"WATER QUALITY ASSESSMENT OF KAGINA RIVER WATER"

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Abstract

The present study was carried out to assess the water quality and to determine water quality index (WQI) of Kagina River near Malkhed Village. This has been achieved by collecting water samples from Kagina River, the various physico-chemical characteristics were analysed. The WQI is calculated by considering the following Parameters i.e. pH, DO, BOD, Total Hardness, Calcium Hardness, Magnesium Hardness, Fluoride, Nitrate, Sulphate, Total Dissolved Solids, and Alkalinity. Based on WQI the Kagina river water falls under "B" grade WQI i.e Good quality water hence it is fit for potable purpose.

KEYWORDS: Water Quality Index (WQI), Water quality, Kagina River, Bureau of Indian Standards(BIS)

I. INTRODUCTION

Water is essential for life on the Earth, it is the source of energy, govern the evolution and function of the universe on the earth. Water is a unique natural resource essential for life and it constantly cycles between the land and the atmosphere. Water is one of the abundantly available substances in nature. It is an essential constituent of all animal and vegetation and forms about 75 % of the matter of earth's crust. It is also an essential ingredient of animal and plant life. (S.K.Pathak, Shambhu Prasad, Tanmay Pathak)

River system comprises both main course and tributaries, carrying unidirectional flow along with sediment load of dissolved matter and anthropogenic sources. River also serves for domestic, industrial and agricultural, navigation, and for recreational activities. Increases in use of chemical fertilizer and pesticides in agriculture are due to industrialization which causes various aquatic environmental pollution and lead to depletion of water quality. Water quality has direct relation with aquatic productivity.

River contains highly crucial component of natural heritage and their water quality. From the evolution of the life of humans, rivers are their basic requirements and only some of them are recently in natural condition. Around the world, aquatic systems mainly rivers are reported to be polluted due to disposal of untreated sewage and industrial waste. There are many types of materials like organic and inorganic which contain; oils, Plastic, solvents, grease, heavy metals, chemicals, pesticides etc. All these waste including storm water runoff enters surface of groundwater. All these are dependent on seasons and henceforth the surface water quality must be reckoned before starting water quality management programme.

Kagina River has its source in Anantagiri hills near Vikarabad in the Ranga Reddy District of Andhra Pradesh. Mullamari River and Bennethora River are the main streams join the Kagina River. After flowing through the Ranga reddy district in Andhra Pradesh it enters Gulbarga district,(77°-09´-25´´longitude 17°-12´-35´´ latitude) in Chincholi taluk and flows in Sedam and Chitapur talukas and joins Bheema river (main tributary of the Krishna river) near Wadi of Chitapur taluk,Gulbarga district.

Malkhed is a village panchayat located in the Gulbarga district of Karnataka state, India. The Coordinates of Malkhed village are 17°11´42´´N, 77°9´39´´E. Bangalore is the state capital for Malkhed village. It is located around 470.8 kilometer away from Malkhed. The other nearest state capital from Malkhed is Hyderabad and its distance is 142.3 km. The other surrounding state capitals are Hyderabad 142.3 km, Mumbai 498.8 km, Chennai 566.5 km.

According to Census 2011 information the location code or village code of Malkhed village is 620493. Malkhed village is located in Sedam Tehsil of Gulbarga district in Karnataka, India. It is situated 13km away from sub-district headquarter Sedam and 45km away from district headquarter Gulbarga. As per 2009 stats, Malkhed village is itself a gram panchayat. The Figure 1 shows the map of Kagina River and sampling points.

1.1. Objective:

1. To find the physico-chemical characteristics of water samples collected from different stretches of Kagina River, Malkhed.
2. To determine the Co-relation Co-coefficients and Regression analysis.
3. To compare the physico-chemical characteristics of water samples with BIS Standards.
4. To find the water quality index (WQI).

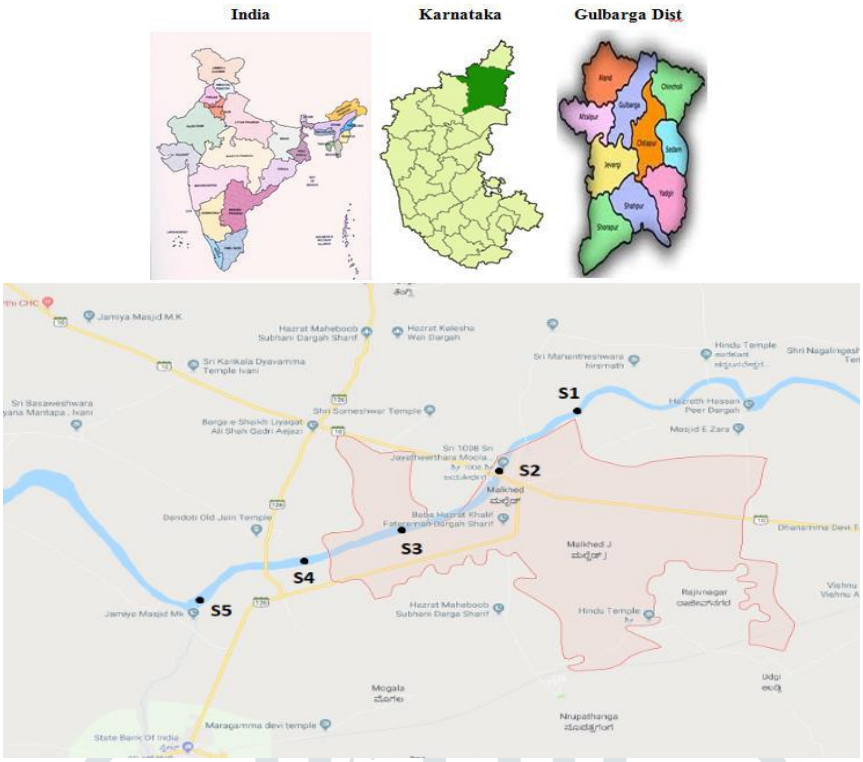

Figure 1. Map of Kagina river and sampling points.

II. MATERIALS AND METHODS

2.1 Sampling

The water samples were collected from 1 Feb 2019 to 30 May 2019 covering premonsoon season. The grab samples were collected from 5 sampling point at an interval of 15 days.One litre of water samples were collected from each sampling point and transported to the laboratory for analysis. All the samples were tested in the laboratory to determine physico-chemical characteristics such as pH, DO, BOD, Total Hardness, Calcium hardness, Magnesium hardness, Fluoride, Nitrates, Sulphate,Chloride ,Total dissolved solids, Alkalinity.The methods adopted for the determination of the parameters are listed below in Table 1.

Table 1: Analytical Methods and Equipment's used in the study

SL. NO	Parameters	Methods	Equipment's
1	pH	Electrometric	pH Meter
2	Dissolved Oxygen –DO and BOD in mg/L	Winkler Method	-
3	Total Hardness – TH in mg/L	Titration by EDTA	-
4	Calcium- Ca in mg/L	Titration by EDTA	-
5	Magnesium – Mg in mg/L	Titration by EDTA	-
6	Fluoride – F in mg/L	Spectrophotometer	Spectrophotometer
7	Nitrates - NO_3 in mg/L	Phenoldisulphonic acid method	Spectrophotometer
8	Sulphate- SO_4 in mg/L	Turbidimetric method	Spectrophotometer
9	Chloride –Cl in mg/L	Titration by silver nitrate	-
10	Total dissolved solids – TDS in mg/L	Electrical Conductivity Method	EC/TDS Analyzer
11	Alkalinity -$CaCO_3$ in mg/L	Titration by 0.02N H_2SO_4	-

III. Results and Discussion

3.1 Characteristics of Kagina River Water at sampling point 5.

Water samples collected from sampling point were analyzed for the following parameters and results are tabulated in the Table 2 below.

3.1.1 pH (Hydrogen Ion Concentration):

The determination of the pH facilitates the broad and quick evaluation of the acidic/alkaline nature of water. The pH in the study area ranges from 7.2 to 7.6.The mean value oh pH is 7.41 and standard deviation value is 0.14 and coefficient of variation value is 1.88.

3.1.2 Dissolved Oxygen:

The dissolved oxygen concentration in the river water varying from minimum value of 6.57 mg/L to maximum value of 7.66 mg/L, mean value is 7.17 mg/L, standard deviation value is 0.29 and the coefficient of variation value is 4.04.

3.1.3 Biochemical Oxygen Demand:

The BOD concentration in the river water varying from minimum value of 0.69 mg/L to maximum value of 1.39 mg/L, mean value is 1.11 mg/L, standard deviation value is 0.22 and the coefficient of variation value is 19.81.

3.1.4 Total Hardness:

The total hardness of the river water ranges from a minimum value of 92.7 mg/L to maximum value of 112.8 mg/L, the mean value is 98.31 mg/L, standard deviation value is 5.58 and the coefficient of variation value is 5.67.

3.1.5 Calcium Hardness:

The calcium hardness of the river water ranges from a minimum value of 60.6 mg/L to maximum value of 90.7 mg/L, the mean value is 79.07 mg/L, Standard deviation value is 7.23 and the coefficient of variation value is 9.14.

3.1.6 Magnesium Hardness:

The magnesium hardness of the river water ranges from a minimum value of 12.5 mg/L to maximum value of 32.7 mg/L, the mean value is 19.24 mg/L, standard deviation value is 5.92 and the coefficient of variation value is 30.76.

3.1.7 Fluoride

The Fluoride concentration in the river water varying from a minimum value of 0.22 mg/L to maximum value of 0.32 mg/L , the mean value is 0.26 mg/L , and the standard deviation value is 0.03 and the coefficient of variation value is 11.53 .

3.1.8 Nitrate:

The Nitrate concentration in the river water varying from a minimum value of 1.32 mg/L to maximum value of 1.95 mg/L, the mean value is 1.61 mg/L and the standard variation value is 0.17 and the coefficient variation value is 10.55.

3.1.9 Sulphate:

The sulphate concentration in the river water varying from minimum value of 32.67 mg/L to maximum value of 40.32 mg/L, the mean value is 35.70 mg/L, and the standard deviation value is 2.29 ,and the coefficient of variation value is 6.41.

3.1.10 Chloride:

The Chloride concentrations in the river water varying from a minimum value 45.3 mg/L to a maximum value of 80.20 mg/L, the mean value is 62.14 mg/L , standard deviation value is 13.23 and the coefficient of variation value is 21.29.

3.1.11 Total Dissolved Solids:

The Total dissolved solids in river water varying from minimum value of 352.7 mg/L to maximum value of 395.5 mg/L .The mean value is 372.02 mg/L and the standard deviation value is 14.44 and the coefficient of variation value is 3.88.

3.1.12 Alkalinity

The alkalinity concentration in the river water varying from a minimum value of 48.8 mg/L to maximum value of 75.3 mg/L. The mean value is 61.13 mg/L and the standard deviation value is 9.82 and the coefficient of variation value is 16.06.

Table 2: Characteristics of Kagina River Water at sampling point 5

No. of samples	pH	DO	BOD	TH	Ca	Mg	F	NO3	SO4	Cl	TDS	Alkalinity
1	7.3	7.66	1.09	102.8	77.2	25.6	0.23	1.59	32.67	76.5	355.2	48.8
2	7.3	6.67	1.39	94.6	76.5	18.1	0.27	1.55	34.54	59.5	395.5	52.4
3	7.4	7.36	1.23	97.4	84.6	12.8	0.28	1.67	35.78	45.3	363.4	68.2
4	7.6	7.16	1.19	94.4	80.2	14.2	0.26	1.53	35.6	48.2	352.7	75.3
5	7.5	7.36	0.89	99.2	76.7	22.5	0.31	1.74	37.65	53.2	376.1	68.9
6	7.3	6.57	1.19	93.3	60.6	32.7	0.22	1.46	35.16	79.4	390.8	48.9
7	7.5	7.26	0.89	92.7	80.2	12.5	0.24	1.32	40.32	48.6	372.8	56.8
8	7.4	7.06	1.39	99.2	84.5	14.7	0.26	1.67	35.28	80.2	362.3	69.2
9	7.6	7.26	0.69	94.9	78.8	16.1	0.27	1.39	33.1	53.6	389.5	72.9
10	7.2	7.16	0.89	101.6	82.7	18.9	0.25	1.95	36.45	64.8	358.2	64.1

11	7.6	7.36	1.19	96.9	76.2	20.7	0.32	1.81	38.6	78.1	369.1	58.6
12	7.3	7.16	1.32	112.8	90.7	22.1	0.29	1.65	33.28	58.3	378.7	49.5
SUM	89	86.04	13.35	1179.8	948.9	230.9	3.20	19.33	428.43	745.7	4464.3	733.6
MAX	7.6	7.66	1.39	112.8	90.7	32.7	0.32	1.95	40.32	80.2	395.5	75.3
MIN	7.2	6.57	0.69	92.7	60.6	12.5	0.22	1.32	32.67	45.3	352.7	48.8
MEAN	7.41	7.17	1.11	98.31	79.07	19.24	0.26	1.61	35.70	62.14	372.02	61.13
SD	0.14	0.29	0.22	5.58	7.23	5.92	0.03	0.17	2.29	13.23	14.44	9.82
%CV	1.88	4.04	19.81	5.67	9.14	30.76	11.53	10.55	6.41	21.29	3.88	16.06

All the parameters are in mg/L except pH.

3.2 Kagina River water characteristics at different Sampling points

The variation of Kagina River water characteristics at different sampling points are shown in the Fig 2-Fig 13 for pH, DO, BOD,Total Hardness, Calcium hardness, Magnesium hardness ,Fluoride ,Nitrates ,Sulphate,Chloride ,Total dissolved solids, Alkalinity respectively.

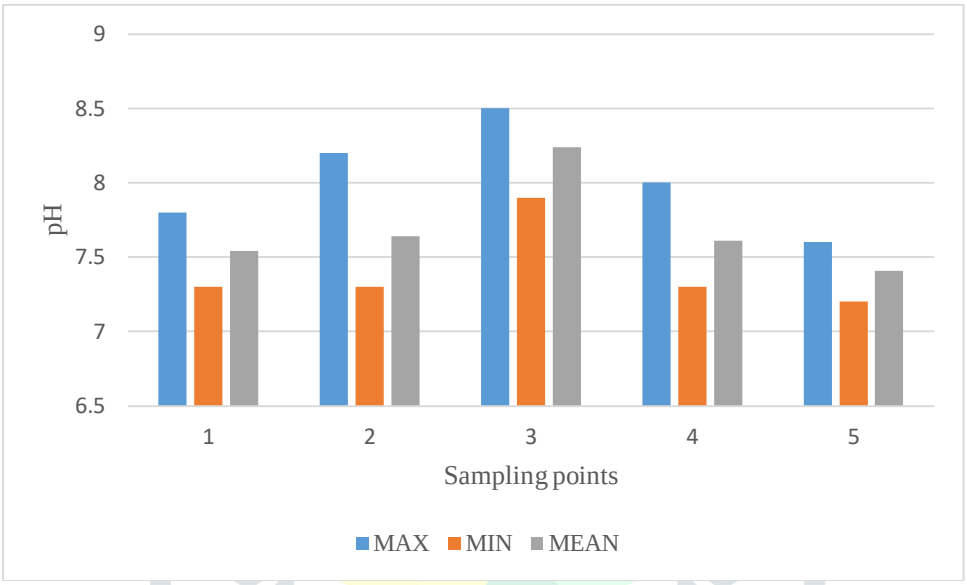

Figure 2: variation of pH

Maximum pH is observed at point 3 due to washing of clothes, utensils, animals etc.

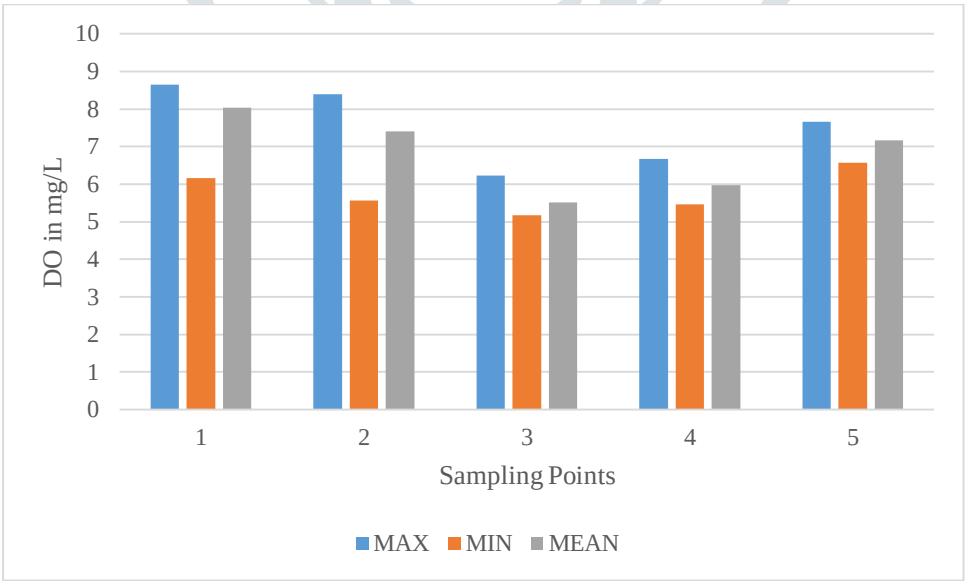

Figure 3: variation of DO

Maximum DO is observed at point 1 and 5 as water here is free from any discharge and used for drinking purpose.

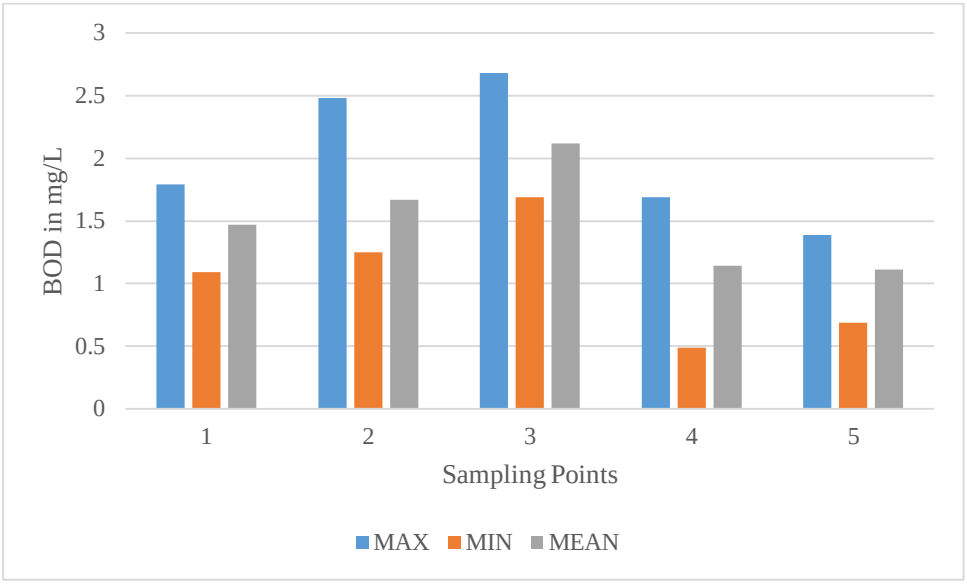

Figure 4: Variation of BOD

Maximum BOD is observed at point 3 due to discharge of temple waste, washing of clothes, utensils and animals.

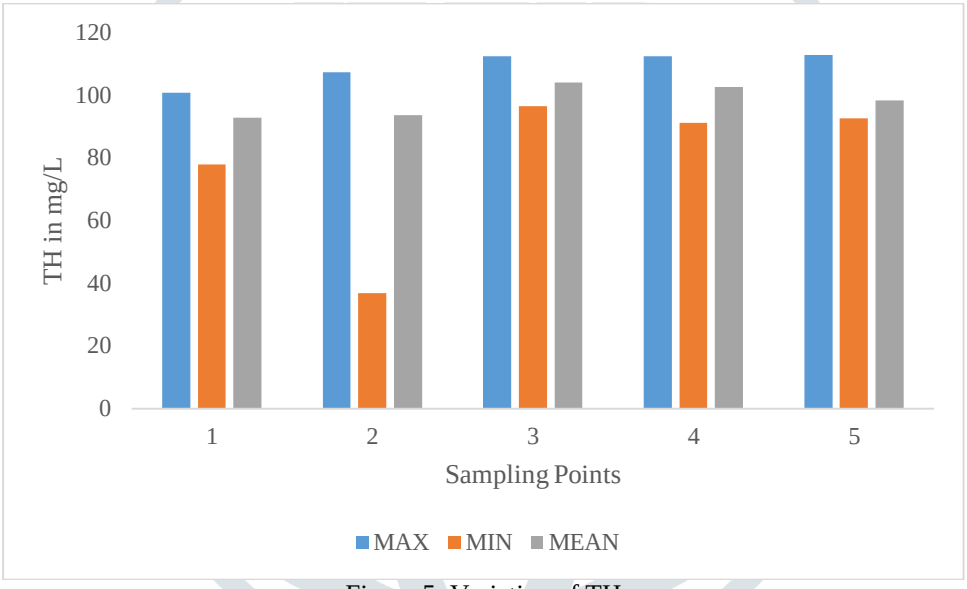

Figure 5: Variation of TH

Maximum TH is observed at point 3 due to presence of minerals, carbonates, bicarbonates.

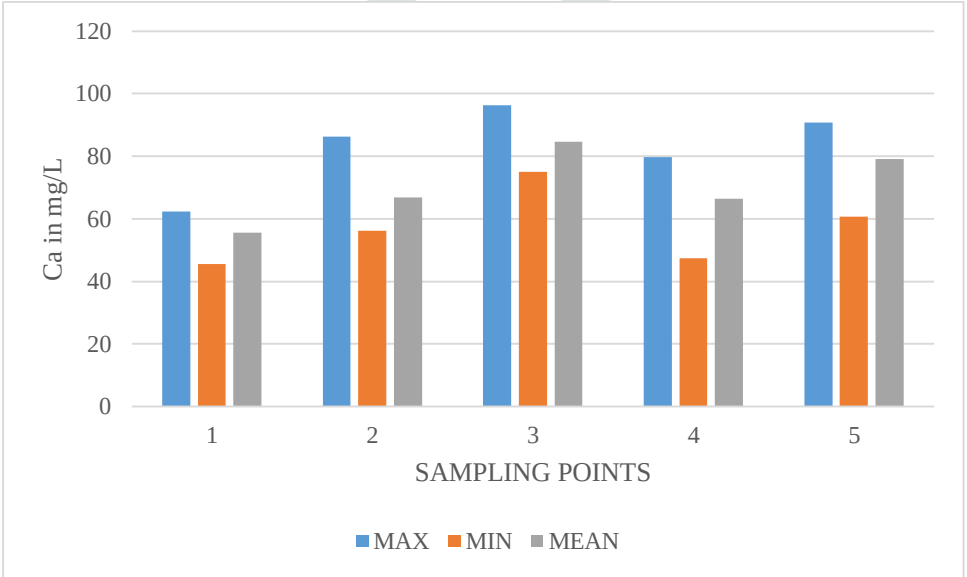

Figure 6: Variation of calcium

Maximum Ca is observed at point 3 due to presence of minerals, carbonates and Bicarbonates.

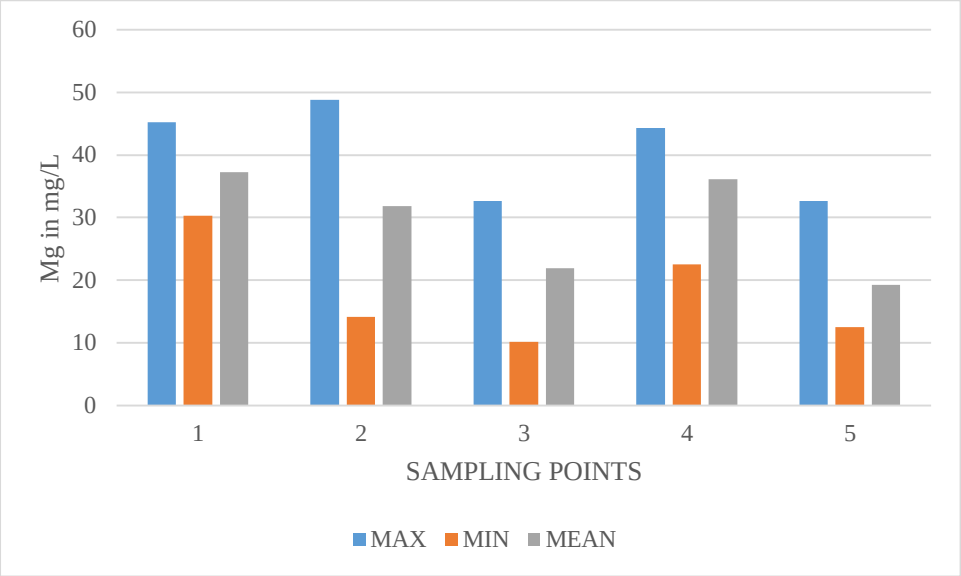

Figure 7: Variation of Magnesium

Maximum Mg is observed at point 2 due to presence of minerals,carbonates, Bicarbonates

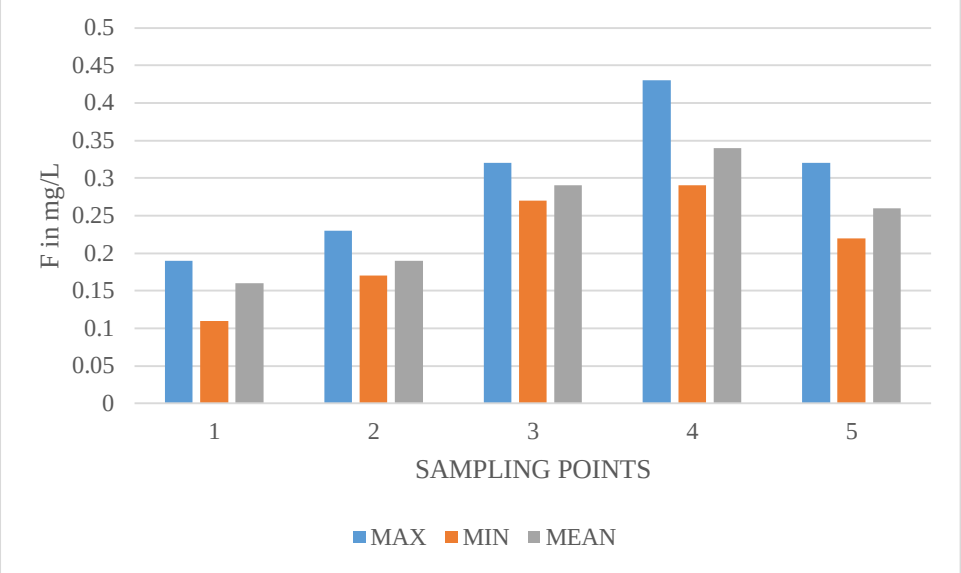

Figure 8: Variation of Fluoride

Maximum Fluoride is observed at point 4 due to nature of soil .

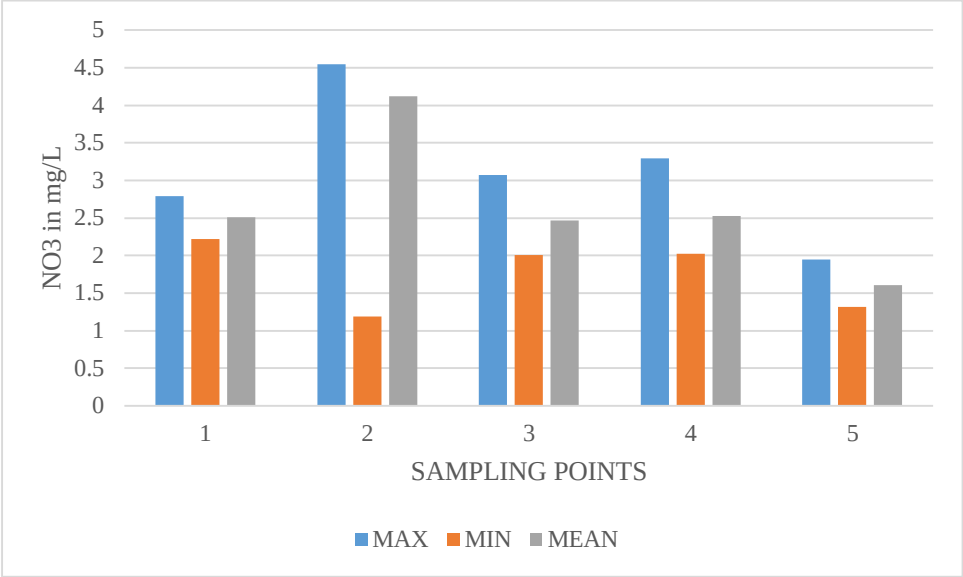

Figure 9: Variation of Nitrate

Maximum nitrate is observed at point 2 due to agricultural run off, disposal of temple waste.

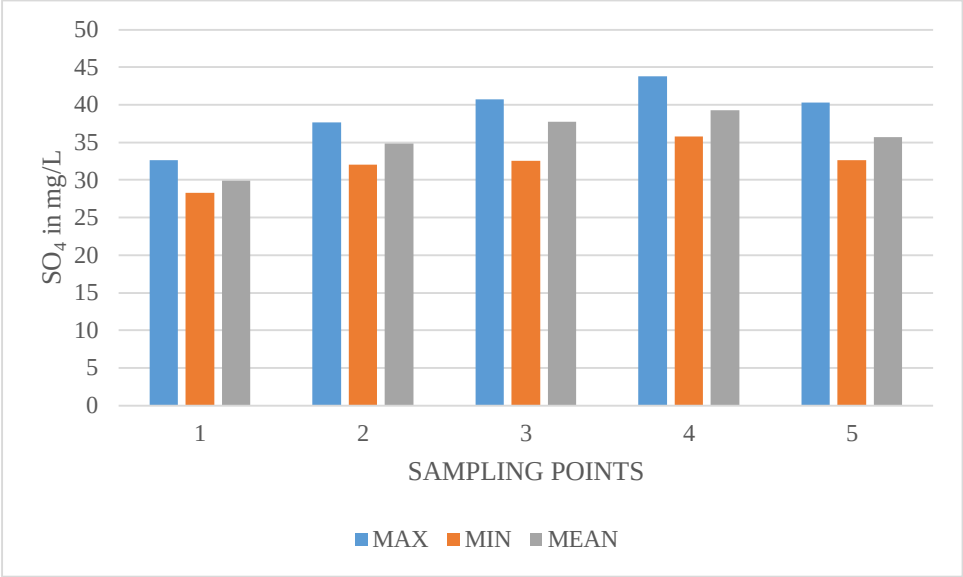

Figure 10: Variation of sulphate

Maximum sulphate is observed at point 4 due to presence of minerals and agricultural waste.

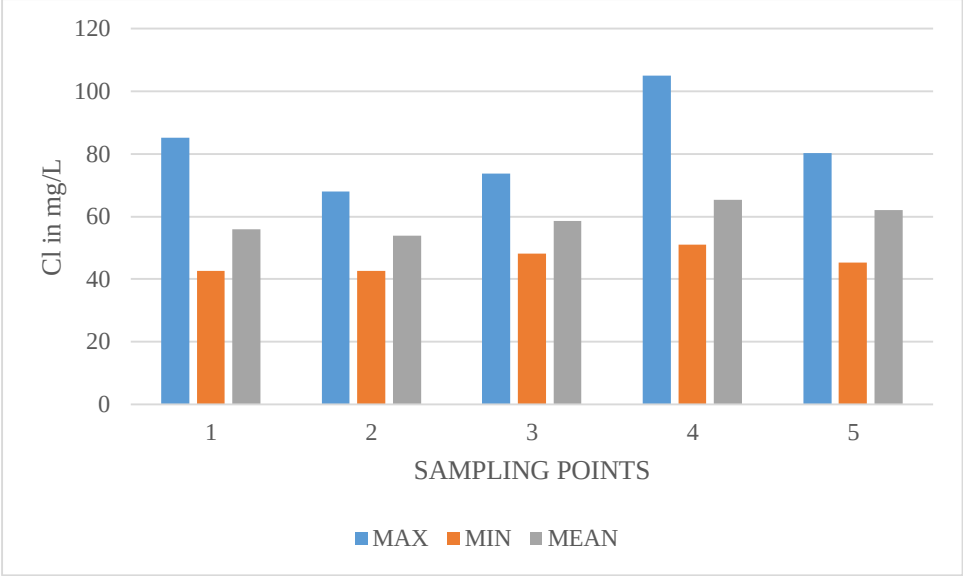

Figure 11: Variation of Chloride

Maximum Cl is observed at point 4 due irrigation drainage and use of inorganic fertilizers.

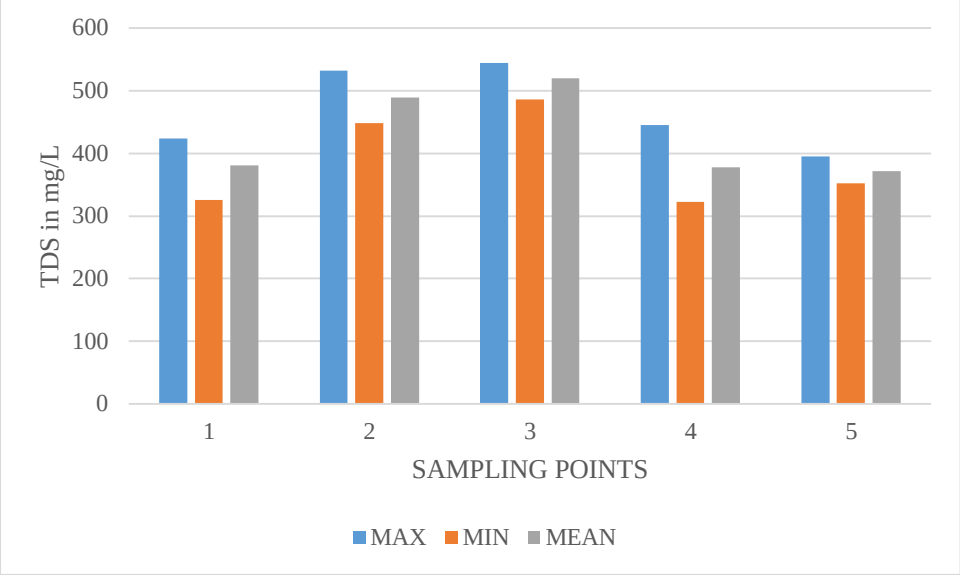

Figure 12: Variation of TDS

Maximum TDS is observed at point 3 due to agricultural runoff, leeching from soil contamination etc.

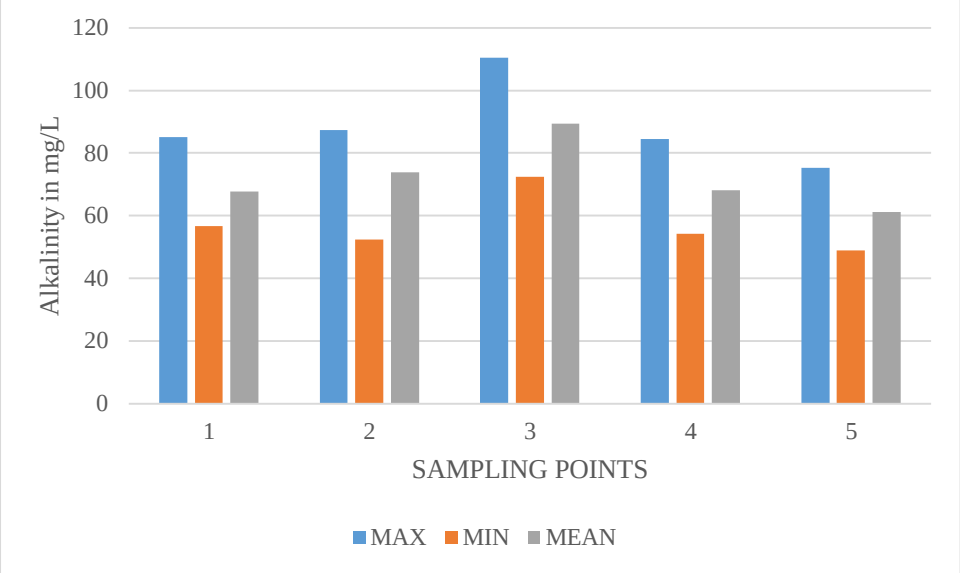

Fig 13: Variation of Alkalinity

Maximum alkalinity is observed at point 3 due to presence of carbonates and bicarbonates.

IV. Correlation Analysis of Kagina River at Sampling Point 5.

In the present study, the correlation co-efficient(r) between the parameters is computed. Correlation co-efficient (r) between any two parameters ,X and Y is calculated for parameters such as pH ,DO ,BOD ,TH , Ca ,Mg, F, SO_4 ,NO_3, TDS, Cl , alkalinity of the River is given in Table 3 below. The degree of line association between any of the water quality parameters as measured by the simple correlation (r) is represented in Table 3.The correlation coefficient (r) is calculated by using the formula:

$$r = \frac{N\Sigma xy - (\Sigma x)(\Sigma y)}{\sqrt{[N\Sigma x^2 - (\Sigma x)^2][N\Sigma y^2 - (\Sigma y)^2]}}$$

Where:

- N = number of pairs of scores
- Σxy = sum of the products of paired scores
- Σx = sum of x scores
- Σy = sum of y scores
- Σx^2 = sum of squared x scores
- Σy^2 = sum of squared y scores

If the correlation coefficient is ≥0.67 there exists a relation between two parameters. Alkalinity and pH are best correlated. For such parameters regression equations are computed and best fit line is drawn in Fig 14.

Table 3: Correlation Co-efficient of Kagina River Water

PARAMETERS	pH	DO	BOD	TH	Ca	Mg	F	NO_3	SO_4	Cl	TDS	Alkalinity
pH	-											
DO	0.300	-										
BOD	-0.310	-0.375	-									
TH	-0.453	0.359	0.215	-								
Ca	-0.011	0.483	0.107	0.599	-							
Mg	-0.413	-0.251	0.072	0.210	-0.657	-						
F	0.443	0.294	0.065	0.242	0.364	-0.216	-					
NO_3	-0.311	0.224	0.151	0.468	0.289	0.089	0.458	-				
SO_4	0.357	0.060	-0.215	-0.417	-0.086	-0.287	0.230	0.094	-			
Cl	-0.323	-0.181	0.326	0.125	-0.401	0.607	-0.211	0.273	-0.172	-		
TDS	-0.041	-0.615	-0.030	-0.211	-0.414	0.306	0.071	-0.425	-0.137	-0.022	-	
Alkalinity	**0.701**	0.180	-0.412	-0.307	0.047	-0.346	0.359	0.169	0.305	-0.050	-0.238	-

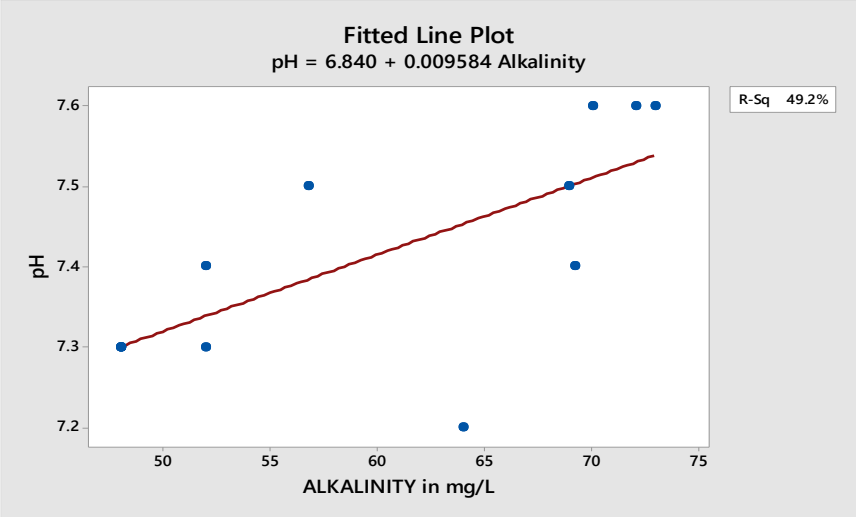

Figure 14: Regression Line pH v/s Alkalinity in mg/L

V. Comparison of physico-chemical characteristics with BIS standards (IS 10500:2012)

Parameters	Observed Average Values	Standards	Remarks
pH	7.68	6.5-8.5	Complying
DO	6.82	5.0	Complying
BOD	1.502	3-5	Complying
TH	99.31	200-600	Complying
Ca	70.50	75-200	Complying
Mg	29.25	30-100	Complying
F	0.248	1-1.5	Complying
NO_3	2.64	45	Complying
SO_4	35.49	200-400	Complying
Cl	59.11	250-1000	Complying
TDS	428.12	500	Complying
Alkalinity	71.87	200-600	Complying

All the parameters are in mg/L except pH.

VI. CONCLUSIONS

Based on the study analysis and interpretation of the numerical data, the following conclusion have been drawn.

1. The Physico-chemical characteristics of Kagina River water at different sampling points were analysed and found all the values are within the permissible limit of BIS standards.
2. The pH of Kagina River is between 7.41 to 8.24.
3. The DO of Kagina River is between 5.51 to 8.03.
4. The BOD of Kagina River is between 1.11 to 2.12.
5. The water quality index (WQI) of sampling point 1,2,3,4 and 5 are 34.22, 35.3, 34.5, 32.72, and 32.64 respectively and they fall under "B" grade WOI (Good Quality Water) and it is fit for drinking purposes.

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