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Assessment of Spatial Variations of Water Quality Index of Deepor Beel, Assam, India

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Abstract - *The aim of the study is to represent the water quality of Deepor Beel in terms of Water Quality Index (WQI) parameters and to assess the contamination sources. For determining the water quality variation, data were collected in the month of September and October, 2017 from 6 different sampling stations distributed around the Beel. The 13 Physico-chemical water quality indicators used are - Temperature, pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TSS), Hardness, Alkalinity, Conductivity, Calcium, Magnesium, Chloride and Turbidity. The WQI calculation was done using arithmetic index method. The WQI value for these samples ranges from. The calculation was done using arithmetic index method. More or less, water of all the sites are found to be affected. The WQI value for these samples ranges from 78.82 to 158.25. The highest WQI value of 158.25 was recorded from site2 (Pamohi, near railway bridge) which is a picnic spot and its water is unsuitable for drinking and other house hold purposes. Deepor Beel is a large and internationally important natural wetland of Brahmaputra valley located in the Guwahati city. The waste from the city to this Beel has mainly degraded its water quality and hence it needs preventive study to take strong step for providing overall safety to the Beel.*

Key Words: Deepor Beel, Assam, Water Quality Index, Physico-Chemical Parameters, Weighted Arithmetic Index Method

1. INTRODUCTION

Water quality describes the conditions of the water, including chemical, physical, and biological characteristics, usually with respect to its suitability for a particular purpose. The composition of water is affected by natural processes and human activities and is controlled by dissolved as well as suspended constituents. Other important factors affecting water quality include intensity and composition of the rainwater and the runoff , chemical interactions between water and soil composition or sediment, use of fertilizers or some chemicals in agricultural practices, industrial activities in the catchment and effluent discharge , emissions and subsequent depositions from the atmosphere and solid waste dumping. A healthy river or any wetland is very much essential as it is a source of fresh water for the substance and well-being of a society. But, unfortunately these natural resources are continuously being used during the last few decades for the society development and flood hazard mitigation. However, the Brahmaputra river along with their numerous wetlands in North-East India serve as the refuge to diverse organism and sub-ecosystems. Water Pollution is the contamination of water bodies such as lakes, rivers, oceans, aquifers and groundwater. This form of environmental degradation occurs when pollutants are directly or indirectly discharged into water bodies without adequate treatment to remove harmful compounds. Despite its importance to human life, water is the most poorly managed resources in the world. The existing tendency of industrialization and urbanization may contribute greatly to the poor quality of water through indiscriminate disposal of solid waste, industrial effluents and other toxic wastes which are the major environmental issues causing threats to the existence of human being. Wetlands are among the most productive ecosystem in the world and are associated with the environmental, social, and economic well-being of society. They provide livelihood & nutrition to the local human population. Wetlands near towns and cities have been adversely affected by urban storm water runoff. . There are no regulations controlling inputs from non-point sources because of difficulty in implementing them and the wetlands have continued to receive large loads of pollutants. The pollutants from city streets, urban and suburban households, business and industrial establishment are carried into low lying wetlands nearby, deteriorating water quality and destroying fish habitats and killing aquatic life including water birds. One of the largest & most important riverine wetland in the Brahmaputra Valley of lower Assam is the Deepor as it has a great biological and environmental importance. But the inflow wastewater from Guwahati city to this Beel has degraded its water quality making it hazardous. It is the only major storage water basin for Guwahati's drainage. Thus, for the importance of freshwater body towards society its water quality assessment in terms of water quality index (WQI) is required to be found out. It will give an overall picture of the current water quality status of the Beel.

2. LITERATURE REVIEW

Barman D et al., (2015) in this paper, eleven physico – chemical parameters of wetlands in Meghalaya were recorded in different seasons for two years to assess the quality status of water. COD and TSS were beyond the permissible limit. It may be due to addition of sewage or other agricultural residues. Brraich Singh Onkar et al.,(2015) Studied physico-chemical parameters of Ranjit Sagar Wetland, Punjab and found that WQI indicated poor quality of water so water of this wetland is not suitable for drinking

purposes without prior treatment. Charkhabi and Sakizadeh (2006) studied the spatial variation in water quality parameters in most polluted stretch of the Anzali River (Iran). Das and Acharya (2003) reported the possible impact of domestic sewage on the lotic water quality in and around Cuttack city, India. Ouyang et al., (2006) studied the river water quality in rural and urban areas and reported that type of river pollution varied markedly between two areas.

3. MATERIALS AND METHODS

For water quality assessment the work was divided into three parts as initial pre-field survey which was carried out for identifying the sampling stations for water collection. Secondly, as a field work 6 study sites have been selected from the surrounding of the Beel. Lastly, collected samples were tested in Public Health Engineering Department laboratory & State Public Health Laboratory, Guwahati for analyzing the variation of water quality in the same time but in different places.

3.1 Sampling Sites

Water samples were collected from six different stations and those are namely at Pamohi, near bird watching tower (site 1), Pamohi, near railway bridge (site 2), Dharapur, near GIMT College (site 3), Khanamukh (site 4), Tetelia, near wooden bridge (site 5), Boragaon (site 6). Samples are taken twice from the stations selected, first on 13th September and second time on 8th October of 2017 at day time. The collected samples were tested on Public Health Engineering Department Laboratory (Chandmari, Guwahati) & State Public Health Laboratory. To determine the WQI of water, we had selected **13** parameters for testing namely- Temperature, pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), Hardness, Alkalinity, Conductivity, Calcium, Magnesium, Chloride and Turbidity.

3.2 Calculation of Water Quality Index (WQI)

In this current study, the calculation of the WQI was done using weighted arithmetic water quality index which was originally proposed by Horton (1965) and developed by Brown et al (1972). The weighted arithmetic water quality index (WQIA) is in the following form:

$$WQIA = \Sigma wiqi \,/\, \Sigma wi$$

Where,

n = the number of variables or parameters,
wi = relative weight of the i^{th} parameter
qi = water quality rating of the i^{th} parameter.

Table -1: Classification of Water Quality Based On Weighted Arithmetic WQI Method

WQI	STATUS
0-25	Excellent
26-50	Good
51-75	Poor
76-100	Very Poor
Above 100	Unsuitable for drinking

4. RESULTS AND DISCUSSIONS

In this current study two types of results are found out. First of all the samples for analysis are collected in the months of September and October, 2017. Then by laboratory testing Water Quality Index of Deepor Beel are calculated for analyzing the variation of water quality in the same time at different places. The observed values of the parameters for every sample collecting sites are shown in table 2.

Table -2: WQI parameters for Deepor Beel

Parameters	Month	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
pH	September	7.82	7.86	7.68	7.41	7.13	6.89
	October	7.16	7.33	7.17	6.85	6.92	6.33
Temperature	September	32	32	31	32.5	31	32.5
	October	28	28	28	29	29	29
Conductivity	September	106.5	107.6	108.6	102.3	103.7	97.1
	October	114.06	106.25	109.38	109.38	106.25	104.68
T.D.S	September	68.16	68.86	69.5	65.47	66.37	62.14
	October	114.06	106.25	109.38	109.38	106.25	104.68
Turbidity	September	4	8	13	13	0	14
	October	19	10	15	0	15	21
D.O	September	1	2.8	3	0.7	2	0.5
	October	1.1	2.6	2.9	0.7	1.9	0.6
B.O.D	September	9	8	4	5	7	7

	October	11.2	2.29	3.52	1.2	10.4	10.2
C.O.D	September	36.16	31.97	20.85	34.76	31.97	36.15
	October	48	11.2	17.6	1.6	41.6	47
Chloride	September	20	34	26	26	24	30
	October	14	16	16	12	16	14
Alkalinity	September	100	100	100	100	100	100
	October	84	86	84	70	76	72
Total Hardness	September	88	88	96	88	92	92
	October	86	84	90	86	92	92
Calcium	September	65	60	60	60	80	55
	October	60	56	58	58	64	50
Magnesium	September	5.61	6.83	8.78	6.83	2.92	9.02
	October	6.344	6.832	7.808	6.832	6.832	10.248

4.1 Analysis of Variations of Water Quality Index Parameters around the Deepor Beel:

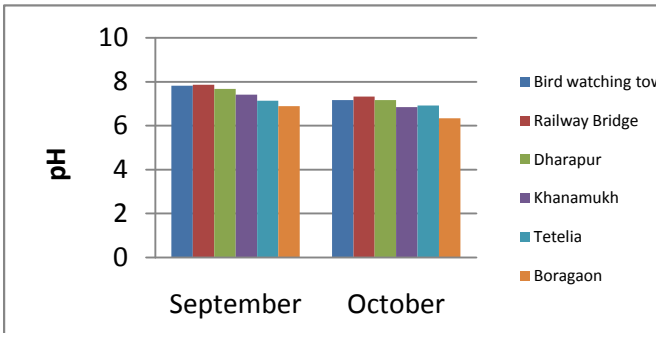

Chart-1: pH Variation around the Lake

In the month of September, the pH of water ranges from 7.13 to 7.86 as shown in chart 1. The mean pH value along the Deepor Beel water is 7.465 which is under permissible value. In the month of October, the pH of water ranges from 6.33 to 7.16 as shown in chart 1.The mean pH value along the Deepor Beel water is 6.96 which is under permissible value.

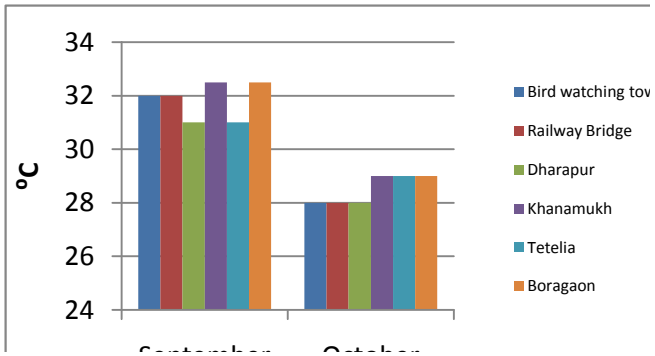

Chart-2: Temperature variation around the lake

The temperature of Deepor Beel water during September 2017 varies from 31^{0}C to32.5 ^{0}C as shown in chart 2. The mean temperature values are 31.83 ^{0}C which is not under permissible value. In October the temperature of Deepor Beel water during September 2017 varies from 28^{0}C to 29^0 and the mean temperature value is 28.5 ^{0}C which is not under permissible value.

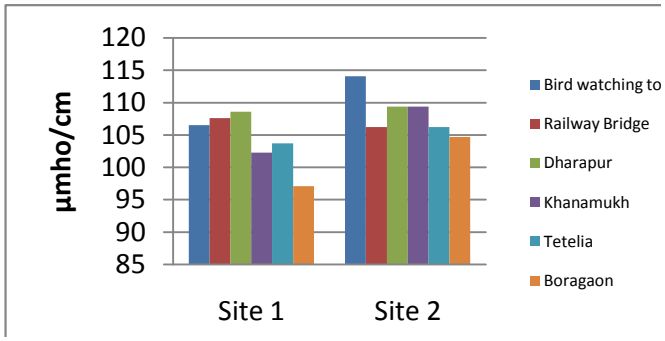

Chart-3: Conductivity Variation around the Lake

In September, conductivity ranges from 97.1 to 108.6 around the Beel as shown in chart 3. The mean conductivity is 104.3which is under permissible value. In October conductivity ranges from 104.68 to 114.06 along the Beel as shown in figure 3.The mean conductivity is 108.33, which is under permissible value.

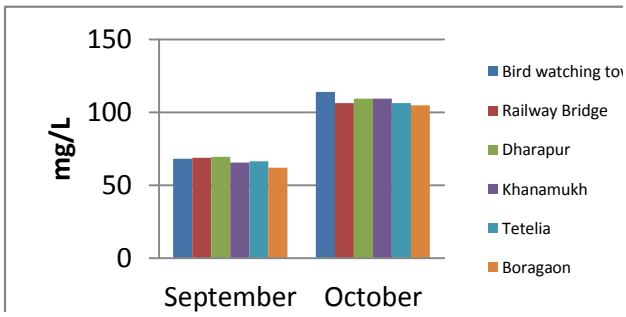

Chart-4: T.D.S. variation around the lake

In the month of September, Total dissolved solids (TDS) have range from 62.14mg/l-69.5 mg/l as shown in chart 4. The mean value is 66.75mg/L which is under permissible value. In October, Total dissolved solids (TDS) have range of 67

mg/l -73 mg/l shown in chart 4. The mean value is 69.33 mg/l which is under permissible value.TDS levels in lakes and streams are typically found in the range of 50 to 250 mg/l

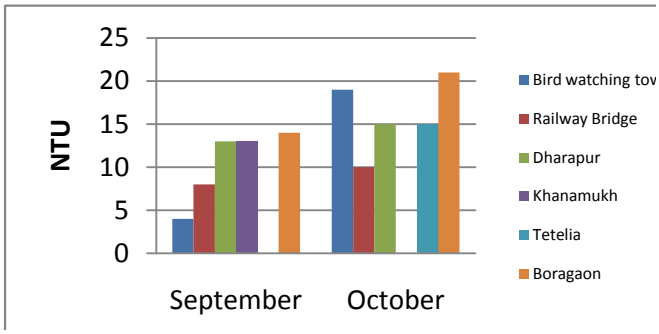

Chart-5: Turbidity Variation around the Lake

Turbidity of the wetland water ranged from 0 NTU to 14 NTU in the month of September 2017 which is shown in chart 5. The mean turbidity level is 8.67NTU which is below the lower permissible value. In October 2017, Turbidity of the river water ranged from 0 NTU to 21 NTU which is shown in figure chart 5. The mean turbidity level is 13.33NTU which is under permissible value.

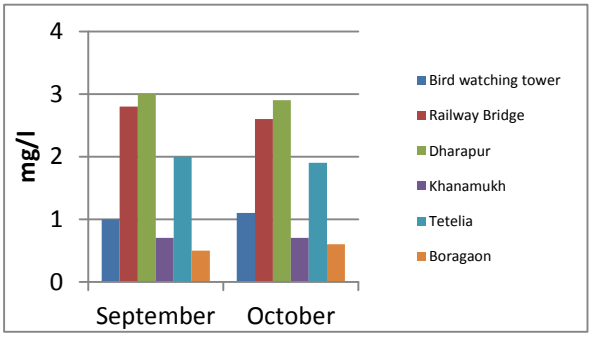

Chart-6: Dissolved oxygen variation around the lake

Dissolved oxygen ranges from 0.5mg/L to 3 mg/L in the month of September 2017 as shown in chart 6.The mean DO is 1.66 mg/L which is below permissible value. In October Dissolved oxygen range from 0.6 mg/L to 2.9 mg/L shown in chart 6. The mean DO is 1.633 mg/L which is below permissible value.

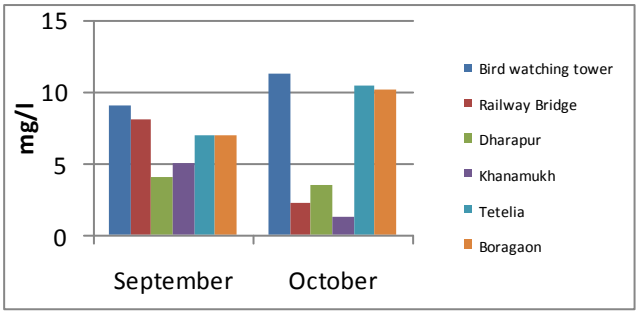

Chart-7: BOD variation around the lake

Biochemical oxygen demand ranges from 4 mg/l to 9 mg/l during the month of September as shown in the chart 7.The mean B.O.D is 6.67mg/l which is not under permissible value. In October Biochemical oxygen demand range from 1.2 mg/L to 11.2 mg/L during our period as shown in the chart 7. The mean B.O.D is 6.46 mg/L which is not under permissible value.

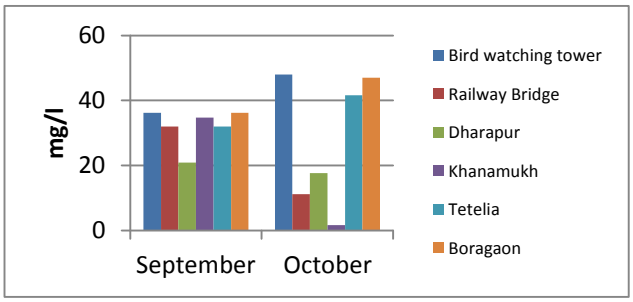

Chart-8: COD Variation around the Lake

The COD level is ranges between 20.85mg/l-36.16mg/l in the month of September 2017 as shown in chart 8. The mean value is 31.97 mg/l which is under permissible value. In October, the COD level is ranges between 1.6 mg/l-48 mg/l shown in chart 8. The mean value 27.833 is mg/l which is under permissible value.

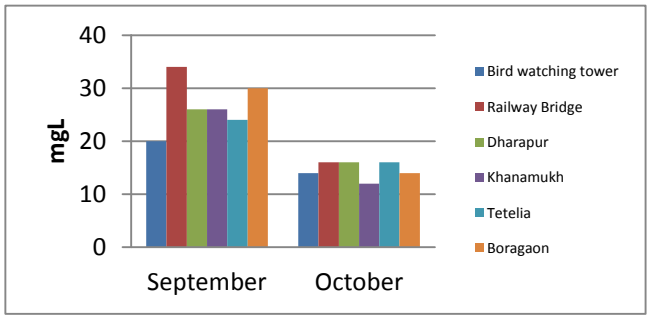

Chart-9: Chloride Variation around the Lake

In the month of September, Chloride value ranges from 20 mg/L-34 mg/L as shown in chart 9.Mean value is 26.67 mg/L which is under permissible value. In October, Chloride value ranges from 12 mg/L-16 mg/L shown in chart 9. Mean value is 14.67 mg/L which is not under permissible value.

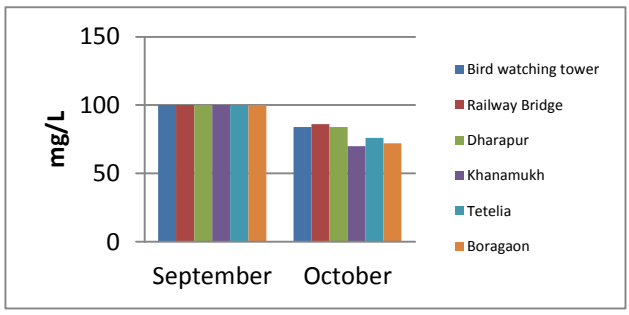

Chart-10: Alkalinity variation around the lake

Alkalinity of water body is a measure of its capacity to neutralize acid to a designated pH. In the month of September Alkalinity values remain constant at all the site. In October, Alkalinity values ranged between 70 mg/L- 86 mg/.The mean value is 78.67 mg/L which is under permissible value.

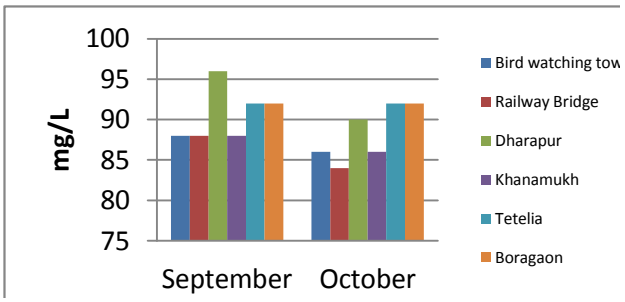

Chart-11: Total hardness variation around the lake

The total hardness values ranged between 88 mg/L- 96mg/L in the month of September 2017 as shown in the chart 11. mean values is 90.67 mg/L which is under permissible value. In October, the total hardness values ranged between 84 mg/L- 92 mg/L as shown in the chart 11.The mean values is 88.33 mg/ L which is under permissible value.

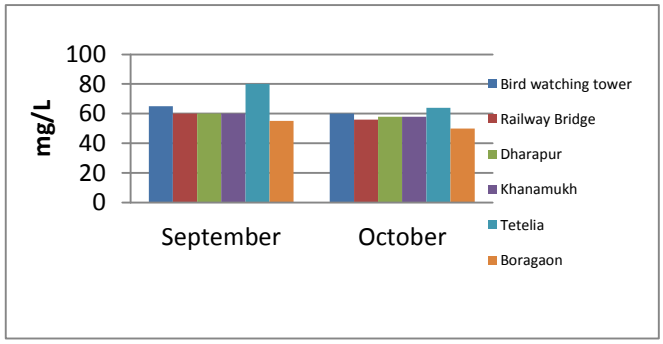

Chart-12: Calcium Variation around the Lake

The concentration of calcium varied from 55 mg/l to 80 mg/L during September 2017 as shown in the chart 12. The mean value is 63.33 mg/L which is under permissible value. In October the concentration of calcium varied from 50 mg/l to 64 mg/l. The mean value is 57.66 mg/L which is under permissible value.

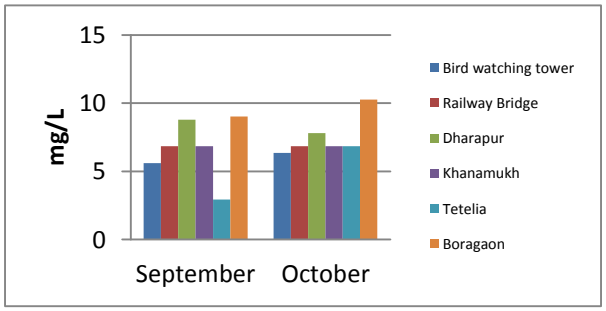

Chart-13: Magnesium Variation around the Lake

Magnesium also occurs in all kind of natural waters with calcium shown in chart 13. In September, Its value range from is 2.92 mg/L to9.02 mg/L .Its mean value is 6.665 mg/L which is under permissible value. In October, Magnesium also occurs in all kind of natural waters with calcium shown in chart 13. Its value range from is 6.344 mg/L to 10.248 mg/L. Its mean value is 7.482 mg/L which is under permissible value.

4.2. Assessment of water quality index

The water quality index (WQI) of Deepor Beel was then calculated using the weighted arithmetic index formula as follows:

For the month of September:

WQI (site1) = ∑ wiqi / ∑ wi = 73.77/ 0.6259 = 117.88

WQI (site2) = ∑ wiqi / ∑ wi = 99.05/ 0.6259 = 158.25

WQI (site3) = ∑ wiqi / ∑ wi = 50.22/ 0.6259 = 80.23

WQI (site4) = ∑ wiqi / ∑ wi = 56.68/ 0.6259 = 90.56

WQI (site5) = ∑ wiqi / ∑ wi = 57.61/ 0.6259 = 92.04

WQI (site6) = ∑ wiqi / ∑ wi = 63.05/ 0.6259 = 101.06

For the month of October:

WQI (site1) = ∑ wiqi / ∑ wi =93.733446 / 0.6259 = 149.76

WQI (site2) = ∑ wiqi / ∑ wi = 49.331797/ 0.6259 = 78.82

WQI (site3) = ∑ wiqi / ∑ wi =52.242873 / 0.6259 = 83.47

WQI (site4) = ∑ wiqi / ∑ wi =50.446635/ 0.6259 = 80.60

WQI (site5) = ∑ wiqi / ∑ wi =83.528503 / 0.6259 = 133.45

WQI (site6) = ∑ wiqi / ∑ wi =86.617095 / 0.6259 = 138.39

Sampling Sites	Water Quality Index Value	
	September	October
Site 1	117.88	149.76
Site 2	158.25	78.82
Site 3	80.23	83.47
Site 4	90.56	80.60
Site 5	92.04	133.45
Site 6	101.06	138.39

The graphical presentation of water quality index of six sampling sites in the month of September and October are shown in figure 14.

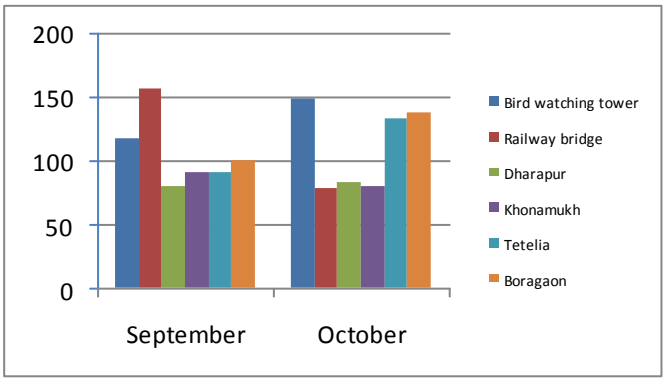

Chart-14: Graphical presentation of WQI

5. CONCLUSIONS

The objective of the study was to calculate the Water Quality Index (WQI) of Deepor Beel, Assam in order to assess its suitability for drinking purpose. In the month of September, the highest WQI was recorded as 158.25 near Railway Bridge and the lowest WQI was recorded as 80.23 at Dharapur. At Bird Watching Tower, near Railway Bridge and Boragaon the WQI are found to be above 100 and hence not suitable for drinking purpose. In the month of October, the highest WQI was recorded as 149.75 at Bird Watching Tower and the lowest WQI was recorded as 78.81 near Railway Bridge. At Bird Watching Tower, Tetelia and Boragaon the WQI are found to be above 100 and hence not suitable for drinking purpose. Hence it is clear that the Deepor Beel water needs some kind of treatment before using to remove harmful compounds and for saving the wetland.

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