

Seasonal variation in physico-chemical parameters of Hirahalla reservoir, Koppal District Karnataka

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Abstract- The Hirahalla reservoir is situated near Pune. The study of physico chemical parameters like temperature, pH, electric conductivity, , potassium, total hardness, calcium, magnesium, alkalinity, chloride, dissolve oxygen, biochemical oxygen demand, nitrate, and phosphate, has been studied in the period of October 2007 to September 2008. The study shows that seasonal variation in the physico-chemical parameters. The results indicate that all the physico-chemical parameters are with in the permissible limits and reservoir is productive.

Key words: Physico–chemical parameters, Hirahalla reservoir, Seasonal Variation

Introduction

Water is an indispensable natural resource on earth. All life including human being depends on water. We have enormous resource on the earth amounting to about 13, 481, 96000 Km³ of water. Due to its unique properties water is of multiple uses for living organisms. In India 77% of water is used in agricultural sector (1). Human being depends on water for almost every developmental activity. Water is used for drinking, irrigation, washing, and Industrial purposes. Although water is very abundant on this earth, yet it is very precious. Out of the total water reserves of the world, about 97% is salty water and only 3% is fresh water. Even this small fraction of fresh water is not available to us as most of it is locked up in polar ice caps and just 0.003% is readily available to us in the form of ground water and surface water. (2). The fresh water resources now a day as consequences of population explosion coupled with industrialization, urbanization, and green revolution. In reservoirs, which are formed at the back of the relieved and accumulated structures on the running water, new organisms come into existence with the effects of different morphological structures. (Fair et al., 1971). In order to benefit from our reservoirs, lakes, ponds, dam lakes and rivers, we have to know the characteristics of these waters and the algae which are the first link of the food chain with regards to ecology and taxonomy. In comparison with natural lakes and marshes, reservoirs have the following features: (1) the water level varies irregularly, which physically destabilizes the lake shoreline, and (2) the hydrogeological structure of dam lakes is complicated and could change easily because the water level is regulated artificially (Nakashima et al., 2007). In recent years, activities to preserve the water quality and ecosystem of reservoirs and lakes have been encouraged. For example, research on the classification of the water quality of reservoirs and lakes and the effects of its use on land have been carried out.

MATERIALS AND METHODS

The physico-chemical variables were estimated as per the Standard Methods (APHA, 1998). Water samples collected for the purpose of estimation of various parameters were brought to the laboratory and subjected to analysis immediately as for as possible. Standards Methods for Estimation of Water and Wastewater 20th edition, 1998 were referred for estimation of parameters viz., Total Dissolved Solids, pH, Dissolved Oxygen, Free Carbondioxide, Total Alkalinity, Hardness, Calcium, Magnesium, Chloride, nitrate , Phosphorus and Biochemical Oxygen Demand.

Results and discussion

Physico-chemical Characteristics

The water quality parameters of the samples analyzed have been presented and discussed with reference to their seasonal variations. (Tables 1) Further, for comparison BIS standards of water quality methods are presented.

Temperature

The temperature is one of the most important ecological factor which controls the physiological behaviour and distribution of the organisms. The catabohc energy released in the form of heat during the decomposition of organic matter and respiration also slightly added to the temperature. In the present investigation, air and water temperature were recorded. Air temperature varied minimum of 23.5°C to 40 oC and maximum of 40.5°C recorded in summer season. Subsequently, water temperature ranges from 21°C to 25.3 oC respectively. The maximum temperature was noticed in summer season. The results clearly showed that, water temperature remained lesser than air temperature throughout the study period. Similar observations were made by Ade and Vankhede (2001).

pH

pH is an important parameter that determines the suitability of water for various purposes. pH of water is important for the biotic communities because most of the plant and animal species can survive in a narrow range of pH from slightly acidic to slightly alkaline condition. During the study period the high pH (8.60) value at station 4 and low pH value (7.3) at station 1 was recorded. The present results confirmed with the study of Das et al. (1961) observe, high pH values coincided with plankton density reaches peak. On the other hand, Puttaiah (1986) has obtained a direct relationship between water temperature and pH. Whereas, Mary Bai (1989) reported that the pH of polluted water fluctuates in the range of 8.0 to 9.0. In the present investigation pH recorded ranges between 7.30 to 8.60 Therefore, pH values all the stations shows slightly alkaline condition.

EC

Conductivity is the capacity of substance or solution to conduct electrical current, most of the salts in water are present in the ionic forms, capable of conducting electric current. EC recorded minimum of 64.89 $\mu\text{S}/\text{cm}$ at station 3 and maximum of 23 $\mu\text{S}/\text{cm}$ at the station 4. While, higher values of electrical conductivity recorded in northeast monsoon season and low during monsoon seasons. This may be due to agricultural run-off. Similar observations have been made by munnavar (1885) and nagarathna (1986).

Total alkalinity

Alkalinity of the water is the capacity to neutralize strong acids that gives primarily a function of carbonate, bicarbonate and hydroxide content and formed due to the dissolution of carbon dioxide in water. In the present investigation the total alkalinity values were fluctuated between 27.82 mg/L at station V to 49.07 mg/L at station Seasonal variation exhibited the highest values of alkalinity during northeast monsoon season and low value, recorded during monsoon season. Narashimha Rao and Jaya Raju (2001) found that alkalinity values varied between 90 to 265 mg/L in sewage fed fish culture pond at Nambur. Patil and Sankaran Unni (1986) recorded the alkalinity, which ranged between 21 to 52 mg/L¹ and were of the opinion that alkalinity increases in the summer seasons.

Potassium

Potassium is one of the macronutrient found in cationic form. In the present investigation potassium ranges from minimum of 0.30 mg/L at station IV in the southwest monsoon season and maximum of 0.80 mg/L at station III and II in the summer season. Whereas, if seasonal variations are considered higher values of potassium was

noted northeast monsoon season and summer season Mittal and (1988) have stated that, potassium does not show any marked seasonal variation. Hence, the present investigation are partial agreement with findings of above researchers.

Total hardness

Calcium, magnesium, carbonates, bicarbonates, sulphates, chlorides, nitrates, organic matter together associate and forms hardness of water. According to hardness scale by water quality association (Lehr e al., 1980), Hardness value range 0 to 17 mg/L¹ is soft water, 17 to 60 mg/L¹ is slightly hard, 60 to 120 mg/L¹ is moderately hard, 120 to 180 mg/L¹ hard water and more than 180 mg/L is very hard. In the present investigation based on the scale represent low hardness value recorded 6.81 mg/L at station IV and high hardness value recorded 17.45 mg/L at station I respectively. This indicate total hardness values ranged between 7.59 mg/L to 21.97 mg/L indicating the water is soft Total hardness was found high in northeast monsoon season and the low values were recorded in the southwest and northwest monsoon season. Patil et al. (1986) reported higher hardness during monsoon season and attributed it to the inflow of rainwater from agricultural fields carrying good amount of suspended salts. Present investigations are in agreement with these findings.

Calcium

Rich source of calcium will be drained through various sources, which results fresh water alkaline nature being associated with magnesium, barium, strontium etc. But according to reports high calcium content in the water considered no hazardous effect on human health. On the other hand, it plays very important role in growth and metabolism of aquatic organisms.

In the present investigation average calcium content ranges from minimum of 5.07 mg/L to 15.85 mg/L in southwest monsoon and northeast monsoon season. Among the six stations the lowest values were recorded at station IV (4.29) and maximum values recorded at station II (18.66 mg/L) respectively.

With regard to the seasonal variation, a gradual increase in the concentration of calcium in all the six stations of reservoir during post and pre-monsoon seasons. Comparatively, calcium found to be maximum values in monsoon season. To witness, Rajini (1989) also recorded more or less similar values and also reported that calcium concentration increases during monsoon season.

Magnesium

Magnesium concentration in the water always remains lower than that of calcium content. Variations in magnesium concentration have

been attributed to different biogeochemical activities in the water ecosystem. In the present investigation the average concentration of magnesium ranges from 1.94 mg/L to 6.12 mg/L respectively. Among the six stations the maximum magnesium content was recorded at station IV (7.03 mg/L) while low concentration values were recorded at station II (0.99 mg/L) respectively. Similarly, seasonal variations of magnesium concentration showed high during monsoon followed by northeast monsoon season. But comparatively less during summer season. Thus, concentration of magnesium remained lower than calcium throughout the study in all five waterbodies. Dakshini and Gupta (1974) also witnessed similar variations.

Chloride

Higher concentration of chloride in the water may be due to discharge of domestic sewage and also excess of chlorine in water, it serves as an indicator of water pollution. During first year, average annual chloride content ranges from minimum of 4.44 mg/L to maximum 10.0 mg/L. Seasonal variations of chloride content comparatively high during northeast monsoon season and low content were noticed in southwest monsoon season. The findings attributed high chloride value due to increase of organic matter (Adam),

Dissolved oxygen

Dissolved oxygen is one of the most important parameter in assessing the quality of water, which is essential to maintain biotic forms in water. It depends on factors like temperature of water. In the present investigation the dissolved oxygen was found to be maximum of 9.44 mg/L at the station V and minimum of 7.37 mg/L recorded at station VI respectively. To witness Singh (2000) also recorded higher values of dissolved oxygen during summer. The above results witnessed with the results of (Dwivedi)

Free carbon dioxide

Carbon dioxide is the chief parameter required for photosynthesis process in plants. In waterbodies carbon dioxide reacts with water and forms carbonic acid, which soon dissociates into carbonates and bicarbonates, which alters pH of water. In the present investigation the concentration of carbon dioxide in reservoir ranges from 4.4 to 39.6 mg/L. If the seasonal averages are considered the concentration of carbon dioxide at station III recorded higher during northeast monsoon season. Interestingly, carbon dioxide showed varied behaviour in different seasons in all the six stations. Chandler (1953) discussed the behaviour of carbon dioxide with pH and stated that increase in carbon dioxide concentration in water results decrease of its pH due to the formation of carbonic acid.

Biochemical oxygen demand (BOD)

Biochemical oxygen demand is nothing but the amount of oxygen utilized by microorganisms to stabilize the organic matter. BOD determines the strength of sewage, effluents and other polluted waters and provides data on the pollution load in all natural waters. According to BIS specifications potable water should be zero. But BOD value of 3 mg/L¹ is permissible. In the present investigation BOD values ranges 0.26 to 3.23 mg/L. The results indicate that BOD values are relatively higher at station I and station IV. Reason of high values of BOD in these stations may be due to agricultural and domestic discharge during rainy season. If seasonal variations are taken into consideration, higher BOD values were observed northeast monsoon and low BOD values recorded during summer and southwest monsoon season. These results partially agreed with findings of Chatterjee (1992), who has recorded higher BOD values during northeast monsoon and attributed to the enhanced biological activity at higher temperature.

Phosphate

Phosphates are essential for the growth of organism and a nutrient that limits primary productivity of the waterbody. When the phosphate is in low concentration behaves like most important nutrient, when it is excess causes algal blooms. In the present investigation phosphate ranges from a minimum of 0.00 mg/L to a maximum of 0.47 mg/L in station I and VI. There is a slight fluctuation during study period. Whereas, seasonal values are considered, phosphate was found to be high during monsoon and pre-monsoon season but low during post-monsoon season. This may be due to inflow of phosphate content from surroundings through runoff. The low content of phosphate in summer season may be due to utilization of phosphate by the phytoplankton. Kaul et al. (1980) have also observed similar results in the waterbodies.

Nitrate

Nitrate is the oxidized form of nitrogen and end product of aerobic decomposition of organic nitrogenous matter. The presence of nitrate in fresh waterbodies depends mostly upon the activity of nitrifying bacteria, domestic and agricultural source. In the present investigation, nitrate content varied between 0.32 mg/L to 1.09 mg/L through out the study period. On the other hand, seasonal variations are taken into consideration, higher values are recorded during summer and northeast monsoon season and lower values of nitrate recorded during monsoon season. Manikya Reddy (1984) and Sudhakar (1989) have also observed that nitrates are abundant during monsoon season. These changes commonly associated with erosion and

transportation of nitrogenous rich fertilizers, soil and local sources into the water.

Correlation coefficient relationship among different physico-chemical parameters

An attempt was made to study the relationship existing among various physico-chemical parameters by calculating the correlation coefficients. The physico-chemical correlation coefficient values of Sogane kere is given in Table 1. Among the important parameters pH is significantly and negatively influenced by phosphate (-0.45) and calcium(-0.61), whereas influenced by total alkalinity (-0.43), and sulphates (-0.53), But the electrical conductivity of the water in reservoir is positively influenced by chlorides (0.46) and potassium (0.47). Total alkalinity is positively influenced by nitrate (0.46), sulphates (0.56) and sodium (0.43), BOD (0.64) and negatively related with calcium (-0.58).

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Table 1-

Parameter	Season	S I	S II	S III	S IV	SV	S VI	Average
Temp. °C	NEM	25.45	20.85	20.08	21.23	19.95	20.14	21.28
	Summer	35.28	25.07	25.48	25.75	26.22	24.64	27.07
	SWM	21.34	20.08	23.16	22.49	22.30	23.82	22.20
pH	NEM	7.77	7.34	7.10	7.63	7.45	7.75	7.51
	Summer	7.49	6.96	7.97	8.05	7.83	7.95	7.71
	SWM	7.36	6.54	8.19	8.60	7.50	8.44	7.77
EC µS/cm	SWM	123.4	138.31	117.12	123.23	121.19	119.57	123.80
	NEM	97.67	91.52	64.89	115.14	84.14	112.84	94.37
	Summer	72.51	76.79	75.23	75.11	69.40	72.10	73.52
Alkalinity	NEM	49.07	40.05	33.80	44.84	42.32	39.49	41.60
	Summer	47.75	42.19	28.37	32.74	30.30	30.06	35.24
	SWM	32.68	33.12	30.47	28.26	27.82	31.80	30.69
K	NEM	0.60	0.70	0.80	0.65	0.55	0.65	0.66
	Summer	0.55	0.80	0.75	0.55	0.50	0.60	0.63
	SWM	0.50	0.50	0.40	0.30	0.40	0.60	0.45
Total hardness	NEM	22.89	22.98	19	23.38	22.92	20.63	21.97
	Summer	18.93	11.71	11.63	11.26	12.49	13.3	13.22
	SWM	7.18	8.73	7.62	6.81	7.69	7.49	7.59
Ca	NEM	17.45	18.66	13.05	16.24	15.89	13.81	15.85
	Summer	15.66	10.72	10.07	8.27	11.45	11.49	11.28
	SWM	4.79	5.91	5.49	4.29	5.00	4.93	5.07
Mg	NEM	5.44	4.32	5.95	7.14	7.03	6.82	6.12
	Summer	3.27	0.99	1.56	2.99	1.04	1.81	1.94
	SWM	2.39	2.82	2.13	2.52	2.69	2.56	2.52
Cl	NEM	10.74	9.09	8.35	12.39	9.83	10.20	10.10
	Summer	7.15	8.43	6.64	6.91	7.25	7.06	7.24
	SWM	4.27	4.37	4.66	4.57	4.37	4.37	4.44
DO	NEM	7.60	7.50	7.62	7.82	7.56	7.37	7.58
	Summer	9.05	9.12	8.89	9.42	9.44	9.01	9.16
	SWM	8.47	7.51	8.53	9.25	8.52	8.22	8.42
BOD	NEM	3.23	0.71	0.67	0.87	0.54	0.26	1.05
	Summer	1.15	0.98	0.94	0.54	0.82	0.33	0.79
	SWM	0.71	0.63	0.55	0.39	2.05	0.32	0.78
COD	NEM	9.93	7.87	16.15	14.08	13.66	18.22	13.32
	Summer	13.81	13.28	18.42	11.35	10.47	14.52	13.64
	SWM	4.68	3.12	7.03	3.12	1.56	6.25	4.29
NO ₃	NEM	0.82	1.01	0.83	0.93	0.71	0.92	0.87
	Summer	1.09	0.92	1.37	1.17	1.10	1.15	1.13
	SWM	0.33	0.32	0.33	0.35	0.43	0.36	0.35
PO ₄	NEM	0.06	0.00	0.03	0.14	0.03	0.10	0.06
	Summer	0.03	0.05	0.04	0.04	0.47	0.03	0.11
	SWM	0.29	0.36	0.34	0.42	0.29	0.35	0.29