap, detergent, drugs, organic matter, oil and grease and further it results in increase of C.O.D. The phosphorus level was highly affected in postsummer season and it was high in postmonsoon season. It might be

due to huge growth of algal forms in postsummer season which utilize maximum available phosphorus for their further growth and regeneration as well as it might be precipitate and fixed into mudflats, where nitrogen level surprisingly increases at all sites in the postsummer season than the postmonsoon season it may be due to maximum death of phytoplankton and blue green algae due to natural and manmade changes in water which release again back nitrogen in water. The chloride content and hardness of water sample also found same trend. The alkalinity of water sample was also high noted in postsummer season and it was highest at site R1.

In case of biological parameter i.e. M.P.N. of water sample from all the site showed very high number of pathogenic organisms. It indicates that whole lake water body was highly contaminated with various types of pathogenic organisms and it was the indication of mixing of sewage in lake water. From above conclusions it indicates that sampling site R1 and R2 were highly contaminated due to mixing of direct and indirect contaminants into lake water through poor sanitary wastewater system and maximum human activities.

Table - 1 : Post-monsoon season water quality of Lake Rankala from five different stations

Sr. No.	Parameter	Sampling Sites				
		R1	R2	R3	R4	R5
A.	Physical Parameters					
1.	Colour	Greenish Gry	Colour-less	Colour-less	Colour-less	Colour-less
2.	Temperature °C	28.00	28.00	28.00	27.20	28.00
3.	Turbidity NTU	5.40	6.00	4.60	5.20	4.20
4.	Odour	Algal	Nill	Nill	Nill	Nill
5.	pH	8.60	8.90	8.60	8.20	8.60
6.	Total Solids	460.00	226.80	224.90	240.20	271.00
7.	Dissolved Solids	220.80	210.00	162.30	225.20	256.20
8.	E.C. µMhos/cm	710.00	324.00	312.00	304.00	320.00
B.	Chemical Parameters					
1.	Dissolved Oxygen	4.08	6.32	8.57	9.59	8.99
2.	Biochemical Oxygen Demand	12.24	12.24	4.08	6.12	2.46
3.	Chemical Oxygen Demand	24.80	16.80	12.80	8.80	10.40
4.	Total Phosphorus	3.12	1.74	3.04	2.20	2.00
5.	Total Nitrogen	4.48	2.24	1.68	1.68	0.56
6.	Chlorides	48.28	42.60	45.44	45.44	45.44
7.	Hardness	92.00	84.00	88.00	76.00	88.00
8.	Alkalinity	120.00	112.00	96.50	70.65	85.25
C.	Biological Parameters					
a.	MPN/100 ml.	>2400.00	>2400.00	>2400.00	>2400.00	>2400.00

Note : All values unless otherwise stated are in mg/l. except pH.

Table - 2 : Post-summer season water quality of Lake Rankala from five different stations

Sr. No.	Parameter	Sampling Sites				
		R1	R2	R3	R4	R5
A.	Physical Parameters					
1.	Colour	Blakish	Colour-less	Colour-less	Colour-less	Colour-less
2.	Temperature °C	29.00	30.00	30.00	30.50	30.00
3.	Turbidity NTU	23.80	16.60	4.20	3.40	4.10
4.	Odour	Noxious	Marshy	Ab	Ab	Ab
5.	pH	8.10	8.20	8.60	8.20	8.80
6.	Total Solids	397.70	534.70	416.00	453.30	350.10
7.	Dissolved Solids	290.60	215.40	290.40	267.90	292.80
8.	E.C. µMhos/cm	417.00	399.00	391.00	371.00	384.00
B.	Chemical Parameters					
1.	Dissolved Oxygen	9.20	9.00	9.00	9.40	9.60
2.	Biochemical Oxygen Demand	10.94	13.78	8.10	9.32	9.72
3.	Chemical Oxygen Demand	68.00	192.00	48.00	100.00	192.00
4.	Total Phosphorus	1.69	1.89	0.81	0.56	1.45
5.	Total Nitrogen	30.80	47.60	16.80	9.80	5.60
6.	Chlorides	63.90	55.38	55.38	53.96	55.38
7.	Hardness	120.00	134.00	126.00	126.00	128.00
8.	Alkalinity	300.00	300.00	300.00	150.00	200.00
C.	Biological Parameters					
a.	MPN/100 ml.	>2400.00	>2400.00	>2400.00	>2400.00	>2400.00

Note : All values unless otherwise stated are in mg/l. except pH.

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