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## SEASONAL VARIATION IN THE PHYSICO-CHEMICAL CHARACTERISTICS OF ECOLOGICALLY FRAGILE KUHI LAKE OF NAGPUR DISTRICT

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### ABSTRACT

**T**he present research paper highlights the seasonal variation in physico-chemical characteristics of water of Kuhu lake of Nagpur District, carried out during summer, monsoon and winter months to assess the water quality status for limnological study. The physico-chemical parameters such as water temperature, pH, dissolved oxygen and various other parameters were investigated. The results of the present study revealed that the discharge of domestic waste and drainage in to the lake water have contributed to increase in the pollution status in the water body. Significant variations in chemical parameters were observed and recorded at four different sites of Kuhu Lake depicting its present limnological status.

**KEYWORDS** :Physico-Chemical Characteristics, Kuhu lake, Nagpur District, Seasonal variation, Limnological Study.

### INTRODUCTION

Limnological Investigation of water bodies has become top environmental priority today due to the contamination of world's freshwater ecosystems by man continuously. One of the most important crises of the 21st century is the availability of good quality drinking water, a resource basic to our survival and growth. Most of the fresh water bodies all over the world are slowly and steadily getting polluted thus decreasing the suitability of the fresh water for drinking purpose.

The physico-chemical characteristics of aquatic ecosystem



and the nature and distribution of its biota are directly related to and influenced and controlled by a multiplicity of natural regulatory mechanisms. Living plants and animals are affected by chemical conditions of their environment and the reactions may be used to measure some of the conditions. In this context, a systematic attempt has been made to study the seasonal variations of physico-chemical conditions with a view to evaluate the current status of water quality of the lake and delineate the sources and extent of pollution.

The lentic water body selected for the present investigation is located at Kuhu, North - East of the Nagpur district. It is located 21°00'39" N-longitude 79°21'09" E-latitude. Total area of Kuhu freshwater lake is about 20.41 acres. Kuhu is a large village

located in Nagpur district of Maharashtra state in Vidarbha region and the details of kuhi village are given in table 1. The area under study of the lake basin receives domestic raw sewage from surrounding habitation, the activities like washing, religious activities like idol immersion etc. also paves the way to entry of harmful chemicals in the lake water.

**Table 1: Details of Kuhi (Nagpur District)**

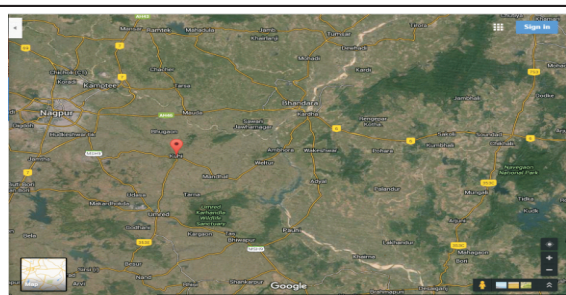
Important Features	Unit	Value
<b>Geographical Position and Area</b>		
North Latitude	Degree	20 <sup>0</sup> - 35 <sup>0</sup>
East longitude	Degree	78.15 <sup>0</sup> - 79.40 <sup>0</sup>
Area	ha	819.71
<b>Climate</b>		
Minimum temperature (Winter)	Degree Celsius	10 <sup>0</sup> c - 11 <sup>0</sup> c
Maximum temperature (Summer)	Degree Celsius	42 <sup>0</sup> c - 44 <sup>0</sup> c
Normal Rainfall	MM	1157
Number of rainy days	Number	114
<b>Demographic Features :</b>		
Population	Number	126316
Density of population	Per sq.km.	154
Population Growth Rate	%	35.13
<b>Agriculture</b>		
Percentage of forest area to geographical area	%	1.91
Percentage of cultivable land to geographical area	%	69.33
Sown area	%	50941
Percentage of net area irrigated to area sown	%	19.55
Percentage of gross irrigated area to gross cropped area	%	21.85

## MATERIALS AND METHODS

Kuhi lake a freshwater lake is situated in the kuhi village in the umred tehsil of the Nagpur district in the state of Maharashtra. The water body covers 20.41 acres approximately. The water of lake is used for bathing and washing by local residents.

Water samples from Kuhi Lake were collected from four different sampling locations covering all the four sides of the lake in the morning hours in containers and immediately transported to the laboratory for the estimation of various physico-chemical properties during summer, monsoon and winter season. Parameters like temperature and pH. were recorded at Lake Site where as the parameters like alkalinity, hardness, chlorides, total phosphates, nitrates, sulphates and other parameters were measured as per the guidelines given by APHA (1989) in laboratory.

Sampling is the most important part of any limnological investigation and its success depends upon the plan of collection of samples. The homogeneity and heterogeneity of the sample may be confirmed by analyzing a number of samples from different sites of the lake. The size of the sample depends on the number of parameters to be analyzed and the procedures to be followed in limnological study for physico-chemical analysis of water.

**Photograph 1: Panoramic View of Kuhu Lake****Photograph 2 : Satellite Image of Kuhu and Adjoining Areas****Photograph 3 : Satellite Image of Kuhu Lake****Table 2: Physico-chemical parameters of different sampling stations of Ecologically Fragile Kuhu Lake of Kuhu Nagpur District During Different Seasons**

Parameters	Summer Season				Rainy Season				Winter Seasons			
	Site A	Site B	Site C	Site D (Un Polluted)	Site A	Site B	Site C	Site D (Un Polluted)	Site A	Site B	Site C	Site D (Un Polluted)
Temperature ( $^{\circ}\text{C}$ )	31	31	31	31	27.3	27.3	27.3	27.3	21.5	21.5	21.5	21.5
Color (Hazen Unit)	Below 5 Hazen	Below 5 Hazen	Below 5 Hazen	Below 5 Hazen	Below 5 Hazen	Below 5 Hazen	Below 5 Hazen	Below 5 Hazen	Below 5 Hazen	Below 5 Hazen	Below 5 Hazen	Below 5 Hazen
pH	7.2	7.85	7.8	7.9	7.8	7.9	8.1	8.2	7.85	7.86	7.90	7.90
Dissolved Oxygen (mg/l)	4.5	5.2	5.4	5.4	6.2	6.3	6.4	6.4	5.2	5.6	5.8	5.8
BOD (mg/l)	9.2	9.1	8.2	8.0	3.1	3.0	2.9	2.8	6.0	5.8	5.0	4.9
COD (mg/l)	99.2	98.4	97.2	98.5	57.8	57.6	57.5	56.5	82	79.8	78.8	78.04
Total Alkalinity (mg/l)	185	184.8	182	182	122.1	123.2	124.1	123	183.1	182.8	181.0	181.0
Total Dissolved Solids (mg/l)	479.2	480.1	481.6	479.5	223.1	224.8	225.5	224	406	405.8	405.9	405.9
Total Suspended Solids (mg/l)	20.5	21.0	20.2	20.0	9.8	10.0	10.5	9.7	64.8	64.5	64.2	64.0
Total Hardness (mg/l)	170.2	169.7	170	169.2	113.5	113.0	113.1	112.0	151.1	150.8	150.8	150.8
Chloride (mg/l)	112.0	112.0	111.0	110.2	32.5	32.0	31.7	31.0	46.3	46.2	45.9	45.9
Sulphate (mg/l)	2.5	2.5	2.5	2.4	1.5	1.5	1.5	1.5	1.81	1.76	1.76	1.72
Nitrate (mg/l)	0.336	0.320	0.316	0.302	0.06	0.05	0.07	0.05	0.08	0.08	0.09	0.06
Total Phosphate (mg/l)	0.04	0.05	0.06	0.04	0.03	0.03	0.04	0.03	0.01	0.03	0.03	0.01
Turbidity NTU	0.6	0.5	0.4	0.3	4.6	4.5	4.5	4.4	1.7	1.6	1.3	1.3
Total Carbon Dioxide (mg/l)	3.6	3.5	2.5	2.3	3.1	3.2	3.0	2.9	3.6	3.6	3.2	3.2
Electrical Conductivity ( $\mu\text{mhos/cm}$ )	678.1	678.2	675.9	677.2	336.4	334.9	336.2	331.0	575.0	573.3	571.2	571.1



## RESULT AND DISCUSSION

The seasonal variation of water of Kuhu lake during summer, winter and monsoon season are presented in Table 2.

During present investigation the water temperature ranged between 21.50°C to 31.00°C. In general the temperature values were low during rainy and high during summer season. The low water temperature in the winter might be due to lower solar radiation where as maximum in the summer is due to low water level, greater solar radiation and clear atmosphere. Fluctuation in air and water temperature is due to the influence of various seasons, location and difference in the time of collection. Radhika et.al.(2004) studied the abiotic parameters of Velayuni lake Thiruvananthapuram in Kerala and observed the same results as rise of water temperature in summer and low during rainy season supporting our findings.

Transparency of water is directly proportional to the amount of suspended organic and inorganic particulate matter present in any water body. The other factors which affect the transparency of water body are plankton growth, wind velocity, rainfall, nature of water body and prevailing weather conditions. The minima & maxima of transparency in the lake water was recorded in the monsoon and winter respectively. Our result are well in agreement with Sharma and Sarang (2004) who reported minimum transparency during monsoon and maximum during winter months.

In the present study, the pH of lake water was slightly alkaline throughout the study period which range from 7.2 to 8.2. The maximum value was recorded in monsoon due to the receipt of sewage containing more carbonate and bicarbonate. The pH value ranged between 7.2 to 8.2. pH is the measure of the concentration of hydrogen ions, which provides the range of the acidity or alkalinity of a solution. Similar findings were recorded by Sadhwani (2010) while studying the limnological parameters of Shaha lake, Karanja (Lad), Dist. Washim (M.S.). Pearsall (1930) and Zafar (1996) observed that the pH of water appear to be dependent upon the relative quantities of Calcium carbonates and bicarbonates, being alkaline when the quantities of Carbonates is high.

Dissolved oxygen is an important parameter which affects chemical as well as biological reactions in an aquatic ecosystem. Dissolved oxygen content indicates the health and ability of water body to purify itself through biochemical processes. Oxygen is also needed for many chemical reactions that are important to lake functioning, such as oxidation of metals, decomposition of dead and decaying matters etc. The average dissolved oxygen was found to be in the range of 4.9 to 6.4 mg/L. Minimum value was recorded in summer and maximum in monsoon season. Monsoon maxima might be due to the clear zone, fall in temperature, increase in the solubility of oxygen, slightly more photosynthetic activities & high aeration rate whereas summer minima might be due to the increased organic matter from surface. Similar trend of dissolved oxygen was also observed by Yeole and Patil (2005) while studying physicochemical status of Yedshi lake in relation to water pollution. Carbon dioxide dissolved in water is the source of carbon that can be assimilated and incorporated into the living matter of all aquatic autotrophs (Hutchinson, 1957). A good water body should have solubility of oxygen about 7.0-7.5mg/l. D.O. of water samples of kuhu lake ranged between 4.9 to 6.4 mg/l and the fluctuation in it might be due to the presence of organic matter, and the prevailing anthropogenic activities.

Biochemical oxygen demand is an important parameter that indicates water pollution by oxidisable organic matter. The main sources of organic pollution in lakes are untreated domestic sewage and agricultural runoff. In the present study, minimum value of BOD was observed 2.8 mg/l during monsoon where as maximum value 9.2 mg/l was observed during winter, which might be due to domestic sewage input. This is an important parameter to assess the pollution load of surface water,

where contamination occurred due to the disposal of domestic wastes.

Chemical Oxygen demand is the amount of oxygen required by the organic matter present in the water for its oxidation by strong chemical oxidant. During summer maximum value of COD was observed while minimum was observed during monsoon. The values 99.2 and 56.2 mg/l of water samples of kuhi lake indicates the pollution of water. The values indicates that the pollution status of the water body.

Alkalinity is a measure of the capacity of water to absorb hydrogen ions. The total alkalinity of water samples of kuhi lake was 122.1 mg/l to 185 mg/litre which is much less than 200 mg / l permissible value 200-600) and hence the water of kuhi lake is not suitable for drinking. A decrease in the value of alkalinity during post monsoon period is attributed to heavy monsoon showers that resulted in the dilution of water. It is generally imparted by the salts of carbonates, bicarbonates, phosphates, nitrates, borates, silicates etc. together with the hydroxyl ions in free state. The minimum value was recorded in rainy season and maximum in summer. Salwi (1986) and Dash (1993) stated that fluctuations in alkalinity might be due to the entry of alkaline particles through surface runoff and low production of plankton population

Total dissolved solids refer to matter dissolved in water. Waters with high total solids generally are of inferior palatability (APHA, 1985). Total dissolved solids in case of water samples of Kuhu lake is in range of 223.1 and 480.1 mg/l.

Total hardness of water is the measure of the capacity of water to react with soap. Calcium & magnesium are the principal cations that imparts hardness. The total hardness of water therefore reflects as the sum total of alkaline metal cations present in it (Ramchandra et.al., 2006). During present investigation total hardness was found to be minimum in monsoon i.e rainy season 112 mg/L and maximum in summer 171.2 mg/L. Similar findings were also recorded by Patil et.al.,(2008).

Chloride anion is generally present in natural waters. High chloride content has damaging effect on agricultural crops (Ramachandra et.al., 2006). In present investigation, the maxima in summer and minima in monsoon were noted. Karne and Kulkarni (2009) reported chloride maxima in summer while minima in winter from freshwater bodies in Khatau Tahsil,(M.S.).

Sources of sulphates are mainly sulphates rocks such as gypsum and sulphur minerals such as pyrites and also due to air and water pollution. Sulphates contribute to the total solids content and in a reduced and anaerobic condition produced hydrogen sulphide which gives rotten egg odour to the water. In the present investigation the sulphate contents ranged between 1.5 to 2.5 mg/L with maxima in summer and minima in monsoon season. Similar results were also reported by Angadi et. al., (2005) from Papnash pond, Bidar, Karnataka. The present results are in conformity with above authors findings.

Phosphate is one of the major macronutrients responsible for biological productivity (APHA, 1989). All types of phosphorous recorded maximum in summer and minimum in winter. Similar observations were also reported by Yeole and Patil in 2005.

The nitrate is one of the most oxidized forms of nitrogen and is an essential plant nutrient. Nitrate concentration is associated with rain water runoff, and sludge discharge (Jha & Barat, 2003). During present investigation nitrates of the present water body ranged from 0.09 to 0.305 mg/L with maxima in summer. Similar seasonal peak was also recorded by Bhongade and Patil (2010). Summer peak of nitrates may be due to its negative proportionality to dissolved oxygen (Jakher & Rawat, 2003).

The phosphate content of kuhi lake ranged between 0.01 to 0.06 mg/l with maxima at summer and minima in winter. The Turbidity ranged from 03 to 4.5 with maximum 4.5 in monsoon season and minimum 03 in summer. Total carbon dioxide was maximum during winter and minimum during

monsoon.

The conductivity is a numerical expression of the ability of a water sample to carry an electric current which in turn, depends on the total concentration of the ionized substance dissolved in the water. Electrical conductivity ranged from 332.4 to 678.9  $\mu\text{mhos/cm}$  with maximum at summer and minimum during monsoon. The minimum conductivity value 332.4  $\mu\text{mhos/cm}$  was recorded during monsoon might be due to water dilution and the less human interference and maximum 678.9  $\mu\text{mhos/cm}$  was recorded during summer might be due to increased concentration of dissolved solids usually due to evaporation in summer.

The in depth analysis of Kuhu lake water indicates that the water samples of 3 sampling sites of Kuhu lake have been affected by man's use as compared to site D which is somewhat clean as reflected in analyzed values during seasonal variation of different parameters.

### CONCLUSION :

On the basis of physico-chemical analysis of Kuhu lake water it is recommended that the domestic waste should not be discharged into the Kuhu lake and sustained efforts should be made to bring out greater awareness among masses about the deteriorating quality of freshwater lakes and man's role in curbing it. If the present trend continues it will degrade the lake completely due to man's greedy nature slowly and steadily.

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