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SEASONAL VARIATIONS OF PHYSICO-CHEMICAL CHARACTERISTICS OF RIVER BETWA IN VIDISHA DISTRICT

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Abstract: The water quality of river Betwa in Vidisha district was monitored in the month August 2013, November 2013, February 2014 and May 2014. Ten sampling stations were selected in Vidisha, Sumer, Ganj Basoda and Kurwai town. Water samples were assessed by analyzing 13 physico-chemical parameters like dissolved oxygen, biological oxygen demand, Chemical Oxygen demand, Alkalinity, Acidity, TDS, Total hardness etc. The analysis reveals the water of river Betwa is not polluted in excess amount in these different towns but percentage of oxygen is less than normal. However it needs sufficient management and awareness.
Keywords: River Betwa, Water Quality Parameters, awareness, dissolved oxygen, biological oxygen demand and Chemical Oxygen demand

Introduction

It is a fact that good water quality produces healthier human than one with poor water quality [1]. In the last few decades, there has been a tremendous increase in demand for freshwater due to rapid growth of population and industrialization [2]. Human health is threatened by most of the agricultural development activities particularly in relation to excessive application of fertilizers and unsanitary conditions. Water is an essential requirement of human and industrial developments and it is one of the most delicate parts of the environment [3].

Water quality refers to the physical, chemical and biological characteristics of a water body. These characteristics determine how and for what water can be used and the species and ecosystem process it can support [4].

Seasonal variations in quality of water generally refer to the change in components of water, which are to be present at the optimum level for suitable growth of plants and animals. These components play an important role for the growth of plants and animals in the water body. In natural aquatic system, various chemical parameters occur in low concentration. This concentration increases as a result of rapid growth of population, increased urbanization,

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expansion of industrial activities, exploitation of natural resources [5]. A continuous monitoring of water quality is very essential to determine the state of pollution in our rivers. This information is important to be communicated to the general public and the government in order to develop policies for the conservation of the precious fresh water resources. [6]

Water quality parameters provide the basis of judging the suitability of water for its designated uses and to improve existing conditions. For optimum development and management for the beneficial uses, current information is needed which is provided by water quality programmes [7].

Rivers and lakes are very important part of our natural heritage. They have been widely utilized by mankind over the centuries, to the extent that very few, if any are now in a natural condition [8].

Betwa River is the source of water for an extensive irrigation system and other domestic uses. It has supported irrigated agriculture for centuries and served as the lifeblood of the kingdoms The Betwa rises in the Vindhya Range just north of Hoshangabad in Madhya Pradesh and flows north-east through Madhya Pradesh and Orchha to Pradesh. Betwa is a river in Northern India, and a tributary of the Yamuna and also known as the Vetravati [9].

In this study, water of Betwa River was analyzed from few sampling stations in rainy, winter, spring and summer seasons. It provided very useful information about water quality of Betwa River in these cities. With this it can be intellect the quality of Betwa river water and also understand the level of pollution in Betwa River and its causes which can help to conserve and protect it.

Table 1. Location of sampling sites

sampling station	Name of sampling site	City/Town	Distance from First site(km)
A	Rangai Hanuman temple	Vidisha	0
B	Ramghat		3
C	Triveni		5
D	Upstream area	Sumer	15
E	Downstream area		17
F	Outer area (Sagda river)	Ganj Basoda	48
G	City area		50
H	Downstream area		52
I	Upstream area	Kurwai	86
J	Downstream area		88

Map1. Location map showing the Betwa river and four sampling stations in Vidisha District

Material and Methods

In the present study, seasonal variations in physical and chemical parameters of River Betwa were studied at Vidisha, Sumer, Ganj Basoda and Kurwai towns of Vidisha district of M.P. The sampling done on rainy season August 2013, winter season November 2013, spring season February 2014 and summer season May 2014.The study period consisted of four months and duration of ten months. Ten sampling stations were selected.

The samples were taken from below the water in plastic bottles of 1.5 L capacity. The samples were analyzed for 13 different physico-chemical parameters. At the time of sampling the air and water temperature were recorded by using digital thermometer. pH were determined by using digital pHmeter To. Chloride contents were analyzed by Mohr titration method (APHA 1998), Dissolved Oxygen was fixed immediately after collection and then determined by Winkler's method. Samples for BOD were incubated in Laboratory for 5 days at 20^{o}C.Total hardness was estimated by the complexometric titration with standard EDTA solution using Eriochrome Black-T as indicator. What man 541 filter papers were used for the determination of Total dissolved solids.

Parameters detected

Temperature, pH, Acidity, alkalinity, Free CO_2, Dissolve oxygen, Biochemical oxygen demand, Chemical oxygen demand, Calcium, Magnesium, Total hardness ,Chloride content and Total dissolved solids.

Results and Discussion

The physico-chemical characteristics of all samples are in the form of Total hardness, Alkalinity, Acidity Chloride content, TDS, pH, Free CO_2, COD, BOD and DO. It has been found that parameters for all studying stations of Betwa are in the limit but less amount of dissolved oxygen was observed at different stations.

Temperature influences the life of all biological organisms. During the period of study temperature was recorded ranged from 22 to 30.5^{o}C. The variation is mainly related with the temperature of atmospheric and weather condition (Adebowale*et.al.,*2008).

The pH value ranged between 7.3 to 8.2. This pH range show that river water is slightly alkaline. The higher range of pH indicates the higher productivity of water.[15]pH expresses the intensity of acidity or alkalinity of an aquatic environment. No significantly variations were observed in duration of experimental period.

Total dissolved solids are a measure of the solid materials dissolved in the river water. This includes salts, some organic materials, and a wide range of other things from nutrients to toxic materials. The amount and nature of dissolved and undissolved matter occurring in liquid materials vary greatly. Waters with higher solids content have laxative and sometimes the reverse effect upon people whose bodies are not adjusted to them [9]. Highest TDS value 0.81 mg/l was recorded at station F in month August.

The chemical, physical, and biological aspects of water quality are inter-related. For example, higher water temperature reduces the solubility of dissolved oxygen, and may cause a dissolved oxygen shortage that kills more sensitive fish species. Water quality is highly variable over time due to both natural and human factors. Water temperature, photosynthetic activity, and flows vary with seasons. Many bacteria or aquatic animals in the area may overpopulate due to high temperature by using DO in great amounts. Oxygen levels also can be reduced through over fertilization of water plants by run-off from farm fields containing phosphates and nitrates. Under these conditions, the numbers and size of water plants increase.

Dissolved oxygen is directly related to photosynthesis. During the night, when there is no photosynthesis, the loss of oxygen through respiration is high since there is no counterbalance of oxygen and hence the DO may steadily reduce. The highest value of DO was found at the sampling station H that was 8.9 mg/l and the lowest amount of DO (3.1mg/l) was investigated at the station A in spring season. The lowest value of oxygen at station A could

be because of the heavy oxygen demand due to growth of aquatic species and organic pollutants. (Graph.1)

Table 2. Physico-chemical characteristics of river Betwa in Vidisha district in different season

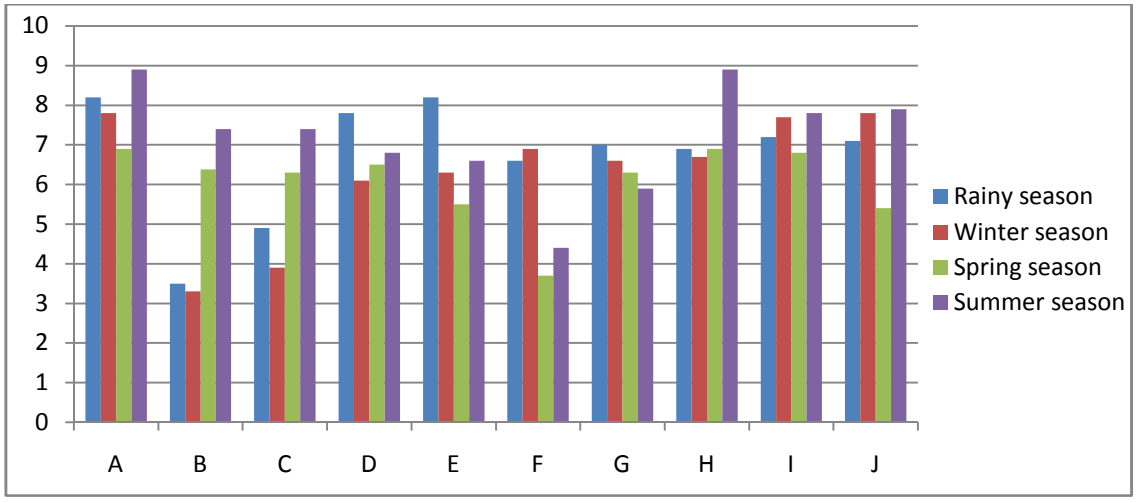
Sites	Tem.	pH	DO	BOD	COD	Alkalinity	Acidity	Free CO2	TDS	Mg	Ca	Total hardness	Chloride content
Month-August 2013													
A	26.2	7.5	7.8	1.6	40	214.4	abs	Abs	0.80	159.9	90.1	250	60.1
B	26.2	7.6	3.5	1.8	122	180.8	12.5	Abs	0.76	143.8	66.2	210	62.4
C	26.3	7.5	4.9	1.5	24	230	2.9	Abs	0.78	239.70	80.3	320	49.7
D	25.6	7.6	7.8	2.1	34	135	10	Abs	0.69	241	79	320	57
E	25.6	7.7	8.2	1.6	54	122	10	Abs	0.76	246	78	324	56
F	26.2	7.5	6.6	1.4	55	135	12.7	Abs	0.65	183	100	283	49.3
G	26.3	7.6	7.0	2.2	165	142	Abs	Abs	0.54	150.3	93.7	244	56.5
H	26.2	7.5	6.9	1.5	56	256	Abs	Abs	0.81	118	92	210	63.7
I	26	7.9	7.2	1.7	42	233	12	Abs	0.58	221	99	320	65
J	26	7.9	7.1	1.7	58	245	12	Abs	0.67	199	112	311	57
Month-November 2013													
A	22.1	7.5	6.4	2.9	55	247.1	Abs	Abs	0.63	176.9	89.1	266	59
B	22.2	7.5	3.3	1.6	144	178.4	12.2	Abs	0.72	155.3	66.7	222	57
C	22.1	7.6	3.9	1.9	36	212.2	10.5	Abs	0.65	231.7	78.3	310	39
D	22	7.6	6.1	1.3	38	111	Abs	Abs	0.64	131.6	121.4	253	48.4
E	22.2	7.5	6.3	1.8	132	121.1	10.5	Abs	0.71	152.5	92.5	245	68.7
F	22.1	7.5	6.9	1.5	35	235	Abs	Abs	0.64	101.3	88.7	190	57.9
G	22.1	7.8	6.6	2.1	156	165	15	Abs	0.80	122	90	212	56
H	22.1	7.8	6.7	1.8	67	158	16	Abs	0.75	166	123	289	58
I	22.4	7.6	7.7	1.5	45	211	10	Abs	0.68	198	122	320	57
J	22.4	7.7	7.8	1.5	49	202	10	Abs	0.66	214	98	312	51
Month-February 2014													
A	25	7.7	3.19	1.6	44	190.8	Abs	Abs	0.80	131.87	64.12	196	59.35
B	25	7.7	6.38	2.6	134	154	12.5	Abs	0.78	143.9	96.1	240	61.23
C	25	7.6	6.39	1.6	49	254.4	12.5	Abs	0.78	166.3	89.7	256	62.48
D	25.5	7.9	6.5	2.2	54	234	15	Abs	0.77	80	98	178	56.2
E	25.5	7.9	5.5	2.1	48	241	15	Abs	0.67	97	98	195	55
F	25.1	7.6	3.72	1.4	38	212	Abs	Abs	0.72	260.3	89.7	350	40.61
G	25.1	7.7	6.39	3.0	69	120	20.1	Abs	0.80	185.4	102.6	288	46.86
H	25	7.6	6.92	1.4	29	122	2.6	Abs	0.77	155.81	96.19	252	31.24
I	25.8	7.7	6.88	1.7	44	145.5	12	Abs	0.87	146.7	97.3	244	46.2
J	25.8	7.7	5.45	1.7	45	144	13	Abs	0.69	158	98	256	46.2
Month-May 2014													
A	30	7.9	8.00	7.16	78	80	40	Abs	0.80	76.65	76.95	153.6	92.3
B	30	7.9	7.48	5.61	75	80	40	Abs	0.76	57.45	76.95	134.4	109.34

C	30	7.8	7.48	6.61	68	80	40	Abs	0.81	70.23	89.77	160	92.3
D	30	8.1	6.8	5.6	45	73	35	Abs	0.72	97	69	166	101
E	30	8.1	6.6	5.2	47	75	34	Abs	0.70	93.4	71.6	165	100
F	30.5	7.6	4.49	2.44	58	80	80	Abs	0.73	89.43	89.77	179.2	68.16
G	31	7.8	5.99	4.52	122	70	80	Abs	0.89	76.63	89.77	166.4	69
H	30	7.8	8.98	5.44	76	70	78	Abs	0.72	111.88	64.12	176	69.58
I		7.9	7.8	5.1	46	60	65	Abs	0.73	109	69	178	70.8
J		7.8	7.9	5.7	54	63	69	Abs	0.73	110	71	181	69.55

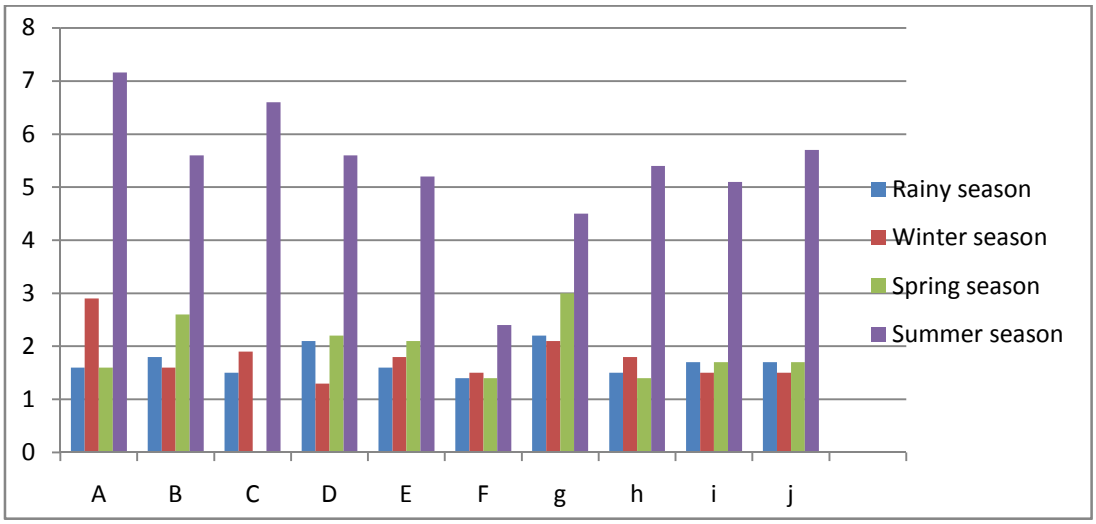
All the values are expressed in ppm except temperature and pH.

The COD test is commonly used to indirectly measure the amount of organic compounds in water. COD is the measure of the amount of oxygen in water consumed for chemical oxidation of pollutants. COD determines the quantity of oxygen required it oxidize the organic matter in water compounds which are disposed domestically, institutionally or industrially under specific conditions of oxidizing agent, temperature and time. Highest COD value 165 mg/l was recorded at station G and lowest value of COD 24 mg/l was observed at station C in rainy season.

Biochemical Oxygen Demand (BOD) refers to the amount of oxygen that would be consumed if all the organic matter present in water were oxidized by bacteria and other micro-organisms which are present in water. The demand for oxygen is proportional to the amount of organic waste to be degraded aerobically. Hence BOD approximates the amount of oxidizable organic matter present in the sample. When the BOD is high, the dissolved oxygen becomes low. Hence greater the BOD, greater is the pollution. The highest value of BOD 7.16 mg/l was observed at station A in month May and lowest value 1.3mg/l was investigated.(Graph-2)



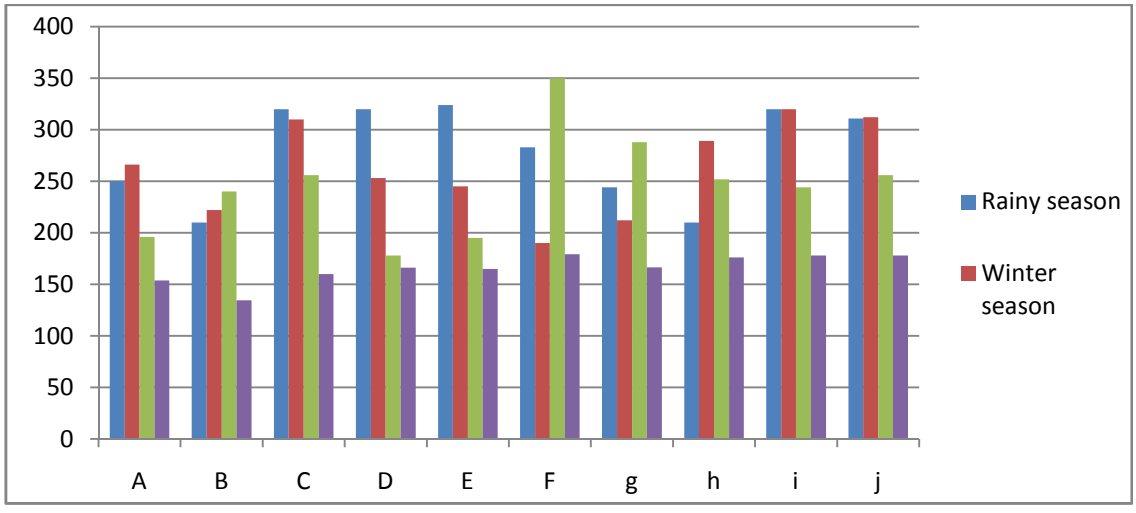
Graph 1. Comparison of highest values of DO in different seasons



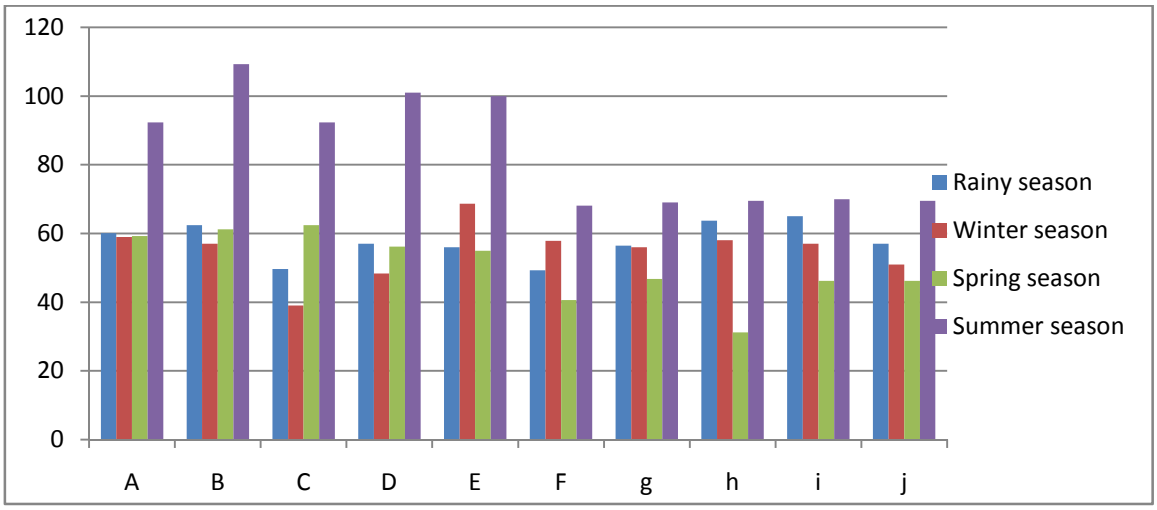
Graph 2. Comparison of values of BOD in different seasons

The range of determined total hardness in all stations is 160 - 350 mg/. The hardness is well within permissible limits. The variations of total hardness every season in all stations are due to the fluctuations in the quantity of water and waste disposals in the river water. The hardness in the water is due to the dissolved minerals from sedimentary rocks and run-off. Detergents and soaps also aggravate the situations.(Graph.3)

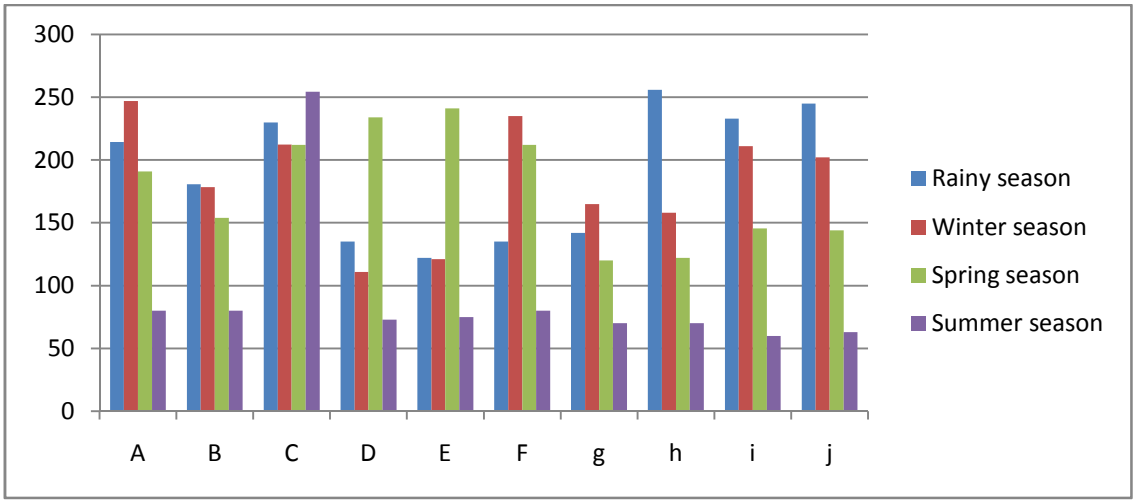
The range of chloride value is 31.24 -109.3 mg/l in all stations on the sampling days. The chloride reaches the river from different anthropogenic activities like septic tank effluents, animal feeds, use of bleaching agents by launderer and washing of cloths (Graph.4).



Graph 3. Comparison of Total hardness values at different stations in different seasons



Graph 4. Comparison of Chloride contents at different stations in different seasons



Graph 5. Comparison of values of Alkalinity at different stations in different seasons

The ranges of total alkalinity in all the sampling stations are 60 – 256 mg/l. These values exceed the permissible limit (200 mg/l). The hydroxides, carbonates and bicarbonates probably released from limestone, sedimentary rocks, carbonate-rich soils, cleaning agents, food residue, discharge of city sewage and domestic solid wastes contribute to the alkalinity. (Graph.5)

Conclusion

It was studied the effect of seasonal variations on Water Qualities of various sampling areas i.e. Vidisha, Sumer, Ganj Basoda and Kurwai. The investigations show that water of these sampling stations are not polluted considerably but amount of dissolved oxygen found less at few sampling stations which shows presence of aquatic organisms in

large number. The increased number of these organisms in river water may be due to different types of organic and inorganic pollutants which are disposed in river water.

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