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Seasonal Variation of physicochemical parameters in water stream of Mahi river in M.P. region India.

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Abstract : Water is most indispensable natural resource. The life is originated and sustained by water. Since rivers plays a vital role in continuous purification of water and becomes an important chain to satisfy the gap of supply and demand of water quality and quantity. Looking to this work plan is dedicated to river **"Mahi"**

Keywords : TDS, Titrimetric pH, BOD, COD .

Introduction: The origin of Mahi river is **"Mind"** village , located in district Dhar of Madhya Pradesh state. It is major interstate west flowing river bounded by Aravalli hills on the north and north west by Malwa plateau on the east, It lies between 72^0 21' – 75^0 19' east longitudes and $21^0$46' - $24^0$30' north latitudes. Before it drains into the Arabian sea through the Gulf of khambhat , its basin extended over states of Madhya Pradesh , Rajasthan and Gujarat having total area of 34,842 sq km with a maximum length and width of about 330 km and 250 km . The study of it's water quality and it's seasonal variation is important because it's 63.63% of the total area is used by farmers for agriculture and 4.34% of the basin is used by water bodies.

Mahi river is plays major role in assimilating or carrying industrial and municipal waste water manure discharge and run-off which are responsible for river pollutions. Water quality problems have intensified because of untreated flow of water discharged by different stations and industrial centre. Aquatic systems required for healthy ecosystem world-wide are reported to be much polluted due to disposal of untreated sewage and other effluents containing a wide range of organic and inorganic pollutants such as suspended solids, heavy metals etc. Since physico- chemical characteristics in many ways have significant influence

and important aquatic life. Any undesirable alteration in these parameters may disturb the quality of water. The nature of whole water body even can be reflected by a single-parameters that is dissolved Oxygen. Strength of waste water is expressed in terms of BOD level.

Therefore, an attempt has been made by study and **redefine** the impact of seasonal variation on water quality of this river.

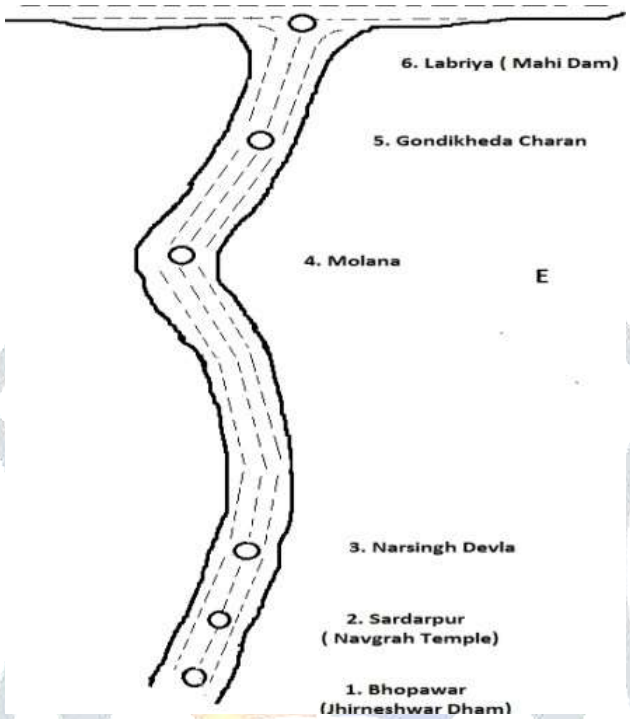


Fig.1:- Map with Sampling Station

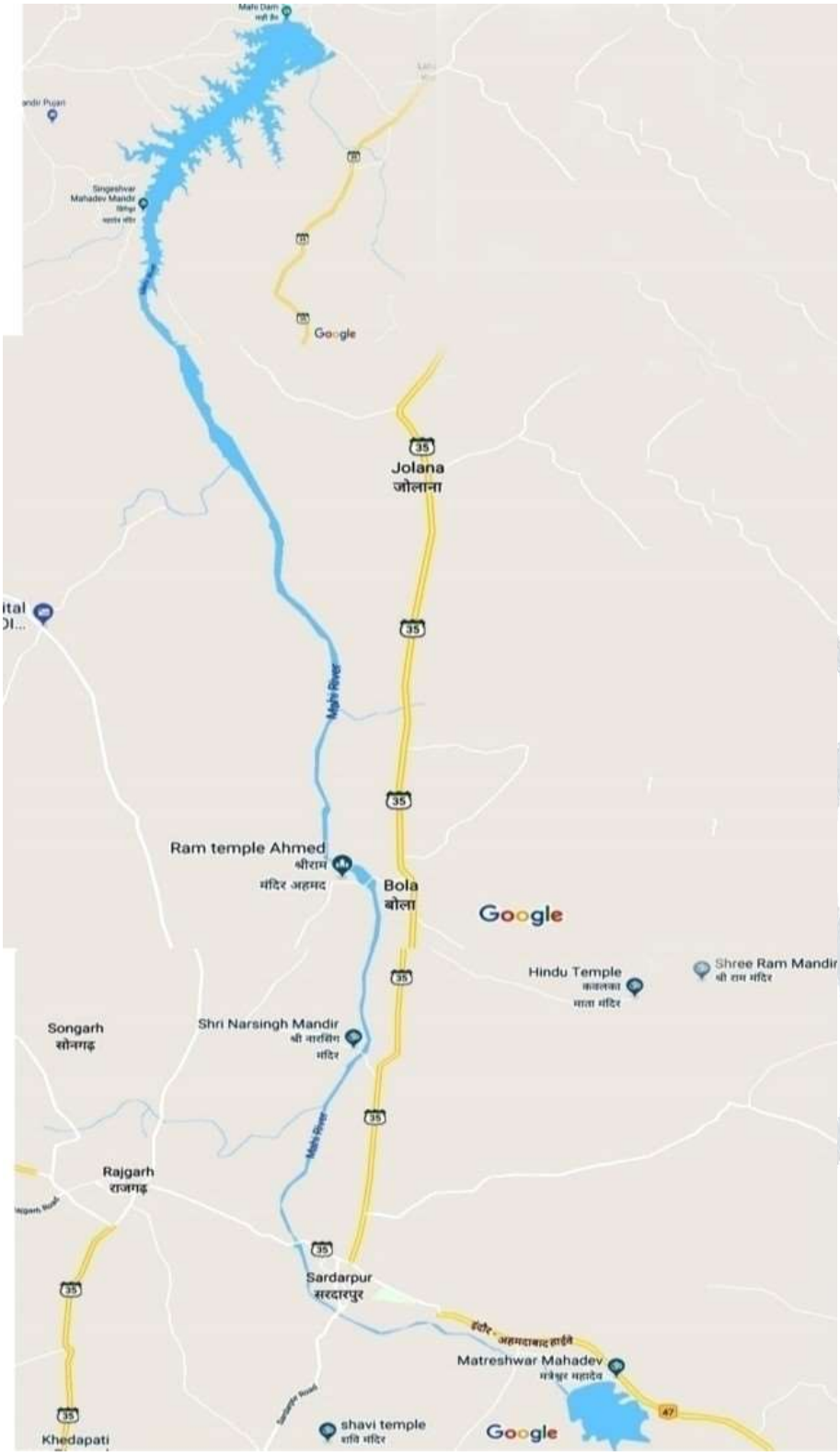


Fig.2:- Map of Mahi River in Dhar District

Physico-chemical Parameters:

Temperature, pH, Total Hardness, Total dissolved solids, D.O. , BOD, COD, Total Coliform.

Material and Method: All glassware and containers were rinsed with double –distilled water and were sterilized. Chemicals used were of AR Grade (Merck, India). Samples collected from six different sites S_1 to

S_6 during summer 2015to winter 2017 in triplicate and kept in polyethylene bottles and stored in refrigerator with the essential and required preservatives.

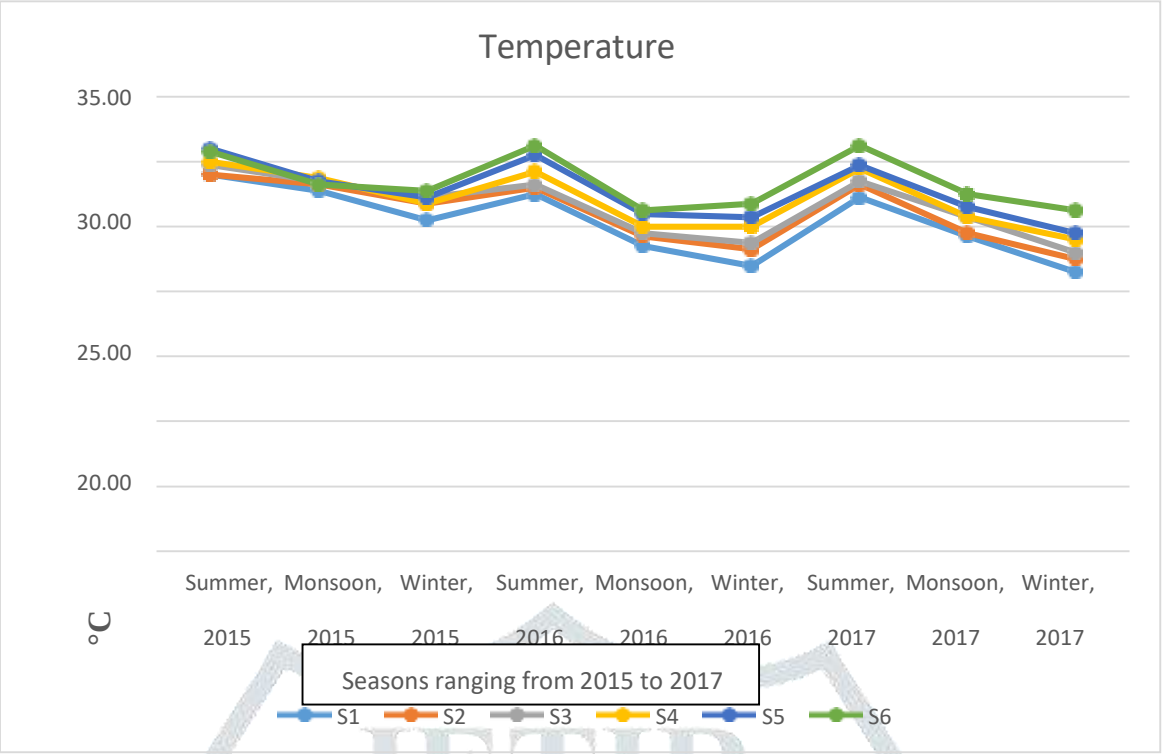
The parameters selected for this study were estimated using standard methods [1].

Methodology: Table: 1

S.No	Parameters	Unit	Method Used
1	Temperature	°C	Mercury Thermometer
2	pH	pH scale	pH meter
3	Total Hardness	mg/L	EDTA Titrimetric
4	Total dissolved solids	mg/L	Gravimetric
5	D.O.	mg/L	DO meter
6	B.O.D.	mg/L	Standardized BOD method
7	C.O.D.	mg/L	Oxidation
8	Total Coliform	MPN	Membrane filtration method

Table 2: Seasonal variation of Temperature in °C during summer 2015 to winter 2017

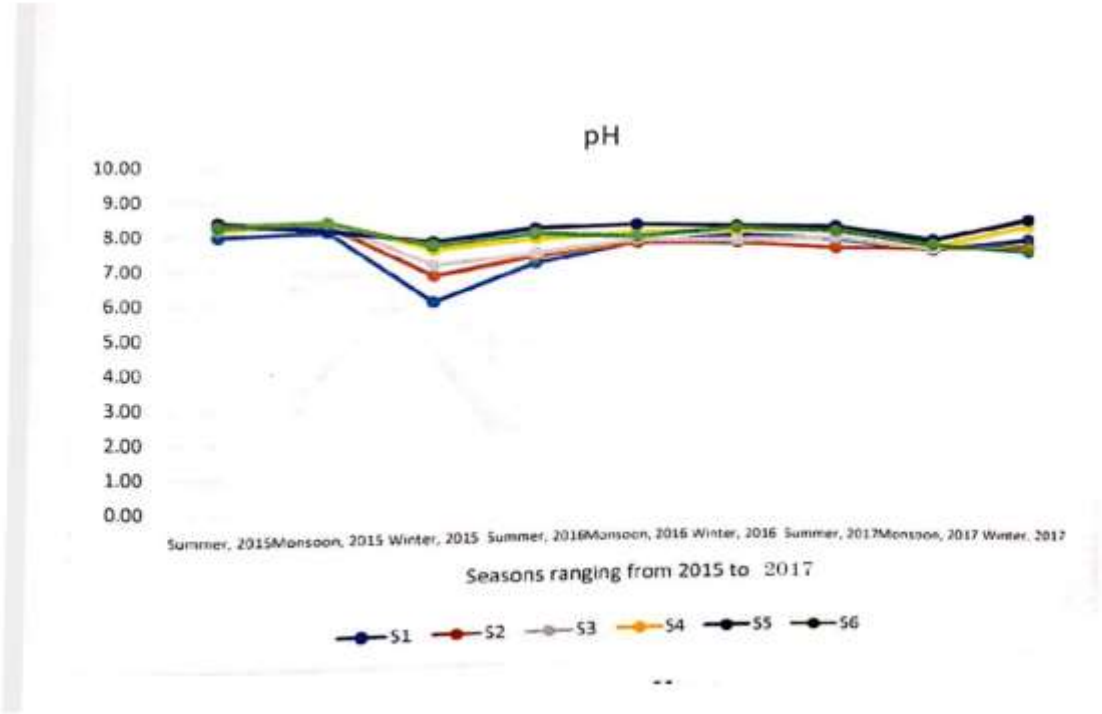
Season	S1	S2	S3	S4	S5	S6
Summer, 2015	29.00	29.00	29.75	30.00	31.00	30.75
Monsoon, 2015	27.75	28.25	28.50	28.75	28.50	28.25
Winter, 2015	25.50	26.75	27.25	26.75	27.25	27.75
Summer, 2016	27.50	28.00	28.25	29.25	30.50	31.25
Monsoon, 2016	23.50	24.25	24.50	25.00	26.00	26.25
Winter, 2016	22.00	23.25	23.75	25.00	25.75	26.75
Summer, 2017	27.25	28.25	28.50	29.50	29.75	31.25
Monsoon, 2017	24.25	24.50	25.75	25.75	26.50	27.50
Winter, 2017	21.50	22.50	23.00	24.00	24.50	26.25



Graph :1 Seasonal Variation of Temperature

Table 3 : Seasonal variation of pH during Summer 2015 to Winter 2017

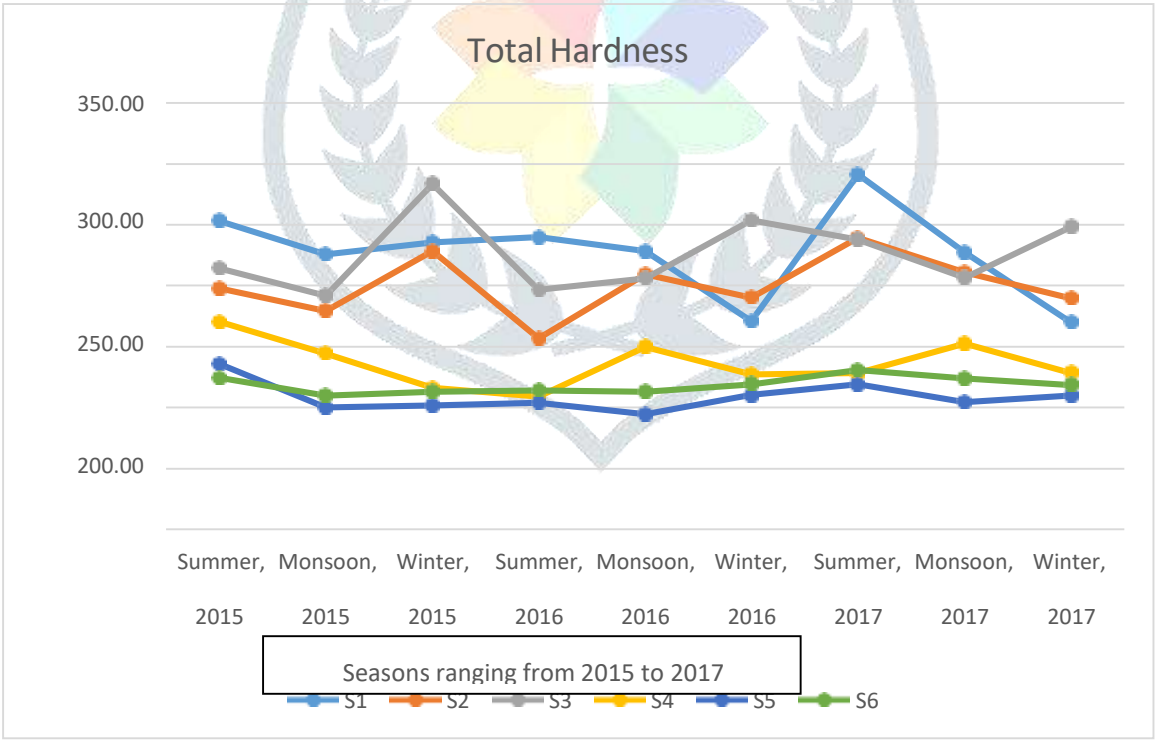
Season	S1	S2	S3	S4	S5	S6
Summer, 2015	8.00	8.43	8.40	8.23	8.40	8.30
Monsoon, 2015	8.23	8.40	8.53	8.53	8.28	8.50
Winter, 2015	6.23	7.00	7.33	7.78	8.03	7.90
Summer, 2016	7.45	7.65	7.76	8.17	8.49	8.34
Monsoon, 2016	8.13	8.11	8.23	8.43	8.67	8.31
Winter, 2016	8.41	8.19	8.27	8.53	8.70	8.64
Summer, 2017	8.35	8.08	8.40	8.69	8.74	8.59
Monsoon, 2017	8.06	8.11	8.09	8.15	8.36	8.22
Winter, 2017	8.41	8.18	8.81	8.82	9.03	8.03



Graph –2: Seasonal variation of pH

Table 4: Seasonal variation of Total Hardness in ppm during Summer 2015 to Winter 2017

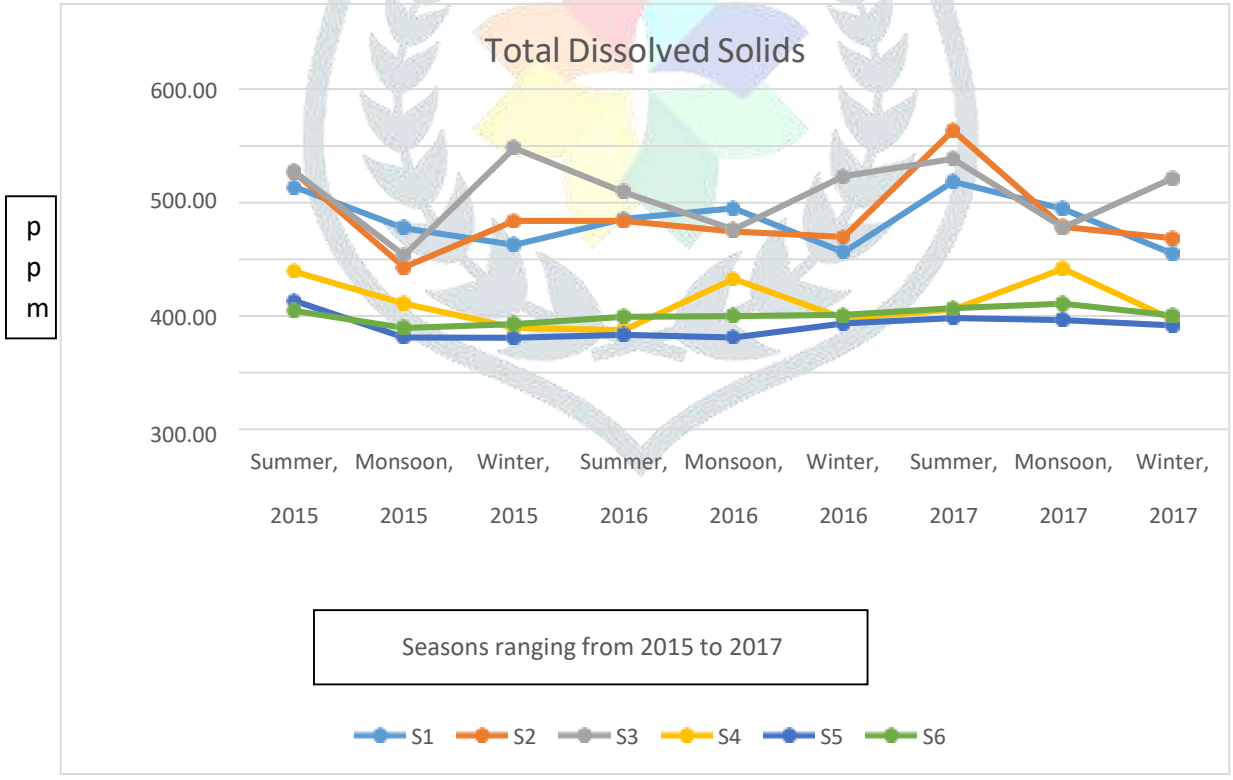
Season	S1	S2	S3	S4	S5	S6
Summer, 2015	253.50	198.00	214.50	170.50	136.00	124.50
Monsoon, 2015	226.00	179.50	192.00	144.50	100.00	110.00
Winter, 2015	236.00	228.50	283.50	116.50	102.00	113.50
Summer, 2016	240.00	157.00	196.75	109.25	104.00	114.50
Monsoon, 2016	228.50	209.50	206.50	150.00	94.50	113.50
Winter, 2016	171.00	190.50	254.00	127.50	110.50	119.50
Summer, 2017	291.50	239.50	238.00	128.50	119.00	131.00
Monsoon, 2017	227.50	211.00	207.00	152.50	104.75	124.00
Winter, 2017	170.25	190.00	248.50	128.75	110.00	118.75



Graph 3 : **Seasonal variation of Total Hardness in ppm**

Table 5 : Seasonal variation of Total Dissolved Solids in ppm during Summer 2015 to Winter 2017

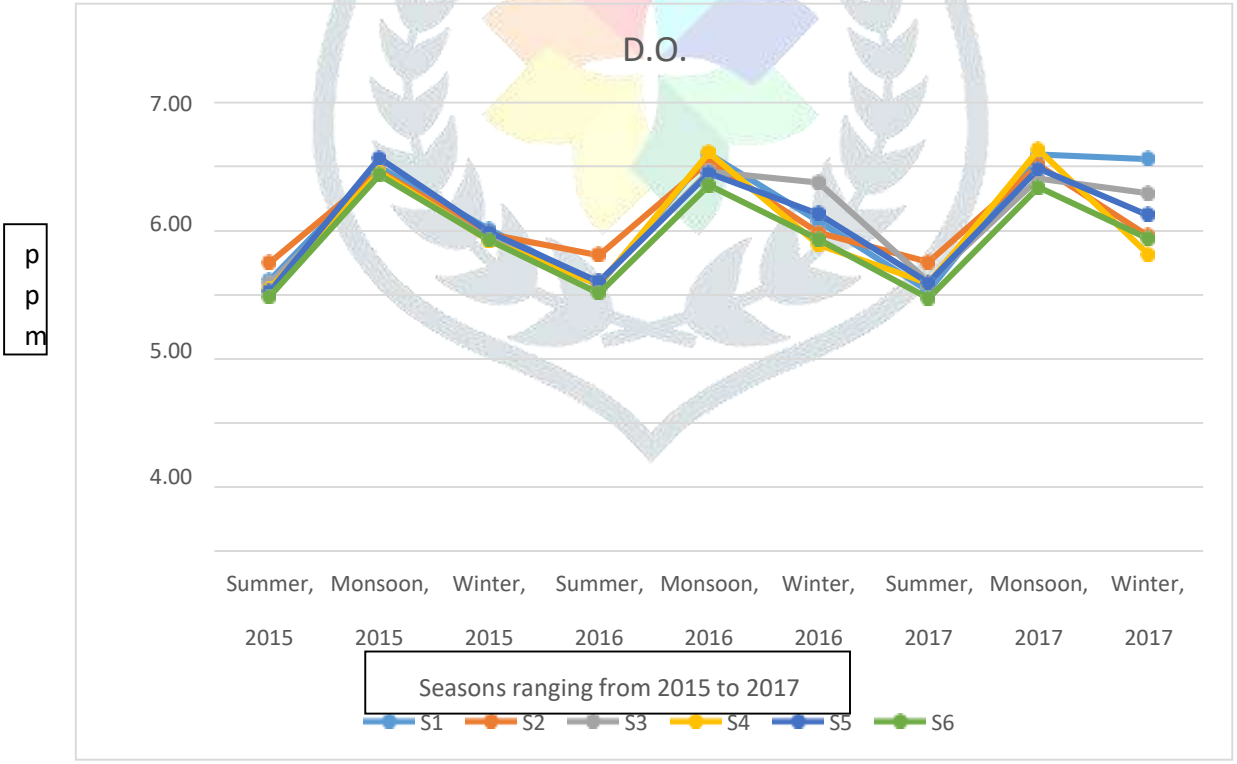
Season	S1	S2	S3	S4	S5	S6
Summer, 2015	427.50	453.25	454.25	279.00	226.50	209.25
Monsoon, 2015	355.25	286.25	306.75	222.00	162.50	178.75
Winter, 2015	325.75	367.25	496.00	179.25	161.50	185.75
Summer, 2016	371.00	367.50	418.75	175.25	167.00	198.75
Monsoon, 2016	390.00	349.25	352.25	265.25	162.25	200.00
Winter, 2016	312.75	339.50	446.50	196.75	186.25	202.00
Summer, 2017	436.75	527.00	477.50	211.50	196.25	213.50
Monsoon, 2017	389.00	357.75	356.25	283.25	192.75	221.75
Winter, 2017	310.00	337.00	443.00	193.50	183.00	201.00



Graph- 4 : Seasonal variation of Total Dissolved Solids in ppm

Table 6 : Seasonal Variation of D.O. in ppm during Summer 2015 to Winter 2017

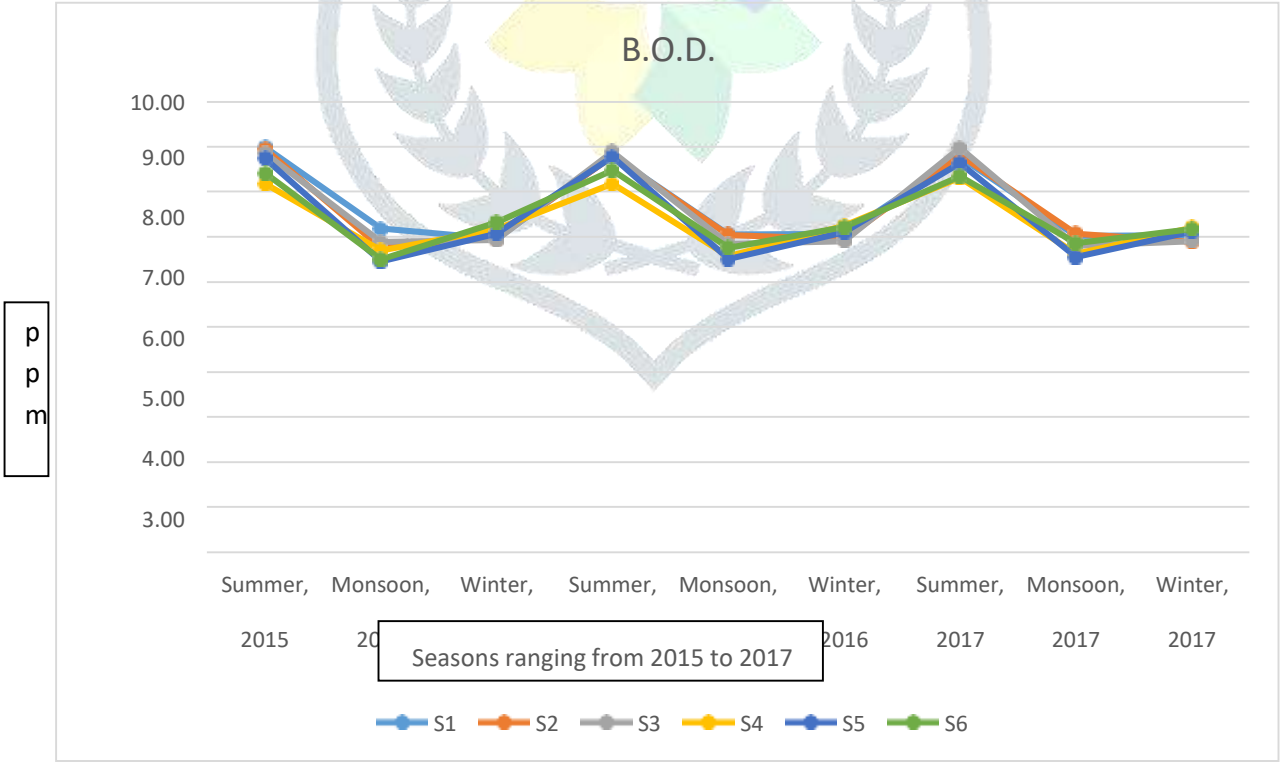
Season	S1	S2	S3	S4	S5	S6
Summer, 2015	4.23	4.50	4.18	4.10	4.05	3.98
Monsoon, 2015	5.99	5.94	5.90	5.92	6.14	5.87
Winter, 2015	5.03	4.96	4.88	4.85	4.98	4.86
Summer, 2016	4.15	4.63	4.21	4.16	4.21	4.03
Monsoon, 2016	6.20	6.09	5.93	6.23	5.90	5.71
Winter, 2016	5.15	4.97	5.76	4.79	5.27	4.87
Summer, 2017	4.06	4.51	4.20	4.19	4.19	3.95
Monsoon, 2017	6.20	6.03	5.81	6.27	5.97	5.68
Winter, 2017	6.12	4.93	5.59	4.64	5.25	4.88



Graph- 5 : Seasonal Variation of D.O. in ppm

Table- 7: Seasonal variation of B.O.D. in ppm during Summer 2015 to Winter 2017

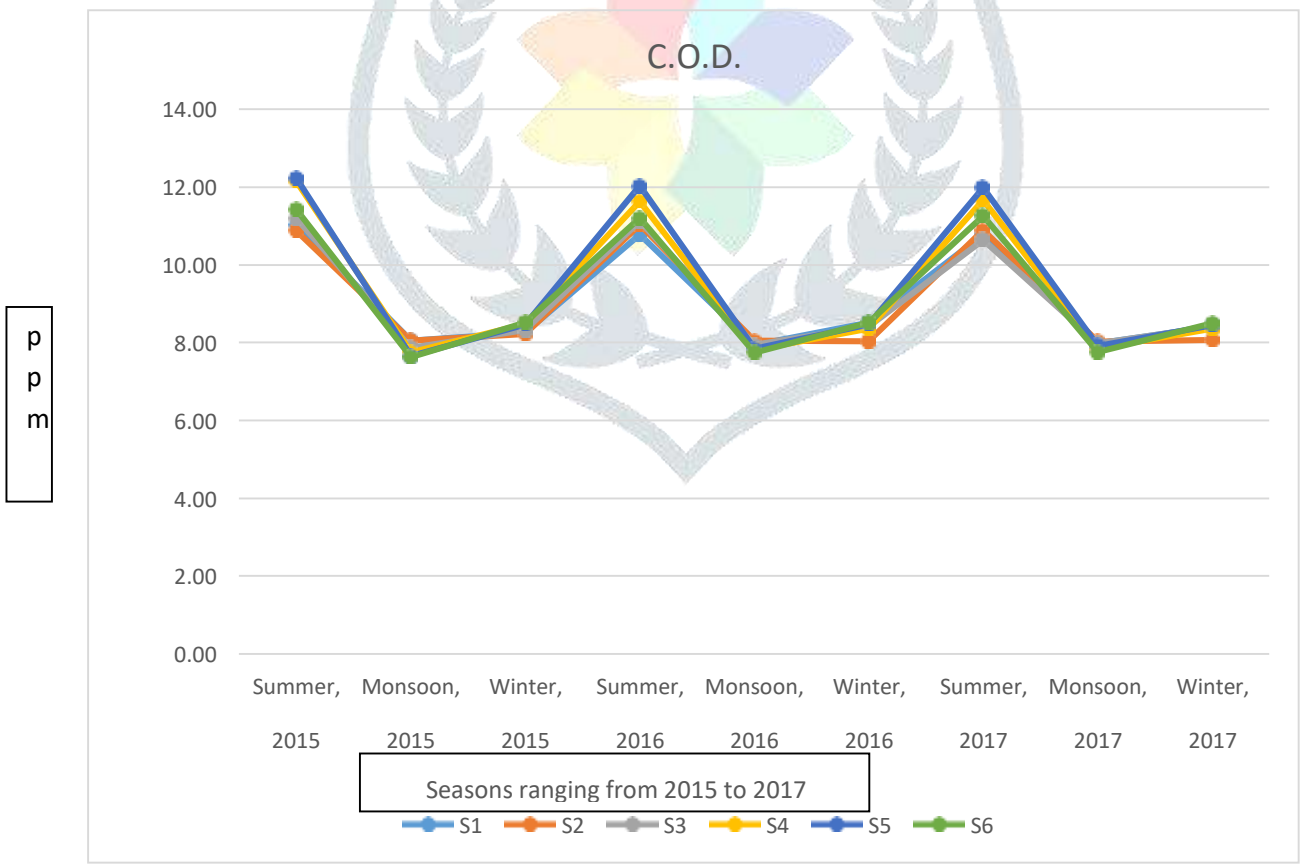
Season	S1	S2	S3	S4	S5	S6
Summer, 2015	8.99	8.95	8.87	8.18	8.75	8.42
Monsoon, 2015	7.19	6.76	6.90	6.70	6.46	6.51
Winter, 2015	6.97	6.99	6.94	7.19	7.08	7.33
Summer, 2016	8.81	8.80	8.90	8.18	8.78	8.48
Monsoon, 2016	7.06	7.05	6.85	6.58	6.51	6.77
Winter, 2016	7.08	6.96	6.92	7.25	7.10	7.22
Summer, 2017	8.77	8.82	8.98	8.32	8.64	8.34
Monsoon, 2017	7.03	7.08	6.81	6.63	6.55	6.86
Winter, 2017	7.05	6.90	6.92	7.21	7.11	7.19



Graph -6 : Seasonal variation of B.O.D. in ppm

Table -8 : Seasonal variation of C.O.D. in ppm during Sumer 2015 to Winter 2017

Season	S1	S2	S3	S4	S5	S6
Summer, 2015	11.04	10.89	11.20	12.16	12.23	11.43
Monsoon, 2015	8.06	8.07	7.88	7.76	7.66	7.64
Winter, 2015	8.27	8.23	8.33	8.48	8.48	8.52
Summer, 2016	10.78	11.05	11.13	11.65	12.03	11.21
Monsoon, 2016	7.95	8.05	7.95	7.82	7.85	7.75
Winter, 2016	8.52	8.04	8.42	8.36	8.47	8.53
Summer, 2017	10.78	10.90	10.65	11.68	11.99	11.27
Monsoon, 2017	7.99	8.03	7.98	7.85	7.93	7.76
Winter, 2017	8.43	8.07	8.42	8.36	8.45	8.50

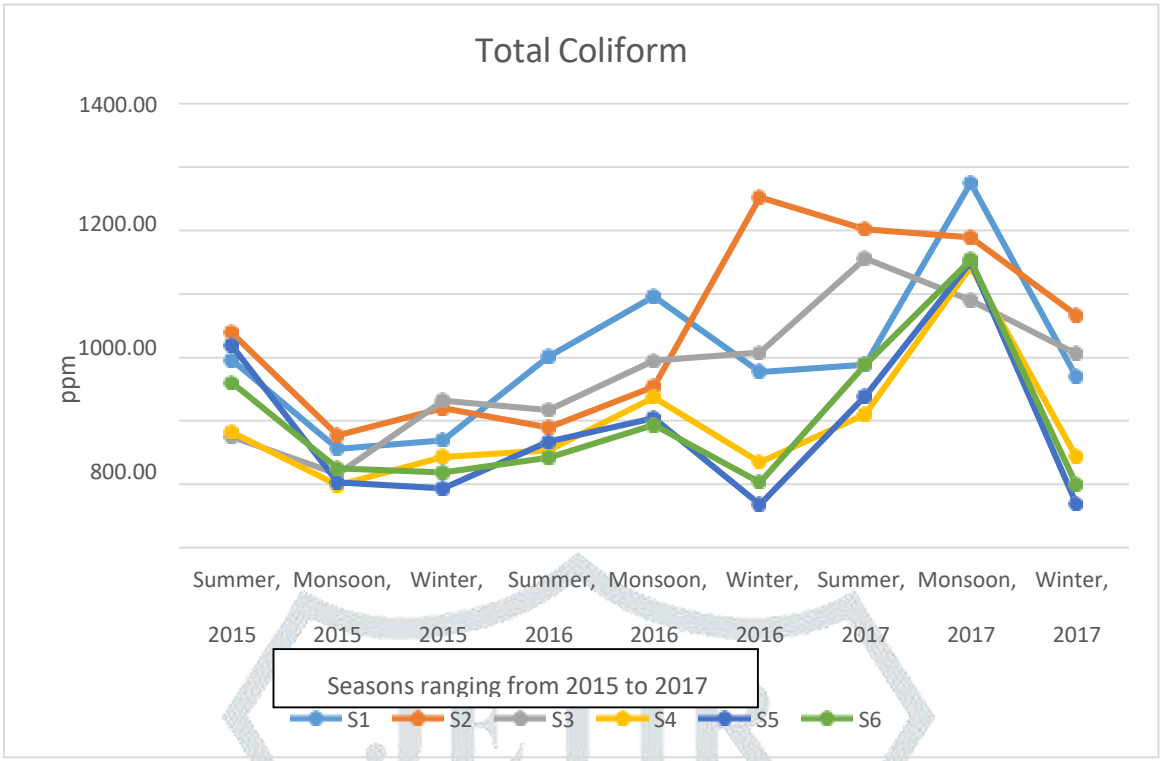


Graph -7 : Seasonal variation of C.O.D. in ppm

Table 9 :

Season	S1	S2	S3	S4	S5	S6
Summer, 2015	592.50	677.50	350.00	365.00	637.50	520.00
Monsoon, 2015	312.50	355.00	232.50	197.50	206.00	250.00
Winter, 2015	340.00	440.00	465.00	287.50	187.50	237.50
Summer, 2016	602.50	380.00	435.00	307.50	335.00	285.00
Monsoon, 2016	792.50	507.50	590.00	475.00	410.00	387.50
Winter, 2016	555.00	1105.00	615.00	270.00	136.50	207.50
Summer, 2017	577.00	1005.00	912.50	421.00	478.00	579.00
Monsoon, 2017	1150.75	978.75	779.50	886.25	901.25	907.75
Winter, 2017	540.75	734.00	612.25	287.75	138.25	199.50

Seasonal variation of Total Coliform in MPN during Summer 2015 to Winter 2017



Graph- 8 : Seasonal variation of Total Coliform in MPN

Result and Discussion:

1. **Temperature:** Observation taken shows variation range from 21.50 ºC to 31.25 ºC. It is due to different time schedule of collection and seasonal influence.[2] During mansoon temperature from March 2015 to February 2017 variation range observed was 3.5℃[3]. The highest temperature was 31.25 ºC in summer season of 2016 of sample collected from S-6 sites, whereas minimum temperature was 21.50 ºC in winter of 2017 of sample collected from S-1 site. The highest values of temperature were recorded in summer followed by monsoon and winter.[4]
2. **pH:**

All winter seasons shows an intermediate-values between maximum during monsoon and minimum during summer. During 2017 except S-2 at all other station the pH value is higher in monsoon and lower in summer seasons. During 2015, except site S-2 and S-5 at all other sites value obtained for pH is low in summer season. The pH affects solubility of several toxic and nutritional chemicals[5]. The trend we get in this study is in accordance with the findings of other workers[6].

3. **Total Hardness:** This parameters states about the level of dissolved minerals (mostly Ca and Mg) attributed to presence of bicarbonate, sulphate, chloride and nitrate of calcium and magnesium. Seasonals observation reveals that during 2015 in sample of S1 and S3 highest values of total hardness were obtained in winter while from S-4 to S-6 this parameter was also high in summer. In year 2016, except S-3 from S-1 to S-6 all values were higher in summer season while the lower values are noticed in winter, similar trends, we have ahead in year 2017. Total hardness is the impact of salts of calcium and magnecium of lower pH which restrict their continued uses [7,8].
4. **Total Dissolved solids:** Probable reason of TDS include carbonate, bicarbonate, chloride, phosphate and nitrate of calcium, magnesium, sodium, potassium and manganese, organic matter, salt and different other particles.[9] Seasonal variation is represented in the table 5 and it's graph is also given below this table. Data available of allseason states that as compare to monsoon season value of TDS was high in winter season. As during rainy season sediment load was transported from water shed. It is probably due to the effect of incoming effluents which results into high TDS level in winter season[10,11].
5. **D.O.:** The concentration of gaseous oxygen which is dissolved into water reflects autotropic and heterotropic process which is responsible for production and consumption of oxygen[12].It shows positive correlation with pH and TDS. Negative relativity is found with temperature, BOD and COD values in different seasons.
6. **BOD (Biochemical Oxygen Demand):**

Seasonal variation of BOD is presented in table no 7 and it's graph is also given below this table.During study time from 2015 to 2017 it is observed that highest value was noticed in summer season while least values were obtained in winter season.

During monsoon season of all study time interval values recorded for BOD were lower than summer but highest than winter season. Higher B.O.D. values indicates decline in level of D.O., because the oxygen

that is available in the water is being consumed by bacteria leading to the inability of fish and other aquatics organism to survive in the river [13,14].

7. **C.O.D.:** It is also demanded volume of oxygen to decompose the biodegradable and non-degradable organic waste[15]. It is having positive correlation with temperature, turbidity and with BOD in all three sessions. It shows a strong positive correlation with TDS and BOD. In all three session of study it exhibit negative correlation with DO value.
8. **Total Coliform:** Climatic condition and discharging of waste and open defecation are responsible for total coliform. It shows positive correlation with PH, TDS, BOD, COD values.

Conclusion: Temperature depends upon season, place, time of sampling and water depth. pH range is alkaline in general while at S-1 the lowest value was 4.1. It is regulated by CO_2- HCO_3 system. Hardness were higher in summer while becomes lower during winter season. DO value recorded was not dangerous for aquatic life . Maximum BOD reveals consumption of oxygen in mitigating higher organic pollution load while low values are in favour of decrease in microbial population. COD is greater than BOD as required and it shows negative correlation with DO. Total coliform found low in winter and higher in summer season and monsoon seasons. It is because of low level of water and high temperature in summer while due to higher level of suspended matter and nutrient by influx of rainy water. TDS changes may be attributed to the local climatic condition and water exchange mechanism.

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