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Physico-chemical characteristic of “Gajner Lake” in Arid Region of Rajasthan

Abstract: *The arid region of Rajasthan, constituting the Rajasthan desert, has very limited water resources, particularly lakes. Water, an indispensable component of an ecosystem, is a necessary resource for the sustainability of life on the earth. The freshwater bodies all over the arid region of Rajasthan are getting polluted, thus decreasing the suitability of potable water. Bikaner forms an important part of the arid region of Rajasthan. Ponds present in and around Bikaner city and a few lakes of the district were the primary sources of drinking water in the past. “Gajner Lake” is an artificial lake situated in the Gajner village Bikaner at a distance of 32 km south-west of Bikaner city. The analysis of water quality provides important data about the various changes caused by various biotic and abiotic factors during different seasons. The Present study deals with determining some physicochemical characteristics of water, viz. BOD, COD, DO, nitrate, sulphate and fluoride during the year 2016-2017. Significant variations were observed during different seasons in these parameters.*

Keywords: *BOD (Biological oxygen demand), COD (Chemical oxygen demand), DO (Dissolved oxygen).*

I. INTRODUCTION

Water is the most useful natural resource on the blue planet. Physical, chemical and biological interactions determine the quality of water. Continuous circulation, transformation and accumulation of energy and matter at the different tropic levels of the aquatic ecosystems are causing changes in the quality of water day by day. Lakes are important water resources for domestic, industrial, agricultural, fishery, recreational and energy production purposes. Increased human population has greatly contributed toward the discharge of large amounts of waste material and pollutants, which has converted the freshwater reservoir into an impending contamination sink, giving rise to the water pollution problem (Venkatesan, 2007¹; Aelhikan, 2009²). The ecosystem of lakes is complex and fragile as the rate of discharge of pollutants into them is much more

than the rate of self-cleaning ability, and therefore, they tend to readily accumulate such pollutants (Abid ., 2008³)

Bikaner district is located between 27°11' and 29°03' N latitude and 71°54' and 74°12' E longitude and lies in the north-western part of Rajasthan. The major part of the district covers desolate and dreary regions and forms an important part of the Great Indian Desert. It is characterized by a plain area undulating or interspersed with shifting sand dunes. There are no hills, reevaluates or streams of any significance. The climate ranges from arid to extreme arid with extreme temperature and low and scanty rainfall. The year may be divided into three distinct seasons, viz. winter (November to February), summer (March to June), and rainy (July to October). The Gajner Lake is situated about 32 km at Gajner in the south-west of Bikaner city. The catchment area of this lake is about

129.5 sq. km and is fed by local streams. It belongs to Maharaja, and members of the royal family took their resort during summer. Lake water is used mainly for drinking and bathing purposes. Its bank on one side is green and wooded, while the other side is covered by the composing palace and garden watered from the lake.

The measurement of DO, BOD and COD could indicate the pollution level in a given water reservoir (Manahan, 1992⁴; Kolo, 2010⁵). The wastes consisting mainly of phosphate-containing detergents and nitrate help in the growth of aquatic weeds, causing interference with the dissolved oxygen, biological oxygen demand, conductivity and turbidity (Parashar, 2006⁶). In the present study, seasonal variations in PH, water temperature, nitrate, sulphate, dissolved oxygen (DO), and biological oxygen demand (BOD) were analyzed to determine the pollution status of the lake water.

II. MATERIAL AND METHODS:

Random composite water samples were collected fortnightly in acid-washed water sampling bottles for the period of two years (2016-2017). Collections were done during morning hours. The water temperature and pH were determined by thermometer and digital pH meter, respectively. Nitrate, sulphate, fluoride, DO, BOD, and COD were determined seasonally in winter, summer, and rainy seasons according to the standard method of APHA7.

Parameters	Year	Winter	Summer	Rainy
Water temp. (°C)	2016	16.6±1.23	28.2±1.54	25.2±1.78
	2017	17.0±1.06	27.8±1.32	25.0±1.82
pH	2016	8.2±0.52	8.0±0.09	8.0±1.02
	2017	8.3±0.62	8.0±0.42	8.3±0.83
DO (ppm)	2016	8.8± 0.72	3.5± 0.64	5.5± 0.66
	2017	8.5± 1.12	3.0± 0.95	5.6± 1.08
BOD (ppm)	2016	3.0± 0.38	5.8± 0.58	5.2± 0.72
	2017	3.5± 0.25	8.5± 0.63	5.5± 0.49
COD (ppm)	2016	20.3± 1.63	33.4± 2.32	24.2± 1.45

	2017	20.7± 1.54	30.6± 1.72	26.7± 1.28
SO ₄ ²⁻ (ppm)	2016	15.6±2.12	12.2±1.84	14.6±2.62
	2017	14.2±2.34	13.9±1.53	15.0±2.19
NO ₃ ⁻¹ (ppm)	2016	3,9±0.32	6.7±0.68	3.4±0.56
	2017	3.8±0.47	6.5±0.55	3.6±1.03
F ⁻¹ (ppm)	2016	0.62±0.06	0.71±0.07	0.70±0.02
	2017	0.65±0.02	0.68±0.04	0.75±0.05

(Table – 1) Physico-chemical analysis of Gajner Lake in Bikaner District during different seasons (2016-2017).

III. RESULTS AND DISCUSSION:

Fresh water is a finite source and essential for the existence of life on the earth; without its adequate quantity and quality, sustainable development will not be possible (Kumar, 1997⁸). The addition of various kinds of pollutants and nutrients brings about a series of changes in the physico-chemical characteristics of water, which may make it unfit for drinking and other purposes. The results of the physicochemical characteristics of water with different seasons for two years are presented in Table-1.

Water temperature- Among the several environmental factors, the role of water temperature is an important one as it determines the reactivity of several other physico-chemical and biotic factors of aquatic systems. It determines the status of oxygen in the water body. The temperature varied from 16.6° to 28.2° with a maximum in the summer season followed by rain and a minimum in the winter season in both years. This suggests that fluctuations in an aquatic environment are less violent than those in the aerial.

pH - pH is a measure of relative acidity or alkalinity. In natural water, pH remains slightly alkaline (Sharma et al., 1984⁹). It regulates most of the biological processes and biochemical reactions. The overall average seasonal pH ranged from 8.0 to 8.3, which is nearly within the maximum permissible

limit specified by WHO and BIS. Table - 1 shows the maximum value of pH during winter and minimum in summer in both years, which are in accordance with Mishra et al. (2008¹⁰) and Tara et al. (2011¹¹).

Dissolved oxygen (DO) - The amount of DO in natural water depends on many physical, chemical and biochemical factors. Analysis of DO is a key parameter to determine the pollution status of water bodies. The optimum value of DO for good water quality is 4 mg/L to 6 mg/L, which ensures healthy aquatic life in a water body. The range of DO in the present study was observed to be from 3.0 mg/L to 8.89 mg/L. The DO was highest in the winter season and lowest in summer. The same trend of variation in DO was also observed by Barupal and Gehlot (2016¹²) in an arid zone lake. This can be explained on the ground that a rise in water temperature increases the metabolic rate of organisms and also reduces the solubility of oxygen in water (Hazelwood and Paker, 1961¹³). The concentration of DO below 5 mg/L may adversely affect the functioning of the aquatic ecosystems (Sisodia and Moundiotia, 2006¹⁴).

Biological oxygen demand (BOD) - It is an effective indicator of the organic quality of water (Clair et al., 2003¹⁵). In the present investigation, BOD ranged between 5.2 mg/L and 8.5 mg/L, increasing during the summer season and decreasing during the winter season. Similar results have also been recorded by various workers (Abir, 2014¹⁶; Prasannakumari et al., 2003¹⁷). High BOD during the summer may be due to suitable environment for microbial growth.

Chemical oxygen demand (COD) - The COD of water increases with increasing concentration of organic matter. Its values varied between 22.3 mg/L to 33.4 mg/L and were observed to be higher during summer and lower during winter. The fluctuations in COD indicate the variations in the degree of organic pollution during different seasons. The average seasonal COD during both the years was much beyond the permissible limit as prescribed by WHO (10 mg/L).

Sulphate (SO₄) - The presence of sulfate in drinking water can also result in a noticeable taste. Water containing magnesium sulphate at levels above 600 mg/l acts as a purgative in humans. The major physiological effects resulting from the ingestion of large quantities of sulphate are catharsis, dehydration

and gastrointestinal irritation. Sulphate was estimated maximum (of 15.6 mg/L) in the winter season and a minimum (of 12.2 mg/L) in the summer season.

Nitrate (NO₃) - Nitrates are contributed to freshwater through wastes from human bodies and cattle, sewage, industrial waste and farmland runoff leaching from the soil. Nitrate was estimated maximum (4.7 mg/L) in the summer season and minimum (2.4 mg/L) in the rainy season. Similar results were also recorded by Yadav (2013¹⁸).

Fluoride (F⁻) - The presence of high concentrations of fluoride in water is also a significant problem in the area. People who use surface water resources for drinking are affected by many health problems. The concentration of fluoride was observed to be maximum (0.75 ppm) during summer and minimum (0.62 ppm) during the winter season; these values are within the standard limits. High concentrations of fluoride, often significantly above 1.5 mg/l, constitute a severe problem.

IV. CONCLUSION

The composition of water in any water reservoir depends on various chemical and physical constituents and their concentration, mostly derived from the natural factors in the drainage basin and catchment area of a particular region and vary with seasonal differences in runoff of volume, weather condition and water level. The present study showed that all the parameters studied show seasonal variations. Lake water remains alkaline throughout the year. DO, BOD and COD were much beyond the permissible limit. It may be due to bathing, disposal of waste material, drainage from agricultural fields, or dumping of waste material in the lake's catchment area. The present finding reveals the medium eutrophic nature of the lake.

V. REFERENCES

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