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Water Quality Assessment of the River Godavari, At Ramkund, Nashik, (Maharashtra), India.

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Abstract - *The River Godavari which is a holy river known since ancient times. As per stories of Ramayana it was believed that Prabhu Ramchandra was used to take his bath in river Godavari at Ramkund. The probable reason was that, the river changes its direction from North-South to East –West which causes turbulence in water and helps to increase the dissolved oxygen level in water. Hence the water quality at Ramkund is assumed to be much better. People all across country come to Nashik and take a holy bath in Ramkund and to perform various religious activities. This population is in lakhs during Kumb-mela. Keeping this in view the physico-chemical properties of river Godavari at Ramkunda, Nashik are studied. Water quality is assessed during months of June to October 2012, to ascertain the impact of human activities, particularly due to floating population. Temperature, pH, Chlorides, Total Suspended Solids (TSS), Total Dissolved Solid (TDS), Total Hardness (TH), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) was determined.*

Keywords *- Correlation, Physiochemical Study, Pollution, Ramkund, River Godavari.*

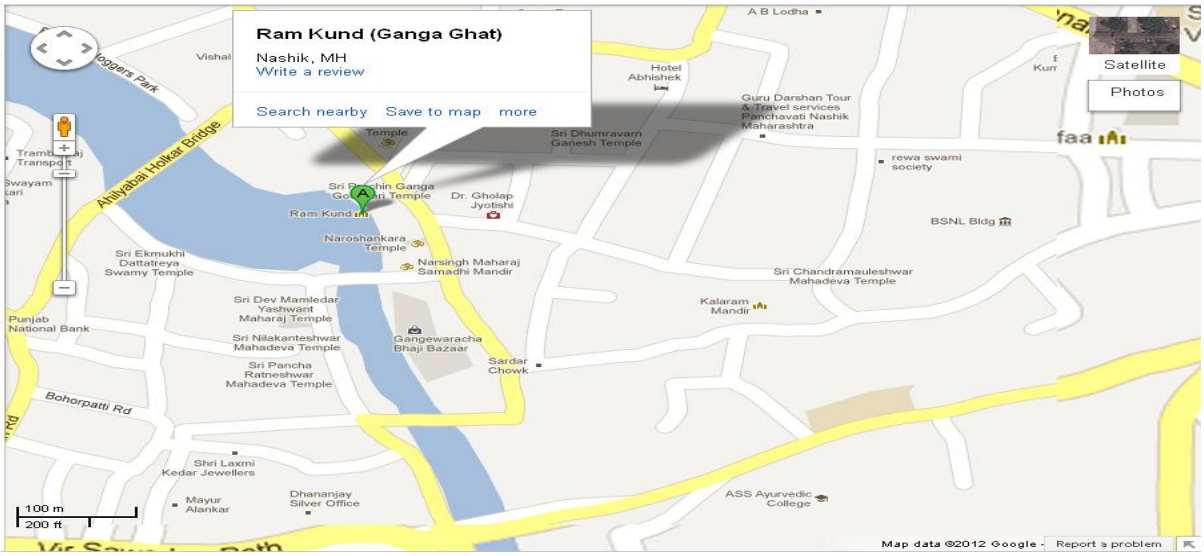
I. INTRODUCTION

The River Godavari is the main source of water supply for Nashik city. Besides this it is used for industrial and domestic waste disposal. Beyond urban area, agricultural activities are carried out at a very large scale on both the banks of river Godavari. The pesticides and chemical fertilizers used on these agricultural fields are usually washed away into the river. These activities are responsible for deterioration of water quality of the river. It has got an overall impact on physical and chemical parameters of the water. The survival of aquatic life is in danger due to the chemicals discharged into the river. Toxins within water are harmful to aquatic ecosystem. The growing problem of degradation and human activities on river ecosystem has made it important to monitor water quality of rivers to evaluate their state of pollution. Being a holy river most of the religious activities are performed on the bank of river Godavari and that too at Ramkund. People from all the parts of country do come to Ramkund for various religious purposes and most of them take a holy dip in Ramkund. Since it is a part of river Godavari and most of the people take bath in Ramkund the water quality at this location is analyzed.

II. Study Area

Ramkund, 35 kms from the origin of river Godavari, is situated in Nashik city of Maharashtra State. It is a place for holy dip. Daily thousands of people take a dip in Ramkund. During KUMBHA PARVA Lakhs of people take holy dip in Ramkund. The belief is that God Rama use to take a bath in Ramkund and the river takes a turn in ninety degree at this place. The turbulence created due to to abrupt change in direction creates lot of turbulence in water which helps in increasing Dissolved Oxygen level in water. But now days due to various human activities this place got polluted. So to determine the pollution level of this scared place, it is selected as the study area. The upper place of the study area Someshwar is near to its origin place and downward area of study i.e.Saikheda village is selected so as we are able to analyze the impact of human activities on the Ramkund. With respect to its upward and downward stream.

The River chart of Godavari is as shown in the following Chart.



III. Materials And Methods

3.1Sample Collection

All water samples were collected from three locations along the river, Someshwar Nashik, Ramkunda Nashik and Saikheda village, all along the banks of river Benue, study area during months June, August, and October respectively. During the present study some of the physical and chemical parameters were determined. The measurement of Temperature, pH and Total Dissolved Solids were taken in the field, immediately after the collection of samples using portable water quality analyzer Chloride, Total Hardness, Calcium, Total Alkalinity were analyzed by titrimetry. Locations of sampling stations are given in Table 2.

Table: 1 Standard Specifications limits for drinking water

Sr. No.	Parameter	ISI (1983)		WHO (1984)		ICMR		BIS	
		HDL	**MPL**	**HDL**	**MPL**	**HDL**	**MPL**	**HDL**	**MPL**
1.	Temperature	------	------	------	------	------	------	------	------
2.	pH	6.5 – 8.5	------	7.0 – 8.5	6.5 – 9.5	7.0 – 8.5	6.5 – 9.2	7.0 – 8.3	8.5 – 9.0
3.	TDS	500	2000	- -	------	500	**1500**	**500**	**2000**
4.	TS	---	**75**	--	**75**	--	--	--	**75**
5.	D.O	--	--	-	--	--	--	--	--
6.	B.O.D	--	--	--	--	--	--	--	--
7.	TA	**200**	**600**	--	**120**	--	--	**200**	**600**
8.	TH	**300**	**600**	**200**	**600**	**300**	**600**	**200**	**600**
9.	Ca^{2+}	**75**	**200**	**75**	**200**	**75**	**200**	**75**	**200**
10.	Cl^-	--	**250**	--	**250**	--	**250**	--	**250**

Abbreviations:HDL - Highest Desirable Level; MPL - Maximum Permissible Level; BIS - Bureau of Indian Standard; ICMR - Indian Council of Medical Research; WHO - World Health Organization;ISI-Indian Standard Institute.

Table 2: Sampling Stations

Sr. No	Category	Sampling Station	Location	Distance from the Origin	Human activities/Remarks
1	River Point	S1	Someshwar	30 Km	1) Bathing, washing activities and puja material (Nirmarlya) thrown.
2	River Point	S2	Ramkund	45 Km	1) Mass bathing activities. 2) Ashes of human dead bodies, sewage/ waste water from settlements/ oil and grease from vehicle washings added. Vegetables waste, puja material (Nirmarlya) thrown. 3) Hospital wastes and over flow from septic tanks is discharged to the river Washing cloths, animals into the river water.
3	River Point	S3	Saikheda Village	75 Km	1) Sewage from restaurants, hotels etc, washing cloths, animals into the river water.

Total Sampling Sites = 3

IV. Experimental Analysis

Table 3: Water quality parameters of samples

Sr. No	Parameters / Month → ↓	Sampling points	Temp	pH	TDS	TS	D.O	B.O.D	TA	TH	Ca^{2+}	Cl^-
			0^0 C	----	mg/ lit	mg/ lit	mg /lit	mg/ lit	mg/lit as $CaCO_3$	mg/lit as $CaCO_3$	mg/ lit	mg/ lit
1.	June	S1	26	7.2	608.1	620.3	6.0	3.3	406.6	78.6	2.0	253.1
		S2	27	8.3	1403.5	1473.1	3.9	11.2	791.8	290.5	14.6	903.3
		S3	27	7.5	927.2	950.2	4.6	11.8	363.8	317.9	4.8	486.4
2.	August	S1	25	6.8	528.9	530.4	4.9	1.4	360.0	56.2	2.9	214.4
		S2	23	8.1	1295.4	1345.8	3.9	9.1	640.0	281.2	9.8	638.2
		S3	28	7.8	829.8	835.8	4.6	14.2	360.0	290.5	4.6	525.8
3.	October	S1	27	7.3	530.2	543.5	5.5	7.0	456.0	73.1	2.4	172.0
		S2	26	8.6	1514.2	1592.7	3.0	8.0	480.0	273.5	9.2	1235.
		S3	28	7.6	912.1	930.3	3.9	8.2	552.0	232.1	4.9	672.3

V. Statistical Analysis

5.1 Correlation Studies

Interrelationship studies between different variables are very helpful tools in promoting research and opening new frontiers of knowledge. The study of correlation reduces the range of uncertainty associated with decision making. The correlation co-efficient 'r' was calculated using the Equation as follows. Let X and Y are the two variables, and then the correlation coefficient [PEARSON] (r) between the Variable X and Y is given by.

$$r = \frac{n\sum(xy)-\sum(x)\sum(y)}{\sqrt{(n\sum x2-(\sum x)2)}\sqrt{(n\sum y2-(\sum y)2)}}$$

Where n = number of data

Table : Correlation Matrix of Sampling Station S1 (Someshwar)									
	pH	TDS	TS	DO	BOD	TA	TH	Ca^{2+}	Cl^-
pH	1								
TDS	0.341	1							
TS	0.452	0.993	1						
DO	0.656	0.846	0.904	1					
BOD	0.869	**-0.168**	**-0.048**	0.383	1				
TA	0.939	**-0.003**	0.118	0.531	0.986	1			
TH	0.910	0.700	0.781	0.973	0.585	0.712	1		
Ca^{2+}	**-0.796**	**-0.840**	**-0.899**	**-0.999**	**-0.393**	**-0.540**	**-0.975**	1	
Cl^-	**-0.215**	0.845	0.774	0.430	**-0.669**	**-0.536**	0.209	**-0.419**	1
Table : Correlation Matrix of Sampling Station S2 (Ramkund)									
	pH	TDS	TS	DO	BOD	TA	TH	Ca^{2+}	Cl^-
pH	1								
TDS	0.994	1							
TS	0.991	0.999	1						
DO	**-0.917**	**-0.869**	**-0.856**	1					
BOD	**-0.444**	**-0.344**	**-0.321**	0.763	1				
TA	**-0.608**	**-0.519**	**-0.497**	0.873	0.937	1			
TH	**-0.555**	**-0.458**	**-0.436**	0.837	0.959	0.997	1		
Ca^{2+}	**-0.214**	**-0.108**	**-0.083**	0.585	0.996	0.905	0.933	1	
Cl^-	0.998	0.998	0.996	**-0.896**	**-0.244**	**-0.567**	**-0.508**	**-0.165**	1
Table : Correlation Matrix of Sampling Station S3 (Saikheda)									
	pH	TDS	TS	DO	BOD	TA	TH	Ca^{2+}	Cl^-
pH	1								
TDS	**-0.982**	1							
TS	**-0.985**	0.999	1						
DO	0.188	**-0.370**	**-0.352**	1					
BOD	0.569	**-0.713**	**-0.700**	0.914	1				
TA	**-0.205**	0.386	0.368	**-0.999**	**-0.921**	1			
TH	**-0.127**	**-0.061**	**-0.042**	0.949	0.742	**-0.944**	1		
Ca^{2+}	**-0.785**	0.887	0.879	**-0.755**	**-0.955**	0.767	**-0.513**	1	
Cl^-	0.012	0.175	0.156	**-0.979**	**-0.815**	0.975	**-0.993**	0.608	1

The correlation coefficient is always between -1 and +1. A correlation closer to +/- 1implies that the association is closer to a perfect linear relation. Interpretation of the Pearson correlation coefficients, adopted in the present study are: r = -1 to -0.7 (strong negative association); r = + 0.7 to + 1.0 (strong positive association); r = -0.7 to -0.3 (weak negative association); r = + 0.3 to + 0.7 (weak positive association); r = - 0.3 to + 0.3 (negligible or no association). The correlation co-efficient (r) among various water quality parameters.

Test of significance of the observed correlation coefficients

Pearson correlation coefficient is commonly used to measure and establish the strength of a linear relationship Out of the total 108 correlations found between two parameters, 37 were found to have significant at 5% level (r > 0.649). The negative (inverse) correlations were found in maximum cases at Ramkund. The negative correlation was found between DO and pH(-0.917),BOD and pH ,(-0.444) , TA and pH (-0.608) TH and pH (-0.608) Ca^{2+} and pH (-0.214) DO and TDS (-0.869),BOD and TDS,(-0.344) , TA and TDS (-0.519) TH and TDS (-0.454) Ca^{2+} and TDS (-0.108),Cl and DO (-0.896), Cl and BOD (-0.244),Cl and TA (-0.567), Cl and TH (-0.508) Cl and Ca^{2+} (-0.165)

VI. Conclusion

The result of the study shows that, the river is polluted at Ramkunda Nashik; it is believed that continuous pollution of the water sources by various human activities may lead to some health problems to human. The analysis of the water quality parameters of River Godavari water from three (03) different stations in Nasik city shows that the pH, Chloride ion, Total Hardness, Calcium values are not well within the permissible limits. The TDS of Ramkund was well above the desirable limit and the average of alkalinity has exceeded the desirable limits which are due to improper drainage system of the different units. In conclusion

from the analysis results of the present study it may be said that the River water of Ramkund is not fit for domestic and drinking purpose need treatments to minimize the Contamination especially the alkalinity. The values of correlation coefficients and their significance levels will help in selecting the proper treatments to minimize the contaminations of River water of Godavari at Ramkund.

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