

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

Correlation Study on Physico-Chemical Analysis of River Bhadra

Megha J Gogi¹, Manjunath N T²

P.G. Student, Department of Civil Engineering, UBDT College of Engineering, Davangere, Karnataka, India¹

Professor, Department of Civil Engineering, UBDT College of Engineering, Davangere, Karnataka, India²

ABSTRACT: Water quality is adversely affected by improper sewage discharge and effluent discharge from small and large scale discharges, human activities viz., bathing on river banks, washing clothes, cattle, utensils, vehicles, swimming etc. which results in contamination of river water body. To overcome the scarcity of natural resources, accurate and enough information about availability of water quality must be known. For this purpose water monitoring is first step in management of these water bodies which are naturally available. Therefore monitoring of water quality is required along the stretch of the river at located points. From the present work it is concluded that Bhadra River water is contaminated at sampling stations 2, 3 and 4 and hence treatment of Bhadra River water is recommended before supplied to portable usage.

KEYWORDS: River Bhadra, Physico-chemical parameters, Correlation, Dissolved oxygen, Biological oxygen demand.

I. INTRODUCTION

Water is very precious and one of the basic resource. It plays important role in life building. Natural resource are extent, hence water is very precious. Water is solvent which dissolves all kinds of chemicals resulting in contamination. Due to increase in industrialization and urbanization, water resources are becoming polluted. Demand for fresh water in future will increase. It is very important and need to consider that human beings uses and manage water in proper beneficial way. Water quality is adversely affected by improper sewage discharge and effluent discharge from small and large scale industries, human activities viz., bathing on river banks, washing clothes, cattle, utensils, vehicles, swimming etc which results in contamination of river water body. To overcome the scarcity of natural resources, accurate and enough information about availability of water quality must be known. For this purpose water monitoring is first step in management of these water bodies which are naturally available. Monitoring is an activity which includes collecting information about water quality. Though it is very complicated it has its own importance in various fields. River monitoring is directly related to chemistry, biology, statistics and economics. Water quality defines characteristics of water change due to physico-chemical and biological parameters which are interrelated. An approval of water quality is done by its users. For example, water for drinking must be wholesome, pure and potable. According to purpose of water usage controlling dissolved solids and toxic substances are important for irrigation and pathogens from outdoor bathing. Industries like textile, brewing, paper and pulp which use water should have particular quality of water. Design of water quality monitoring should be cost effective without losing any information. Understanding the design of water quality is based on related issues, appropriate background information, monitoring goals, expected results, relevant methods, characteristics and dynamics of water systems. In order to address the issues discussed as above, it was planned to take up the study to assess the water quality of River Bhadra at selected points and to suggest remedies there off.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

II. MATERIALS AND METHODOLOGIES

Description of the Study Area: Bhadra River flows 186 km from the origin and meets Tunga River at Kudli. The study has been conducted for 16 km stretch of Bhadra River from upstream of MPM to Kudli. The river Bhadra is polluted at several points and the main pollutants join from discharge of domestic waste and human activity along the bank of the river.

Location of Sampling Stations: In total five sampling stations along the stretch of the river considered for the study are shown in Fig 1. Geographical details of the sampling points is shown in Table 1. Sampling points and sewage discharge points on Bhadra River shown in location map are upstream of MPM, downstream of MPM, downstream of Bhadravathi city, Holehonnur bridge, Kudli confluence point, Nehru nagar, Gundurao shed or Gandhi nagar, Bhuthangudi area, Municipal office, Chamegouda area, Old town police station, Gouligara beedi, Khazimohalla, KSRTC bus stand area, Lower hutta area and Siddaruda nagar.

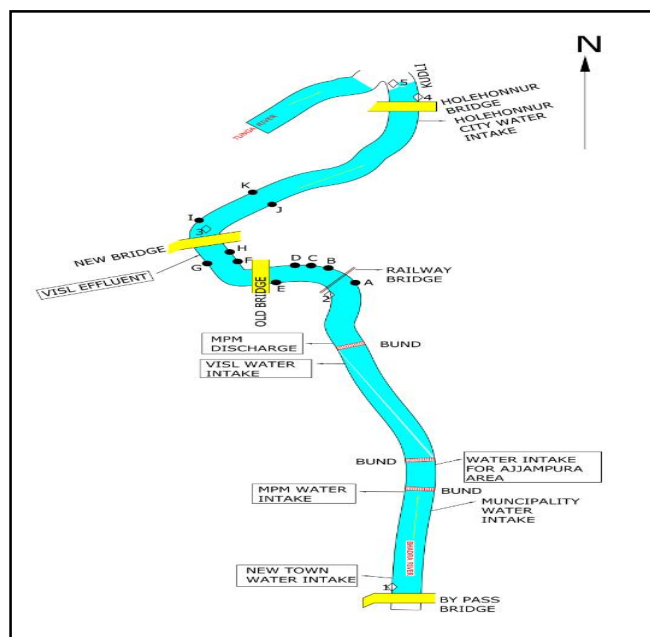


Fig 1: Location Map Showing the Sampling and Discharge Points on Bhadra River

Table 1: Geographical Details of the Sampling Points

Sampling station	Location	Latitude	Longitude
1	U/S of MPM	13° 91' N	75° 57' E
2	D/S of MPM	13° 84' N	75° 69' E
3	D/S of Bhadravathi city	13° 94' N	75° 61' E
4	Holehonnur bridge	13° 98' N	75° 67' E
5	Kudli confluence point	14° 01' N	75° 67' E

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

Sampling procedure and frequency: Grab samples were collected once in a month for all the selected sampling stations for study period from October 2016 to April 2017 covering winter and summer seasons and in June 2017 covering rainy season. Grab samples were collected at each point from a depth of about 20cm from surface of river Bhadra.

III. RESULTS OF CORRELATION MATRIX

Correlation matrices developed for quality of parameters of Bhadra River are shown in Table 2 to 9 from October to June for various parameters viz., Temperature, pH, Dissolved oxygen(DO), Biological oxygen demand (BOD), Conductivity ,Chemical oxygen demand (COD), Total hardness ,Chloride, Alkalinity Suspended solids, Dissolved solids, Turbidity.

IV. EXPERIMENTAL RESULTS

Correlation matrix of October month is established for physico-chemical parameters. Most of the parameters are significantly correlated with each other. Temperature and pH have strong positive correlation with all the parameters except dissolved oxygen. Dissolved oxygen has strong negative correlation with all the parameters. BOD, conductivity, COD, TH (total hardness), chlorides, alkalinity, SS (suspended solids), DO (dissolved solids) and turbidity have both strong and moderate positive correlation with all the parameters except dissolved oxygen.

Table 2: Correlation Matrix of October Month

Parameters	Temp.	pH	DO	BOD	Cond.	COD	TH	Chlorides	Alkalinity	SS	DS	Turbidity
Temp.	1											
pH	0.861	1										
DO	-0.985	-0.931	1									
BOD	0.875	0.993	-0.943	1								
Cond.	0.900	0.936	-0.946	0.969	1							
COD	0.864	0.944	-0.902	0.941	0.934	1						
TH	0.724	0.847	-0.761	0.838	0.838	0.965	1					
Chlorides	0.848	0.874	-0.860	0.869	0.882	0.984	0.976	1				
Alkalinity	0.788	0.898	-0.839	0.916	0.943	0.972	0.962	0.952	1			
SS	0.819	0.976	-0.892	0.949	0.847	0.872	0.754	0.790	0.787	1		
DS	0.842	0.865	-0.862	0.884	0.931	0.974	0.961	0.979	0.984	0.750	1	
Turbidity	0.902	0.571	-0.824	0.588	0.647	0.581	0.410	0.599	0.470	0.554	0.579	1

Correlation matrix of November month is established for physico-chemical parameters. Temperature has weak positive correlation with DO, TH and chlorides and weak negative correlation with other parameters. pH has strong positive correlation with all the parameters except dissolved oxygen. Dissolved oxygen has moderate negative correlation with all the parameters. BOD, Conductivity, COD, TH (total hardness), chlorides, alkalinity, SS (suspended solids), DS (dissolved solids) and turbidity have strong positive correlation with all the parameters except dissolved oxygen.

Table 3: Correlation Matrix of November Month

Parameters	Temp.	pH	DO	BOD	Cond.	COD	TH	Chlorides	Alkalinity	SS	DS	Turbidity
Temp.	1											
pH	-0.218	1										
DO	0.239	-0.339	1									
BOD	-0.094	0.978	-0.458	1								
Cond.	-0.229	0.856	-0.446	0.888	1							
COD	-0.070	0.936	-0.558	0.987	0.916	1						
TH	0.029	0.740	-0.775	0.857	0.833	0.926	1					
Chlorides	0.089	0.674	-0.826	0.805	0.730	0.877	0.985	1				
Alkalinity	-0.047	0.914	-0.470	0.965	0.962	0.983	0.900	0.827	1			
SS	-0.329	0.861	-0.766	0.903	0.830	0.928	0.905	0.883	0.868	1		
DS	-0.201	0.887	-0.641	0.942	0.956	0.977	0.940	0.879	0.972	0.948	1	
Turbidity	-0.206	0.975	-0.484	0.972	0.790	0.939	0.790	0.759	0.881	0.918	0.885	1

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

Correlation matrix of December month is established for physico-chemical parameters. Temperature has moderate negative correlation with DO, weak negative correlation with TH and moderate positive correlation with other parameters. pH has strong positive correlation with all the parameters except dissolved oxygen. Dissolved oxygen is negatively correlated with all the parameters. BOD, Conductivity, COD, TH (total hardness), chlorides, alkalinity, SS (suspended solids), DS (dissolved solids) and turbidity are positively correlated all the parameters except dissolved oxygen.

Table 4: Correlation Matrix of December Month

Parameters	Temp.	pH	DO	BOD	Cond.	COD	TH	Chlorides	Alkalinity	SS	DS	Turbidity
Temp.	1											
pH	0.198	1										
DO	-0.648	-0.302	1									
BOD	0.362	0.967	-0.419	1								
Cond.	0.156	0.998	-0.299	0.956	1							
COD	0.486	0.922	-0.637	0.951	0.915	1						
TH	-0.193	0.142	-0.612	0.099	0.185	0.284	1					
Chlorides	0.510	0.838	-0.761	0.863	0.837	0.976	0.440	1				
Alkalinity	0.266	0.978	-0.482	0.969	0.979	0.969	0.303	0.921	1			
SS	0.273	0.858	-0.661	0.824	0.870	0.931	0.567	0.964	0.931	1		
DS	0.193	0.928	-0.543	0.885	0.940	0.940	0.481	0.936	0.973	0.984	1	
Turbidity	0.160	0.902	-0.439	0.942	0.903	0.880	0.306	0.805	0.935	0.808	0.873	1

Correlation matrix of January month is established for physico-chemical parameters. Most of the parameters are significantly correlated with each other. Temperature and pH have strong positive correlation with all the parameters except dissolved oxygen. Dissolved oxygen has strong negative correlation with all the parameters. BOD, Conductivity, COD, TH (total hardness), chlorides, alkalinity, SS (suspended solids), DS (dissolved solids) and turbidity have strong positive correlation with all the parameters except dissolved oxygen.

Table 5: Correlation Matrix of January Month

Parameters	Temp.	pH	DO	BOD	Cond.	COD	TH	Chlorides	Alkalinity	SS	DS	Turbidity
Temp.	1											
pH	0.536	1										
DO	-0.977	-0.663	1									
BOD	0.603	0.926	-0.660	1								
Cond.	0.605	0.996	-0.717	0.946	1							
COD	0.817	0.924	-0.889	0.914	0.953	1						
TH	0.888	0.844	-0.957	0.796	0.878	0.973	1					
Chlorides	0.790	0.906	-0.881	0.829	0.928	0.972	0.979	1				
Alkalinity	0.734	0.965	-0.823	0.943	0.984	0.990	0.938	0.955	1			
SS	0.906	0.689	-0.959	0.655	0.730	0.869	0.922	0.832	0.826	1		
DS	0.834	0.904	-0.918	0.852	0.931	0.990	0.990	0.980	0.974	0.911	1	
Turbidity	0.714	0.859	-0.744	0.973	0.893	0.917	0.818	0.804	0.928	0.754	0.863	1

Correlation matrix of February month is established for physico-chemical parameters. Temperature and pH have weak positive correlation with all the parameters except dissolved oxygen. Dissolved oxygen has both strong and moderate negative correlation with all the parameters. BOD, Conductivity, COD, TH (total hardness), chlorides, alkalinity, SS (suspended solids), DS (dissolved solids) and turbidity have strong positive correlation with all the parameters except dissolved oxygen.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

Table 6: Correlation Matrix of February Month

Parameters	Temp.	pH	DO	BOD	Cond.	COD	TH	Chlorides	Alkalinity	SS	DS	Turbidity
Temp.	1											
pH	0.152	1										
DO	-0.045	-0.266	1									
BOD	0.499	0.602	-0.688	1								
Cond.	0.409	0.615	-0.540	0.964	1							
COD	0.503	0.329	-0.813	0.939	0.850	1						
TH	0.506	0.128	-0.856	0.800	0.649	0.952	1					
Chlorides	0.716	0.005	-0.636	0.748	0.621	0.900	0.943	1				
Alkalinity	0.652	0.388	-0.760	0.921	0.797	0.970	0.945	0.918	1			
SS	0.283	0.189	-0.962	0.706	0.523	0.864	0.945	0.790	0.857	1		
DS	0.417	0.381	-0.917	0.798	0.618	0.891	0.932	0.796	0.922	0.970	1	
Turbidity	0.437	0.348	-0.764	0.953	0.909	0.985	0.894	0.846	0.924	0.787	0.811	1

Correlation matrix of March month is established for physico-chemical parameters. Most of the parameters are significantly correlated with each other. Temperature and pH have weak positive correlation with all the parameters. Dissolved oxygen is negatively correlated with all the parameters. BOD, Conductivity, COD, TH (total hardness), chlorides, alkalinity, SS (suspended solids), DS (dissolved solids) and turbidity are positively correlated all the parameters except dissolved oxygen.

Table 7: Correlation Matrix of March Month

Parameters	Temp.	pH	DO	BOD	Cond.	COD	TH	Chlorides	Alkalinity	SS	DS	Turbidity
Temp.	1											
pH	0.821	1										
DO	0.317	0.228	1									
BOD	0.383	0.468	-0.721	1								
Cond.	0.485	0.595	-0.613	0.988	1							
COD	0.546	0.458	-0.618	0.952	0.940	1						
TH	0.481	0.292	-0.649	0.888	0.852	0.977	1					
Chlorides	0.398	0.192	-0.700	0.858	0.806	0.950	0.993	1				
Alkalinity	0.625	0.542	-0.542	0.937	0.939	0.994	0.960	0.926	1			
SS	0.451	0.385	-0.640	0.946	0.931	0.959	0.929	0.894	0.936	1		
DS	0.370	0.406	-0.689	0.971	0.958	0.931	0.875	0.838	0.904	0.985	1	
Turbidity	0.274	0.472	-0.700	0.965	0.963	0.850	0.752	0.711	0.829	0.900	0.961	1

Correlation matrix of April month is established for physico-chemical parameters. Most of the parameters are significantly correlated with each other. Temperature and pH have strong, moderate and weak positive correlation with all the parameters except dissolved oxygen and turbidity. Dissolved oxygen has moderate and strong negative correlation with all the parameters except turbidity. BOD, Conductivity, COD, TH (total hardness), chlorides, alkalinity, SS (suspended solids), DS (dissolved solids). Turbidity has strong positive correlation with DO, weak and moderate negative correlation with all the other parameters.

Table 8: Correlation Matrix of April Month

Parameters	Temp.	pH	DO	BOD	Cond.	COD	TH	Chlorides	Alkalinity	SS	DS	Turbidity
Temp.	1											
pH	0.857	1										
DO	-0.501	-0.074	1									
BOD	0.859	0.712	-0.546	1								
Cond.	0.791	0.697	-0.636	0.923	1							
COD	0.829	0.519	-0.863	0.886	0.896	1						
TH	0.684	0.294	-0.899	0.826	0.792	0.960	1					
Chlorides	0.646	0.227	-0.933	0.767	0.745	0.946	0.995	1				
Alkalinity	0.823	0.541	-0.813	0.932	0.923	0.992	0.959	0.933	1			
SS	0.583	0.315	-0.669	0.889	0.806	0.846	0.909	0.870	0.899	1		
DS	0.573	0.408	-0.712	0.853	0.934	0.862	0.849	0.812	0.900	0.904	1	
Turbidity	-0.442	-0.031	0.819	-0.193	-0.270	-0.601	-0.587	-0.654	-0.495	-0.197	-0.228	1

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

Correlation matrix of June month is established for physico-chemical parameters. Most of the parameters are significantly correlated with each other. Temperature has weak, moderate and strong positive correlation with all the parameters. pH has strong positive correlation with all the parameters and weak negative correlation with dissolved oxygen. Dissolved oxygen has weak and moderate negative correlation with all the parameters and weak and moderate positive correlation with BOD, Cond (conductivity), SS(Suspended solids) BOD, Conductivity, COD, TH (total hardness), chlorides, alkalinity, SS, DS (dissolved solids) and turbidity have moderate and strong positive correlation with all the parameters except dissolved oxygen.

Table 9: Correlation Matrix of June Month

Parameters	Temp.	pH	DO	BOD	Cond.	COD	TH	Chlorides	Alkalinity	SS	DS	Turbidity
Temp.	1											
pH	0.802	1										
DO	0.315	-0.175	1									
BOD	0.939	0.728	0.526	1								
Cond.	0.902	0.746	0.082	0.794	1							
COD	0.652	0.883	-0.431	0.519	0.808	1						
TH	0.451	0.663	-0.462	0.351	0.740	0.927	1					
Chlorides	0.806	0.961	-0.144	0.755	0.844	0.940	0.809	1				
Alkalinity	0.709	0.762	-0.033	0.713	0.867	0.871	0.889	0.910	1			
SS	0.929	0.809	0.083	0.833	0.994	0.831	0.732	0.888	0.878	1		
DS	0.750	0.890	-0.289	0.632	0.890	0.987	0.912	0.961	0.917	0.909	1	
Turbidity	0.331	0.698	-0.571	0.264	0.578	0.913	0.957	0.804	0.823	0.595	0.862	1

V. CONCLUSION

Most of the parameters are significantly correlated with each other. Dissolved oxygen has weak and moderate negative correlation with all the parameters and weak and moderate positive correlation with BOD, Cond (conductivity), SS(Suspended solids) BOD, Conductivity, COD, TH (total hardness), chlorides, alkalinity, SS, DS (dissolved solids) and turbidity have moderate and strong positive correlation with all the parameters except dissolved oxygen.

REFERENCES

1. **Anjana Sharma, Chandan R Bora and Varsha Shukla**, "Evaluation of Seasonal Changes in Physico-chemical and Bacteriological Characteristics of Water from the Narmada River (India) Using Multivariate Analysis", Natural Resources Research, 2013.
2. **Bawa Kalpana V. and Gaikwad.V.B.**, "Water Quality Assessment of Godavari River at Nashik, India: Impact of Sewage and Industrial Wastewater", Universal Journal of Environmental Research and Technology, 2013, 3(4), 452-457.
3. **Bhupander Kumar and Vikas Gupta**, "Analysis of Pollution of Ram Ganga River by Physicochemical Water Parameters Using Regression Analysis", 4th International Conference on System Modelling and Advancement in Research Trends, 2015, 430-433.
4. **Bruce Ratner**, "The Correlation Coefficient: It's Values Range Between +1/-1, or Do They?" Journal of Targeting, Measurement And Analysis For Marketing, 2009, 17(2), 139-142.
5. **Goel P.K.**, Water pollution, New age international publication, 2006
6. Guidelines for Water Quality Monitoring –Central Pollution Control Board (2007-2008)
7. **Harish Kumar B.K., Srikantaswamy S, Raghunath T and Vivek**, " Seasonal Water Quality Status in Tugabhadra River around TB Dam, Karnataka, India", Asian Journal of Environmental Science, (2010), 5(2), 99-106.
8. <http://onlinecourses.science.psu.edu/stat100/node/35>
9. <http://www.statisticshowto.com/spss-how-to-index/>
10. Indian standards Drinking Water-Specification, Publication Unit, BIS, New Dehli, India, 2012
11. **Kolhe Bharati G and Shinde Satish M**, "Study of Some Physico-Chemical Parameters of Godavari River Water at Ramkund, Nashik with Reference to Correlation Study", Indian Journal of Research, 2014, 3(5), 1-3.
12. **Mahesh Anand Goudar, Sayeswara H. A and Nafeesa Begum**, "Physico Chemical Aspects of Pollution of Tunga River at Shivamogga, Karnataka State, India", International Quarterly Journal of Environmental Sciences, 2012, 6(1&2), 17-22.
13. **Maiwada Samuel and Lawrence Ethelbert Okey**, "The Relevance and Significance of Correlation in Social Science Research", International Journal of Sociology and Anthropology Research, 2015 1(3), 22-28
14. **Manjunath N T**, Water Quality Analysis Manual, Nem chand and Bros, Civil Engineering Department, UBDTCE, 2006
15. **Mathur R.P.**, Water and Wastewater Testing Lab Manual, Nem chand and Bros, 2005
16. **Narendra Singh Bhandari and Kapil Nayal**, "Correlation Study on Physico-Chemical Parameters And Quality Assessment Of Kosi River Water, Uttarakhand", E-Journal of Chemistry, 2008, 5(2), 342-346.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 7, July 2017

17. **Neha Gupta, Krishna Kumar Yadav, Vinit Kumar and Deepak Singh**, "Assessment of Physicochemical Properties of Yamuna River in Agra City", International Journal of Chem Tech Research, 2013, 5(1), 528-531.
18. **Nida Rizvi, Deeksha Katyal and Varun Joshi**, "Assessment Of Water Quality Of Hindon River In Ghaziabad And Noida, India By Using Multivariate Statistical Methods", Journal of Global Ecology and Environment, 2015, 3(2), 80-90.
19. **Papiya Mandal, Rahul Upadhyay and Aziz Hasan**, "Seasonal and Spatial Variation of Yamuna River water Quality in Delhi, India", Environmental Monitoring and Assessment, 2010
20. **Pawan Kumar Bharti**, "Water Quality Characteristics of Sahastradhara Hill Stream, Dehradun (Uttarakhand), India", International Journal of Higher Education and Research, 2014,4(1),15-27
21. **Pooja Tomar, Malik D.S and Pawan Kumar Bharti**, " Spatial and Temporal Variation in Water Quality Of Kali River in Uttar Pradesh, India", International Research Journal of Environment Science and Studies,(2016),1(2),24-42.
22. **Rita. N. Kumar, Rajal H. Solanki and J. I. Nirmal Kumar**, "Assessment of Spatial and Temporal Variation in Physico-Chemical Properties of Water in River Sabarmati and Khari Cut Canal at Ahmedabad, Gujarat", Nature Environment and Pollution Technology, 2011, 10(1), 147-154.
23. **Smitha, Ajay D and Shivashankar P**, "Physico Chemical Analysis of the Freshwater at River Kapila, Nanjangud Industrial Area, Mysore, India", International Research Journal of Environment Sciences, 2013, 2(8), 59-65
24. **Soumyashree Shetty, Tharavathy N C, Reema Orison Lobo And Nannu Shafakatullah**, "Seasonal Variations In Physico-Chemical Characteristics Along The Upstream Of Tungabhadra River, Western Ghats, India", International Journal of Plant, Animal and Environmental Sciences, 2013, 3(1), 242-246.
25. Standard methods for the examination of water and wastewater, American public health association (APHA), 2006
26. **Venkatesharaju K, Ravikumar P, Somashekar R.K and Prakash K.L**, "Physico-Chemical and Bacteriological Investigation on the River Cauvery of Kollegal Stretch in Karnataka", Kathmandu University Journal of Science, Engineering and Technology, 2010, 6(1), 50-59.