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COMPARATIVE STUDY OF WATER QUALITY PARAMETERS OF SHEONATH RIVER BEFORE AND AFTER LOCKDOWN SITUATION DURING COVID-19

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ABSTRACT

The present study deals with the assessment of water quality of surface water and Nallah water (Drain water) before and after the lockdown situation in the COVID-19 pandemic. Water quality monitored from a few places in the Chhattisgarh region, which includes Sheonath river and drain water. This study includes the comparison of water quality during summer, winter, and after lockdown situation. Total Nineteen parameters such as pH, TDS (ppm), EC (µS/cm), ORP (mV), Temperature (°C), Salinity (ppm), DO (ppm), F^- (ppm), Cl^- (ppm), NO_3^- (mg/l), SO_4^{2-} (mg/L), PO_4^{3-} (mg/l), Total hardness (mg/l), Calcium hardness (mg/l), Magnesium hardness (mg/l), Phenolphthalein alkalinity (mg/l), Total Alkalinity (mg/l), Bicarbonate (mg/l) and Carbonate (mg/l) were analyzed for the assessment of the water quality of samples. The present investigation shows that the values of all measured water quality parameters decreased in COVID-19 situation due to lockdown except one parameter that was dissolved oxygen. Values of dissolved oxygen before and after COVID-19 condition showed that pollution levels decreased during COVID-19 pandemic conditions, and dissolved oxygen value increased. The water quality become better during the COVID-19 situation; this is due to the fact that the people are staying inside of houses in lockdown situation and restricted to go outside. This lockdown situation prevents the pollution in surface water as all human activities such as dumping of waste materials near surface water is restricted. The present investigation also involved the correlation and cluster analysis, which were prepared by using Statistical Package for the Social Sciences (SPSS) software. The present study is the first study for this region, which indicates the water quality from surface water before and after the COVID-19 pandemic. This study will help to estimate the status of surface water quality without the interference of human activity and beneficial to prepare future strategies to protect the surface water body.

KEY WORDS : Lockdown, Water quality, COVID-19, Surface water and Self-healing.

INTRODUCTION

Water is life; it is being put to vivid uses by us like drinking, washing, cooking, irrigation, bathing, disposal of sewage, producing electricity in power plants, manufacturing of various types of industrial products and other processes (Ahmad *et al*., 2012; Raju *et al*., 2012). In these all types of processes, the polluted water and pollutants are dumped or flowinto the water sources to such an extent that our massive amount of surface water sources like streams and rivers contain contaminated water. This is fact because water is a universal solvent and therefore, various elements or compounds are found dissolved in it. Various government organizations used surface water source for the supply of water in the city or areas after proper treatment, and many people depend on these water supply. Pollution of surface water sources is also affecting the economy of the country and state to use for filtration or

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treatment of polluted water. Water quality deliberated as an essential factor for the judgment of environmental changes that are associated with social and economic development (Ahmad, *et al*., 2012). Since in study areas (Chhattisgarh region), surface water is the prime and frequent source of public water supply. Hence, in this study, we have selected seven water sampling sites, including drain and river water, to check the effect of seasonal variation in water quality. The quality of water sources has depleted naturally, as well as due to human activities. The most common and widespread threat associated with water is contamination either directly or indirectly, by sewage, other wastes, human or animal excrement. The chemical characteristics of surface water ultimately decide the possibilities of development and utilization of this water in any region.

Assurance of water safety is a basis for the control and prevention of waterborne diseases (Ahmed Aziz, *et al*., 2013). As per report of World Health Organization (WHO), diarrhea is a one of the major killer in poor and developing countries around 4 billion case of diarrhea worldwide reported each year and around 2.2 million people killed every year mostly, children who were under five years of age group. Approximately 80% of all type of diseases in people are due to water (WHO, 2003, 1993; Ghosh, 2006). The ecosystem of water has become perceptibly altered in numerous respects in recent years due to the incredible development of industry and agriculture (WHO, 2009). Studies on different water quality parameters, including Physico-chemical parameters of surface water, yielded useful data for the understanding of the Nature of the water environment. Now, we all are facing a very critical situation that is COVID-19, which is declared by WHO as a pandemic worldwide. In this pandemic condition, the Government of India has announced a total of 96 days lockdown. Initially, it was set from March 24, 2020 to April 14, 2020 which extended multiple times, and still, it is extended upto June 30, 2020 (National Portal of India, 2020). In the Lockdown situation, the Public or individual are having restricted movement and are affecting the surrounding environment and itis cause of reducing the pollution because various types of human activities, industries activities, and other significant sources of water pollution are closed during this time. Hence, Nature healing itself in different aspects, as the surface water may be cleaner due to less pollution. Therefore, the Aim of this study is to monitor the water quality of surface water before and after lockdown. Study locations are located inthe Durg District of Chhattisgarh region. GPS coordination latitude and longitude of study areas are shown in Table 1. The present study area covers the seven locations in the Chhattisgarh region. All the collected samples were in the form of surface water. For the proper management strategies and monitoring of water quality, this study will help tocreate new approaches to control water pollution or assessment of the self-healing capacity of Nature in the absence of human activities.

MATERIALS AND METHODOLOGY

Total Nineteen parameters were selected for the assessment of water quality from surface water samples. All samples were collected in new polypropylene 1000 ml bottles, which were washed three times properly before sampling. The samples were collected threetimes, including two seasons, before and after monsoon mean summer and winter season and after lockdown situation during COVID-19, and all collected samples were immediately transported to the laboratory for testing all parameters. The following techniques were adopted for assessment of water quality (APHA, 1989; Diwan, *et al*., 2019; Santosh Kumar *et al.,* 2018; Sar, *et al.,* 2017). Temperature measured through the thermometer. Total Hardness of water sample determined by the complexometric EDTA titration method and standard solutions of M/100 EDTA solution, Buffer solution, and EBT were used for titration. Calcium and magnesium hardness of water samples were also monitored by using this EDTA method. Additionally, Patton and Reeder's indicator was used for the determination of Calcium hardness. Total Alkalinity of water sample indicates the presence of Bicarbonate, Carbonates, and hydroxides. Total Alkalinity of water samples was determined by adopting the Acid-Base Titration method. Chloride is generally present in water samples due to adding salts, animal residues, and runoff from industries, domestic waste, and other human activities. Chloride was determined by the Agentometric titration method. Standard N/50 Silver Nitrate solution and potassium chromate solution were used for the determination of the value of Chloride.Value of pH, Conductivity, Salinity, ORP and TDS were detected through Hanna Multiparameter equipment model number HI 5521 and HI 5522. The ion-selective electrode

technique was used for the measurement of fluoride values by Hanna instrument no. HI 5522. The Sulphate (SO_4^{2-}) values of water samples were determined by the Turbidimetric method through Systronic UV-VIS double beam spectrophotometer with the help of a suitable 1 cm quartz cell. The values of nitrate (NO_3^-) and phosphate (PO_4^{3-}) were also measured by the Systronic UV-VIS spectrophotometer. Measurement of DO and fluoride was carried out by using an ion-selective electrode through Orion 4-star, Thermo Scientific; the USA make instrument.Correlation and cluster analysis were analyzed by using the SPSS (Statistical Package for the Social Sciences) software version 23.

RESULTS AND DISCUSSION

The all analyzed data for nineteen water quality parameters of all samples are shown in Table 1. pH of water samples ranged observed from 7.43 to 7.73; 7.17 to 7.96 and 7.04 to 7.35 with mean value were 7.54±0.04, 7.41±0.11 and 7.15±0.04 for summer, winter and after lockdown situation respectively, which shows that all samples were found within the prescribed limit 6.5 to 8.5 (WHO, 2003). Total Dissolved Soliȕs (TDS) ranged from 66.33 to 487.70 ppm, 107.80 to 441.10 ppm and 69.80 to 278.40 ppm in summer, winter and after lockdown situation respectively. The recommended value for TDS is 500 ppm (WHO, 2011). The mean value of TDS during lockdown situation was found to 173.83±31.64 ppm and for summer and winter be season were 246.53±59.00 and 294.11±55.15, respectively.

Electrical Conductance (EC) measured the ability of flow current in an aqueous solution and the range of EC values from all samples were found 132.70 to 975.30 µS/cm, 215.60 to 888.00 µS/cm and 127.40 to 373.80 µS/cm with the average value of EC was found 493.07, 589.07 and 253.79 µS/cm for summer, winter and during lockdown situation respectively. All values of Oxidation- Reduction Potential (ORP) were found negative, and there is no prescribed limit for these water quality parameters. The temperature of water samples varies based on climate conditions (Singh Dhanesh and Jangde Ashok Kumar, 2013). It varied from 27 to 29°C, 25 to 27 °C in summer and winter season. The average value of temperature during the lockdown situation was 27.03 °C. The mean value of Salinity for summer, winter season and during lockdown sampling were analyzed 174.29 ppm, 221.43 ppm and 133.57 ppm, respectively. Measurement of Alkalinity was indicated that the bicarbonate alkalinity only present in all water samples. pH values of water samples were not found too higher than 7, so the Alkalinity of water samples was found less in all samples. Ranges of bicarbonate alkalinity were observed 52.50 to 257.50 mg/l, 61.20 to 262.50 mg/l and 45.80 to 176.50 mg/l for summer, winter and lockdown conditions respectively. The maximum value of total Hardness was 365 mg/l, 355 mg/l, and 206 mg/l from water samples in summer, winter and lockdown condition, respectively. The accepted value of the hardness range 200-600 mg/l (IS:10500; WHO, 2012). Calcium and magnesium hardness values were not found high in all samples and found less in a lockdown situation.

Dissolved oxygen value varied from 6.20 to 7.70 ppm and 7.10 to 7.80 ppm during summer and winter season, respectively and during lockdown condition, it ranged 8.90 to 11.70 ppm with an average value of 10.61±0.38 ppm. The values of DO indicate that due to lockdown conditions without human activities increases due to lesser pollutants as compared to normal days. Chloride (Cl^-) is one of the major inorganic anions and it is present due to various activities. During the analysis of the samples, Chloride ranged varied from 8.90 to 194.02 ppm, 14.20 to 177.50 ppm and 5.90 to 164.70 ppm in summer, winter season and lockdown condition respectively. The prescribed limit for Chloride is 250-1000 mg/l (IS:10500; WHO, 2003). Based on the report of the Indian standard, the fluoride range of usable water should be 1-1.5. Fluoride was found to be between 0.45 to 0.96 ppm in summer; 0.54 to 1.02 ppm in the winter season and 0.35 to 0.72 ppm in a lockdown situation. Nitrate (NO_3^-), Sulphate (SO_4^{-2}) and Phosphate (PO_4^{-3}) are present in water samples due to various activities such as uses of fertilizers, manures, other industrial activities, wastewater treatment and from human and animal excreta and due to flow of nutrients from soil and rocks. According to IS-10500, the value of nitrate and Sulphate in water should be <45 mg/l, 200-400 mg/l (IS:10500). All values of these parameters in studied samples were found within the recommended range. Phosphate also reaches water through rocks, soils and agricultural runoff. Phosphate varied from 0.72 to 1.29 mg/l in summer; 0.71 to 1.31 mg/l in winter and 0.56 to 1.12 during lockdown situation.

Correlation Analysis

Correlation between all water quality parameters for

Table 1. Values of water quality parameters from study areas in summer, winter and after lockdown situation.

Name of sampling locations		Industrial Nallah (near Chhawani industrial area)	Pulgaon Nallah	Sheonath after joining of Nallah (anicate)	Sheonath river below the bridge	Samoda Nallah	Kosa Nallah	River after joining of Samoda Nallah
GPS Coordinates	Latitude (N)	21°13.588'	21°10.626'	21°10.872'	21°09.875'	21°16.904'	21°13.017'	21°18.307'
Longitude (E)	81°23.189'	81°15.856'	81°15.235'	81°14.787'	81°19.030'	81°19.553'	81°18.442'	
pH	Summer	7.46	7.48	7.73	7.52	7.43	7.52	7.66
	Winter	7.17	7.29	7.7	7.96	7.21	7.23	7.29
	After lockdown	7.04	7.15	7.35	7.18	7.09	7.18	7.04
TDS (ppm)	Summer	487.7	302.2	85.15	66.33	362.5	283.1	138.7
	Winter	441.1	367.5	127.5	107.8	424.8	398	192.1
	After lockdown	278.4	235.2	75.9	69.8	205.8	230.2	121.5
EC (µS/cm)	Summer	975.3	604	170.2	132.7	726	566.1	277.2
	Winter	888	734.4	255.2	215.6	849.2	795.7	385.4
	After lockdown	322.5	253.7	147.4	127.4	354.2	373.8	197.5
ORP (mV)	Summer	-19.9	-20.5	-36.3	-23	-17.3	-22.9	-34.3
	Winter	-12.3	-20	-44.6	-60.8	-15.5	-16.3	-19.9
	After lockdown	-11.9	-19.8	-28.4	-19.8	-13.6	-15.8	-12.4
Temperature (ºC)	Summer	28	27	28	27.5	28	29	28
	Winter	26	25	27	25.6	27	27	27
	After lockdown	27	25.4	27.4	27	26.2	28.4	27.8
Salinity (ppm)	Summer	430	230	BDL	BDL	290	210	60
	Winter	380	300	50	20	360	330	110
	After lockdown	321	206	BDL	BDL	186	174	48
DO (ppm)	Summer	6.2	7.3	7.7	6.7	7.2	6.9	7.3
	Winter	7.4	7.5	7.8	7.2	7.4	7.1	7.4
	After lockdown	11.7	11.2	10.5	10.8	9.7	8.9	11.5
F^- (ppm)	Summer	0.695	0.799	0.694	0.8	0.962	0.45	0.7
	Winter	0.54	0.812	0.725	0.91	1.02	0.57	0.78
	After lockdown	0.43	0.52	0.43	0.63	0.72	0.35	0.62
Cl^- (ppm)	Summer	194.02	89	8.9	12.46	81.88	46.28	26.7
	Winter	177.5	99.4	14.2	17.75	92.3	63.9	28.4
	After lockdown	164.7	78.5	5.9	12.7	68.4	38.3	17.4
NO_3^- (mg/l)	Summer	3.1	1.29	0.32	1.29	5.019	0.27	1.3
	Winter	2.8	2.38	0.5	2.25	5.89	1.2	1.34
	After lockdown	1.5	1.13	0.25	1.17	3.25	0.17	0.84
SO_4^{2-} (mg/L)	Summer	13.52	6.36	4.52	5.05	6.36	5.047	4.52
	Winter	13.1	7.72	5.23	7.2	7.12	6.98	5.68
	After lockdown	6.23	5.75	3.67	4.75	5.34	4.65	3.76

Table 1. Values of water quality parameters from study areas in summer, winter and after lockdown situation.

Name of sampling locations		Industrial Nallah (near Chhawani industrial area)	Pulgaon Nallah	Sheonath after joining of Nallah (anicate)	Sheonath river below the bridge	Samoda Nallah	Kosa Nallah	River after joining of Samoda Nallah
PO_4^{3-} (mg/l)	Summer	0.77	1.29	0.8	0.74	0.72	0.88	1.1
	Winter	0.71	1.31	0.92	1.3	0.84	0.94	1.1
	After lockdown	0.65	1.12	0.65	0.56	0.58	0.73	0.86
Total hardness (mg/l)	Summer	365	295	40	30	275	255	125
	Winter	355	310	50	50	300	295	135
	After lockdown	195	175	40	29	148	206	87
Calcium hardness (mg/l)	Summer	345	155	20	10	115	105	70
	Winter	335	160	25	20	135	130	75
	After lockdown	181	106	20	15	108	124	59
Magnesium hardness (mg/l)	Summer	20	140	20	20	160	150	55
	Winter	20	150	25	30	165	165	60
	After lockdown	14	69	20	14	40	82	28
Total Alkalinity (mg/l)	Summer	201.25	257.5	108.75	52.5	216.25	215	127.5
	Winter	195	262.5	110	61.2	232.05	227.5	132.6
	After lockdown	110.2	156.2	94.2	45.8	176.5	163.5	100.4
Bicarbonate (mg/l)	Summer	201.25	257.5	108.75	52.5	216.25	215	127.5
	Winter	195	262.5	110	61.2	232.05	227.5	132.6
	After lockdown	110.2	156.2	94.2	45.8	176.5	163.5	100.4

three different conditions such as summer season, winter season and after lockdown during pandemic conditions was analyzed through software and where correlation values showed by significant at the 0.01 level (2-tailed) and the 0.05 level (2-tailed). pH has shown the negative correlation with ORP in all conditions includes summer, winter season and during lockdown condition. But it shows a negative relationship with TDS (-0.862), EC (-0.862), Salinity (-0.861), total Hardness (-0.866), Total Alkalinity (-0.839) and Bicarbonate (-0.839) in the winter season. TDS has a strong correlation with EC, Salinity, Chloride, Total Hardness, and calcium hardness in all three conditions. TDS also shows the positive relationship with Sulphate (0.805) and total Alkalinity in the form of Bicarbonate (0.803) in the summer season, with ORP (0.860) and total Alkalinity in the form of Bicarbonate (0.902) in the winter season and with Sulphate (0.799) in a lockdown situation. EC has shown the Pearson relationship with Salinity, Total Hardness, calcium hardness, and Bicarbonate Alkalinity in all conditions. Chloride has found a positive correlation with EC in summer (0.928) and winter (0.853) season, and sulphate (0.804) and ORP (0.860) also found a positive correlation in summer and winter season respectively. ORP has a positive correlation with Salinity (0.859), Total hardness (0.865) and Bicarbonate alkalinity (0.836) in the winter season.

Temperature, DO, Nitrate, Phosphate and Fluoride values were found no significant correlation with any studied water quality parameters. Salinity has a good positive correlation with Chloride, total Hardness and calcium hardness in all three conditions. Salinity shows the relationship with Sulphate in summer (0.819) and lockdown (0.866) condition and with Alkalinity in summer (0.786) and winter (0.903) season.

Chloride was showing a positive correlation with Sulphate and calcium hardness; Sulphate showing correlation with calcium hardness in all conditions, which indicates the presence of Calcium

chloride and calcium sulphate in water samples of this region. Correlation values of magnesium hardness and bicarbonate alkalinity also indicated that the availability of magnesium bicarbonate compounds in water samples.

Cluster analysis

Cluster analysis is the method to categorize the similarity between groups or classified the same number of groups or clusters among all data set (Yadav Janeshwar *et al*., 2013). The present study indicates that the Dendrogram cluster formation of clusters were used for the identification of similar groups or clusters for various water quality parameters in different conditions, which are presented Fig 1, 2, and 3 for the summer season, winter season and during lockdown period respectively.

Dendrogram cluster formation for all states showed that a slightly different cluster for industrial Nallah water samples compared to other locations water samples. Water samples from the Shivnath river below the bridge and Sheonath river after joining of Nallah (anicate) have a similar group of clusters in all three situations. This analysis indicated only water quality parameters for samples from Sheonath river below the bridge and Sheonath river after joining of Nallah (anicate) were the same

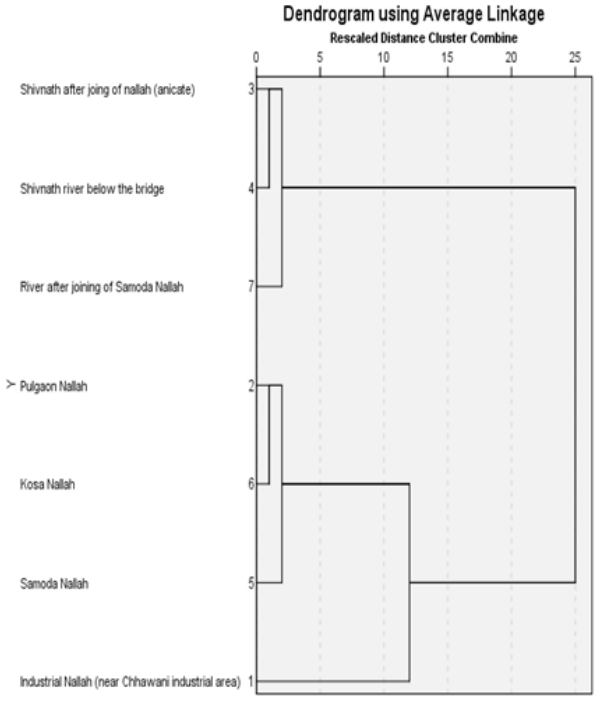

Fig. 1. Dendrogram cluster formation for various water quality parameters in summer season.

set of data from the summer season and after lockdown situation. Kosa Nallah and Samoda Nallah samples showed a similar set of data in the winter season.

CONCLUSION

The correlation values between various water

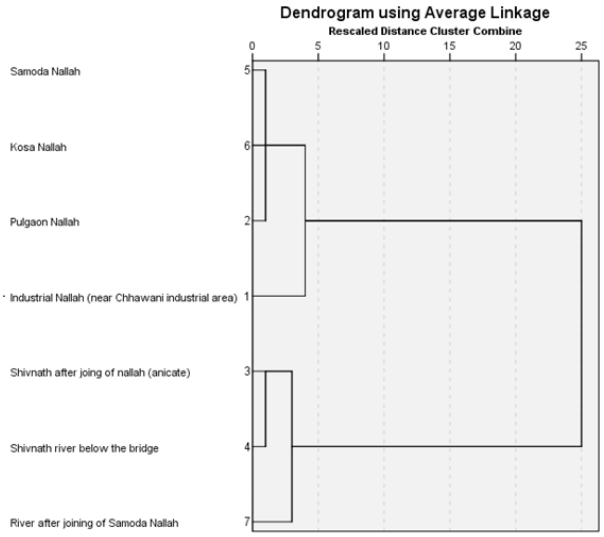

Fig. 2. Dendrogram cluster formation for various water quality parameters in Winter season.

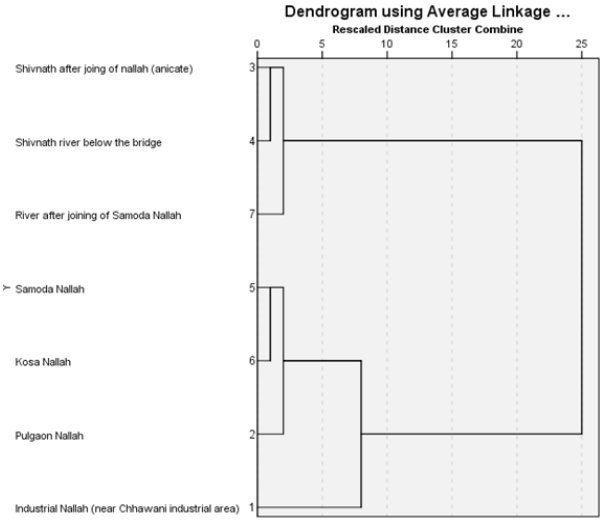

Fig. 3. Dendrogram cluster formation for various water quality parameters in after lockdown during COVID-19.

quality parameters indicated that the Nature of correlation and cluster pattern was found almost similar type in summer and lockdown condition. In this study, it was found that the overall measured water quality parameters have decreased in lockdown condition (after 60 days of lockdown) as

compared to other seasons (summer and winter). Dissolved oxygen values of water samples were found to be high in lockdown condition and lower in summer and winter season. The high value of dissolved oxygen shows abetter quality of water. In lockdown conditions, human activities restricted, which highly impact water quality and found that Nature has self-healing capacity in the absence of human activities and able to convert it into the usable form. This indicates the positive impact of the lockdown situation during COVID19. There is an amazing variation of chemical quality within a few days of lockdown during a pandemic situation. Hence, it will be beneficial to create strategies to control water pollution after this pandemic situation worldwide.

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