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RESEARCH ARTICLE

IMPACT OF SEASONAL VARIATION ON MINERAL AND HEAVY METAL CONTENT OF BANSAGAR DAM, SHAHDOL, INDIA

[1,*]Mahendra Kumar Tiwari and [2]Mahendra K Tiwari

[1]Professor, Department of Environment Science, AKS University, Satna 485001, India
[2]Research Scholar, Department of Environment Science, AKS University, Satna 485001, India

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Corresponding author:
Mahendra Kumar Tiwari

ABSTRACT

Water plays a noteworthy role in maintaining the human strength and interests. Hygienic water is now distinguished as a basic accurate of human beings. Heavy metals and high minerals content being perceptible contaminants positions imperative toxicological impacts to human life and exist ecological backgrounds. Physical properties of heavy metals having, relative a high atomic weight along with binding abilities with additional elements. It is a leading usual resource, contributes structures and drinking water reserve in increasing countries is a global alarm. The piece of task is carried out to study the water suitability of Bansagar dam, Shahdol for irrigation and consumption views. Three water samples were collected from three specific sites which serve as groundwork of water at various positions of Bansagar dam. Samples were examined for minerals and heavy metal content throughout 2019 and 2020 to assess the impact of seasonal variations in water of the dam via observing different minerals and heavy metal content viz, Ca, Mg, Na, K, Fe, Hg, and Fluoride, in different seasons. Basically all explored parameters communicated their standard and below position suggested by means of WHO and ISI as drinking and utility of water. Parameters were under seasonal modification variety, Hence, it can concluded that Bansagar Dam water influenced due to participation of geographical association and their recurrent alterations, other than water increasingly concentration towards eutrophication which point in the direction and suggested about the accessibility of protected dam water in expressions of drinking along with the irrigation exploitation. For a detailed analysis the monitoring and analysis should be carried out for a longer period of time. The minimum time for such monitoring should be two year in order to have a series of data or trends to confirm the study reliability.

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INTRODUCTION

Water is most precious natural resources necessary for the protection of all forms of life (FAO, 1997). Surface (rivers, lakes and dams) water are the major sources of water. In recent years, since of rapid urbanization, industrialization and increasing inhabitants, the rate of expulsion of pollutants into the atmosphere which ultimately locate their way into these water resources is advanced than the rate of cleansing (Reza and Gurdeep, 2009). And it is believed that exterior water is usually more polluted than ground water, therefore the employ of ground water as the chief source of drinking water is have a preference. Standards methods for the examination of water are also essential which express the status of contamination (APHA 2005, APHA 2012). Contamination difficulties are rising since of improper removal of the rising number of toxic materials that are exploited in industry in addition to agriculture.

Even where no basis of anthropogenic pollution exists, there is the possible for usual levels of toxic metals and other substances in groundwater appropriate harmful to human health (Prasanth et al. 2012). Natural levels of heavy metals in groundwater have been established to create harmful impacts on humans (Shankar et al. 2014; Akoto and Adiyiah 2007: Anawara et al. 2002). Drinking contaminated water can have serious health issues, among the variety of pollutants that affect water quality. Heavy metals are exacting concern owing to their strapping toxicity at short attentions and persistent nature (Marcovecchio et al. 2007). Heavy metals and metalloids can reason serious human health issues with indications depending on the character and measure of the metal ingested. Extensive intake of metals in water may consequence in illnesses (Asante et al. 2007), neurotoxicity by Hg (Johnson and Atchison 2009) and immune system disruption through Pb (Mishra 2009).

There is consequently the require to assess the chemical traits and assess the human health hazards as of metals in drinking water. Such understanding will assist support water resource organization and pollution control programs.

BANSAGAR DAM

The Bansagar dam is multipurpose, for hydro-electric power generation and irrigation, constructed on across the Son River. Dam site is situated near Deolond bridge on Rewa-Shahdol road, at a distance of 50.7 km from Rewa, it coordinate with $24^0$11'30'N $81^0$17'15'E, The Son river initiated from Amarkantak in Shahdol district at an altitude of about 1066.8 m. River runs 508.54 km in Shahdol and Sidhi, Madhya Pradesh and river flows 96 km length cover Uttar Pradesh, There after it enters Bihar, then meets with the Ganga river. The study of heavy metals and minerals of water is complicated to appreciate the biological activities of water body exclusive of adequate information of water chemistry. There are more than a few abiotic factors, which straight or indirectly influence the expansion and biodiversity of aquatic atmospheres. The heavy metals and minerals attributes of water characteristic include physical, chemical and biological limitations that conclude its nutrient point along with the contamination altitude.

MATERIAL AND METHODS

Samples digestion for examination of Heavy metals The research work was carried out for 2019-2020 with standard methods. The samples were collected from different three specify sampling point include in investigation as station A, B and C. the seasonal (Rainy, summer and winter) sampling of water was done and water was collected in wide mouthed glass bottles and kept in an icebox (at low temperature). Investigation was done in laboratory of department of Environment Science, AKS University, Satna, M.P. Manual of standards quality for water allowed with Indian standard specification ICMR, (1975), ISI, (1991). Samples digestion for metal status investigation was done with concentrated HNO_3 (Akoto et al., 2008). 5 mL concentrated HNO_3 was put in to 50 mL of water sample in a 100 mL beaker. This was heated on a hot plate awaiting its volume decreased to about 20 mL. Another 5 mL of concentrated HNO_3 was added as well as then heat for next 10 min. The sample was allowed to cool to room temperature. 5 mL of HNO_3 was used to rinse the sides of the beaker, and the solution was quantity basis shifted into a 50-mL volumetric flask and complete up to the mark with distilled water. A blank solution was similarly prepared. Heavy metal analysis was done by means of atomic absorption spectrophotometer (Agilent 200 series AA) calibration curves were drawn for each metal through running appropriate attentions of their standard solutions, from which the concentrations of the elements were obtained via extrapolation. Average values of three replicates were in use for each purpose. The absorbance of the blank was taken earlier than the analysis of the samples. Minerals and heavy metal content viz, Ca, Mg, Na, K, Fe, Hg, and Fluoride, value were expressed in n=3 mean±SD with their seasonal alteration.

SAMPLING SITES/STATIONS

Station A: It lies around the Mahadev temple of the dam and has a literal and undisturbed area to the interferences of human beings with a water depth range between 1 m. to 1.5 m.

Station B: It is situated near the Vijay Sota Railway Station and is characterized with almost semi disturbed area particularly to human activities with a water level to be vitiated between 1m. and 1.5 m.

Station C: It lies in the main gate area of the dam and relatively has higher disturbance of human, with a water depth range between 1 m. to 1.5 m.

RESULTS AND DISCUSSION

Calcium and Magnesium: The content of Ca recorded in 2019 in winter, with maximum value of 35.9 mg/L for station A and 32 mg/L at station C. Minimum Ca recorded was 3 mg/L at the station A and 5 mg/L at the station B in the summer season. In winter average Ca were recorded for station A, B and C as 35.83 mg/L, 33.66 mg/L and 32.33 mg/L (Table 14 Fig 14) with Standard deviation of 0.05, 0.57 and 0.57 respectively. Mean±SD for Ca content in summer were 3.0±0.0, 5.0±0.0 and 20.66±0.57 in favors of station A, B and C whereas in rainy season it was 16.00±0.57, 12.66±0.57 and 18.66±0.57 mg/L (Table 1). In year 2020, maximum Ca recorded at station C it was 23 mg/L and 22 mg/L in rainy and summer. The minimum amount of Ca found at station A and B was 11 mg/L in winter season. Average amount of Ca with SD recorded in the winter season was 11.66±0.57, 11.83±0.28 and 14.0±1.0 intended for station A, B and C. Mean±SD for Ca in summer season at station A, B and C was 16.66±0.57, 18.66±0.57 and 21.66±0.57 respectively. Mean±SD for calcium content in rainy season recorded were 18.66±0.57, 19.66±0.57 and 22.33±1.15 mg/L concern to station A, B and C (Table 1).

The assessments of Mg evidenced at diverse stations of Bansagar dam are represented (Table 15). The status of Mg were varied from 1.5 to 24.11 mg/L at station A, 2.2 to 21.8 mg/L at station B and 8.3 to 21.1mg/ L at station C respectively during 2019. The maximum values of Mg were recorded in the winter season (Table 1). Mean±SD values of Mg were recorded as 5.16±0.05, 6.2±0.02 and 7.36±0.05 at station A, as for summer, winter and rainy period respectively. Similarly 7.66±0.05 mg/L, 5.96±0.05 mg/L and 7.73±0.11 mg/L Mg (mg/L) status were calculated at station B whereas 9.33±0.11mg/L, 7.56±0.05 and 8.86±0.05 Mg mg/L status were found at station C in winter, summer and rainy weather respectively in investing year (2020). During 2020, the maximum Mg hardness was recorded all through winter (9.4 mg/L) and minimum in summer i.e. 5.1 mg/L (Table 1).

Sodium and Potassium: The minimum and maximum status of Na contents recorded among 15 to 42 mg/L during 2019 and 12-21 mg/L during 2020. The mean± SD values of Na content in 2019 recorded in winter season, it was 41.66±0.57mg/L, 32.33±0.57 mg/L and 26.66±0.57 mg/L, In summer it was found 26.66±0.57 mg/L, 30.33±0.57 mg/L and 23.66±0.57 mg/L, whereas in rainy climate it was recorded as 15.66±0.57 mg/L, 14.66±0.57 mg/L and 19.66±0.57 mg/L in favor of station A, B and C respectively. Similarly the mean±SD values of Na content in 2020 recorded in winter season was 15.0±0.0 mg/L, 15.66±0.57 mg/L and 18.66±0.57 mg/L; in summer season was 17.66±0.57 mg/L, 16.33±0.57 mg/L and 20.66±0.57 mg/L; in rainy season was 12.66±0.57 mg/L, 17.66±0.57 mg/L and 19.4±0.1 mg/L at station A, B and C respectively. In 2020 there was less variation in Na content in

all stations in all seasons (Table 1). The potassium were recorded in 2019 with mean±SD of 2.66±0.57 mg/ L, 3.0±0.0 mg/L, and 2.33±0.57 mg/L at station A; 1.66±0.57 mg/L, 3.66±0.57 mg/L and 3.33±0.57 mg/L at station B and 2.0±0.0 mg/L, 2.66±0.57 mg/L, 3.33±0.57 mg/L at station C in winter, summer and rainy season (Table 18, Fig/18). In 2020 Potassium value recorded with mean±SD of 2.0±0.0 mg/L, 2.0±0.0 mg/L and 1.16±0.05 mg/L at station A; 1.66±0.57 mg/L, 1.53±0.05 mg/L and 1.23±0.05 mg/L at station B and 2.66±0.57 mg/L, 1.66±0.57 mg/L and 1.56±0.05 mg/L at station C in winter, summer and rainy season respectively (Table 1). USEPA (2002) and Ayodele (1995), suggestion were justified in favor of potassium status determination.

Metal Analysis: The study assessed the status of mercury (Hg) obtained from surface water of Bansagar dam. All sampled from three specify stations used for prospects of metal toxicity concern to Hg and Pb. Status of Hg were studied for two sequential year 2019 and 2020 with specification of seasonal changes presented in Tables (2-5).

Mercury (Hg) and Lead (Pb): Hg concentrations in water samples was investigated as station A- (Mahadev temple) ranged from 0.031 to 0.191 mg/L with a mean of 0.095±0.005 mg/L, whilst levels recorded in Station B (Vijay Sota Railway station) ranged from 0.011 to 0.184 mg/L with a mean concentration of 0.075±0.015 mg/L, similarly for the Station C (Maingate Bansagar dam) expressed ranged from 0.028 to 0.259 mg/L with a mean of 0.119±0.006 mg/L. The level of Hg for all three seasons was exhibited as exceeding results in concern to sampling stations followed by year 2019 (Table 2). Mean Hg status regarding station A (Mahadev temple) 0.031±0.004mg/L in summer, 0.153±0.002 in rainy, and 0.191±0.006 Hg concentration were recorded as maximum level in winter 2019. Similarly station B (Vijay Sota Railway station) Hg concentration 0.011±0.002 mg/L in summer, 0.032±0.005 in rainy, and 0.184±0.008 Hg concentration were accounted as higher level in winter, the station C (Maingate Bansagar dam) was represent 0.028±0.006 Hg level in summer (Minimum), 0.072±0.008 mg/L in rainy and 0.259±0.004 mg/L in winter (maximum) of 2020 (Table 2). The order of Hg concentration as per the seasonal changes was summer (Minimum) > Rainy > winter.

Hg concentrations in water samples was investigated as station A- (Mahadev temple) ranged from 0.127 to 0.208 mg/L with a mean of 0.162±0.015 mg/L, whilst levels recorded in Station B (Vijay Sota Railway station) ranged from 0.040 to 0.96 mg/L with a mean concentration of 0.068±0.020 mg/L, in the same consequences of investigation Station C (Maingate Bansagar dam) expressed ranged from 0.132 to 0.196 mg/L with a mean of 0.160±0.005 mg/L. The level of Hg for all three seasons was exhibited as exceeding results in concern to sampling stations followed by year 2020. Signify Hg status regarding station A (Mahadev temple) 0.127±0.009 mg/L in summer, 0.153±0.002 in rainy, and 0.208±0.009 Hg concentration were recorded as maximum level in winter 2020. Similarly station B (Vijay Sota Railway station) Hg concentration 0.040±0.010 mg/L in summer, 0.068±0.010 in rainy, and 0.096±0.004 Hg concentration were accounted as higher level in winter, the station C (Maingate Bansagar dam) was represent 0.132±0.003 Hg level in summer (Minimum), 0.153±0.004 mg/L in rainy and 0.196±0.009 mg/L in winter (maximum) of 2020 (Table 2). The study assessed the concentrations of Lead (Pb) obtained from surface water of Bansagar dam employed for investigation of Pb finding in water, concentrations of the Pb studied was presented in Tables 3. Pb concentrations in water samples was investigated as Station A- (Mahadev temple) ranged from 0.005 to 0.038 mg/L with a mean of 0.022±0.009 mg/L, whilst levels recorded in station B (Vijay Sota Railway station) ranged from 0.012 to 0.026 mg/L with a mean concentration of 0.019±0.008 mg/L, similarly for Station C (Maingate Bansagar dam) ranged of Pb from 0.019 to 0.036 mg/L with a mean of 0.028 ±0.010 mg/L. The level of Pb for all three seasons was exhibited as exceeding results in concern to three sampling stations during 2019. Mean Pb level for station A (Mahadev temple) 0.005±0.012 mg/L in summer, 0.024±0.012 in winter, and 0.038±0.005 in rainy, Pb concentration were recorded as maximum level in rainy seasons. Similarly station B (Vijay Sota Railway station) 0.012±0.011 mg/L in summer, 0.021±0.006 in winter and 0.026± 0.008 in rainy, the station C (Maingate Bansagar dam) was represent 0.019±0.009 Pb level in summer (Minimum), 0.029±0.009 mg/L in winter and 0.036±0.013 mg/L in rainy (maximum) during 2019 (Table 3). Pb concentrations were recorded as higher level in rainy, as compared to winter and summer. The order of Pb concentration as per the seasonal changes was summer (Minimum) > winter > Rainy (maximum).

Pb concentrations in water samples was investigated as Station A- (Mahadev tample) ranged from 0.019 to 0.041 mg/L with a mean of 0.029±0.007mg/L mg/L, whilst levels recorded in station B (Vijay Sota Railway station) ranged from 0.032 to 0.001 mg/L with a mean concentration of 0.039±0.005mg/L, the station C (Maingate Bansagar dam) ranged from 0.024 to 0.043 mg/L with a mean of 0.035±0.010mg/L Status of Pb for all three seasons was exhibited as elevated results in concern to three sampling stations. Mean Pb level for station A (Mahadev temple) 0.019±0.002 mg/L in summer, 0.027±0.009 in winter, and 0.041±0.011 in rainy, Pb concentration were recorded as maximum level in rainy 2020. Similarly station B (Vijay Sota Railway station 0.032±0.001mg/L in summer, 0.039±0.010 in winter and 0.046± 0.006 in rainy, similarly station C (Maingate Bansagar dam) was represent 0.024±0.011 Pb level in summer (Minimum), 0.038±0.011 mg/L in winter and 0.043±0.010 mg/L in rainy (maximum) of 2020 (Table 3). Pb status was found higher in rainy as compared to winter and summer. On the year wise comparison, the sampling year 2020 expressed more Pb content compared to 2019. Results intimated gradual enhancement according to year wise seasonal change. The order of Pb concentration as per the seasonal changes was summer (Minimum) > winter > Rainy (maximum). The high content of Pb in the stream could be due to weathering and leaching of lead from waste rocks dumps. Lead is one of the most significant toxicants of the heavy metals and the inorganic forms are absorbed through ingestion by food and water, and inhalation (Rajkovic et al., 2008).

Iron (Fe) and Fluoride: Study assessed the Fe (mg/L) concentrations from surface water of Bansagar dam to observe the Fe level in water, values of Fe found was incorporated in Tables 4. Fe (mg/L) concentrations was evaluated, Station A- (Mahadev temple) ranged from 0.20 to 0.38 mg/L with a mean of 0.28±0.02mg/L, whilst levels recorded in station B (Vijay Sota Railway station) ranged from 0.031 to 0.045 mg/L with a mean concentration of 0.38±0.03mg/L, similarly for Station C (Maingate Bansagar dam) ranged of Fe from 0.012 to 0.031 mg/L with a mean of 0.44±0.01mg/L (Table 4). The level of Fe for all three seasons was exhibited as exceeding results in concern to three sampling stations during 2019. Mean Fe level for station A (Mahadev temple) 0.20±0.002 mg/L in summer,

Table 1. Effect of seasonal variation on Calcium, Magnesium, Sodium and Potassium Content, during 2019 and 2020

Parameters (Mean ±SD)		2019				2020			
		Winter	Summer	Rainy	Yearly average	Winter	Summer	Rainy	Yearly average
Calcium	Station A	35.83±0.05	3.0±0.0	16.66±0.57	18.49±0.20	11.66±0.57	16.66±0.57	18.66±0.57	15.66±0.54
	Station B	33.66±0.57	5.0±0.0	12.66±0.57	17.10±0.38	11.83±0.28	18.66±0.57	19.66±0.57	16.71±0.47
	Station C	32.33±0.57	20.66±0.57	18.66±0.57	23.88±0.57	14.0±1.0	21.66±0.57	22.33±1.15	19.33±0.90
Magnesium	Station A	24.06±0.05	1.56±0.05	6.16±0.05	10.59±0.05	6.2±0.02	5.16±0.05	7.36±0.05	6.24±0.04
	Station B	21.76±0.05	2.26±0.05	5.16±0.05	9.72±0.05	7.66±0.05	5.96±0.05	7.73±0.11	7.11±0.07
	Station C	21.06±0.05	9.86±0.05	8.33±0.05	13.08±0.05	9.33±0.11	7.56±0.05	8.86±0.05	8.58±0.07
Sodium	Station A	41.66±0.57	26.66±0.57	15.66±0.57	27.99±0.57	15.0±0.02	17.66±0.57	12.66±0.57	15.10±0.38
	Station B	32.33±0.57	30.33±0.51	14.66±0.57	25.7±0.52	15.66±0.57	16.33±0.43	17.66±0.5	16.55±0.54
	Station C	26.66±0.57	23.60±0.51	19.66±0.57	23.30±0.55	18.66±0.57	20.63±0.52	19.4±0.1	19.57±0.39
Potassium	Station A	2.66±0.57	3.0±0.1	2.33±0.57	2.66±0.37	2.0±0.0	2.0±0.0	1.16±0.05	1.72±0.016
	Station B	1.66±0.57	3.66±0.51	3.33±0.57	2.88±0.55	1.66±0.57	1.53±0.05	1.23±0.05	1.47±0.22
	Station C	2.0±0.0	2.66±0.57	3.33±0.51	2.66±0.37	2.66±0.57	1.66±0.57	1.56±0.05	1.96±0.39
Value were expressed in n=3 mean ±SD									

Table 2. Concentration (mg/L) of Hg in water samples collected from sampling stations under seasonal changes in year 2019

Sampling Sites	Hg (mg/L) (n=6) 2019				Hg (mg/L) (n=6) 2020			
	Summer (Minimum)	Rainy	Winter (Maximum)	Mean± SD	Summer (Minimum)	Rainy	Winter (Maximum)	Mean± SD
Station A	0.031 ± 0.004	0.063 ± 0.006	0.191 ± 0.006	0.095 ± 0.005 mg/L	0.127 ± 0.009	0.153 ± 0.002	0.208± 0.009	0.162 ± 0.015 mg/L
Station B	0.011 ± 0.002	0.032 ± 0.005	0.184 ± 0.008	0.075 ± 0.015 mg/L	0.040 ± 0.010	0.068 ± 0.010	0.096± 0.004	0.068 ± 0.020 mg/L
Station C	0.028 ± 0.006	0.072 ± 0.008	0.259 ± 0.004	0.119 ± 0.006 mg/L	0.132± 0.003	0.153 ± 0.004	0.196± 0.009	0.160 ± 0.005 mg/L
<0.001 APHA 23rd 3112. Permissible limit for drinking water-0.010 mg/L as WHO 2008								

Table 3. Concentration (mg/L) of Pb in water samples collected from sampling stations under seasonal changes in year 2019 and 2020

Sampling Sites	Pb (mg/L) (n=6) 2019			Pb (mg/L) (n=6) 2020				
	Summer (Minimum)	Winter	Rainy (Maximum)	Mean ±SD	Summer (Minimum)	Winter	Rainy (Maximum)	Mean ±SD
Station A	0.005± 0.012	0.024± 0.012	0.038± 0.005	0.022± 0.009 mg/L	0.019±0.002	0.027±0.009	0.041±0.011	0.029±0.00mg/L
Station B	0.012 ± 0.011	0.021± 0.006	0.026± 0.008	0.019±0.008 mg/L	0.032±0.001	0.039±0.010	0.046±0.006	0.039±0.00mg/L
Station C	0.019 ± 0.009	0.029± 0.009	0.036± 0.013	0.028 ±0.010 mg/L	0.024±0.011	0.038±0.011	0.043±0.010	0.035±0.01mg/L
<0.001 APHA 23rd 3112. Permissible limit for drinking water-0.010 mg/L as WHO 2008								

Table 5. Concentration (mg/L) of Fluoride in water samples collected from sampling stations under seasonal changes in year 2019 and 2020

Sampling Sites	Fluoride (mg/L) (n=6) 2019				Fluoride (mg/L) (n=6) 2020			
	Summer (Minimum)	Winter	Rainy (Maximum)	Mean±SD	Summer (Minimum)	Winter	Rainy (Maximum)	Mean±SD
Station A	0.12±0.006	0.19.±0.03	0.31±0.10	0.20±0.04mg/L	0.24±0.009	0.33.±0.07	0.38±0.11	0.31±0.06mg/L
Station B	0.21±0.004	0.32±0.05	0.39±0.11	0.30±0.05mg/L	0.31±0.006	0.37±0.09	0.31±0.08	0.33±0.05mg/L
Station C	0.19±0.010	0.28±0.07	0.36±0.06	0.27±0.07mg/L	0.21±0.012	0.28±0.09	0.36±0.07	0.28±0.05mg/L
Permissible limit for drinking water 0.01 to 0.3 mg/L as WHO 2008.								

0.38±0.013 in winter, and 0.27±0.07 in rainy, Fe concentration were recorded as maximum level in winter seasons. Similarly station B (Vijay Sota Railway station) 0.31±0.006 mg/L in summer, 0.45±0.010 in winter and 0.38±0.09 in rainy, the station C (Maingate Bansagar dam) was represent 0.12±0.011 Fe level in summer (minimum), 0.31±0.012 mg/L in winter (maximum) and 0.26±0.012 mg/L in rainy during 2019 (Table 4). Fe concentrations were recorded as higher level in winter, as compared to rainy and summer. The order of Fe concentration as per the seasonal changes was summer (minimum) > Rainy > winter (maximum). In 2020 Fe status for Station A- (Mahadev temple) ranged from 0.034 to 0.043 mg/L with a mean of 0.038±0.002mg/L, even as station B (Vijay Sota Railway station) ranged from 0.026 to 0.32mg/L with a mean concentration of 0.032±0.003mg/L, the station C (Maingate Bansagar dam) ranged from 0.024 to 0.036mg/L with a mean of 0.29±0.05mg/L Status of Fe for seasons was exhibited as elevated results in concern to stations. Mean Fe status for station A (Mahadev temple) 0.34±0.008mg/L in summer, 0.043±0.013 in winter, and 0.038±0.06 in rainy, Fe status were found as maximum in winter 2020. Similarly station B Vijay Sota Railway station 0.26±0.009mg/L in summer, 0.38±0.007 in winter and 0.32±0.10 in rainy, similarly station C (Maingate Bansagar dam) was represent 0.24±0.010 Fe in summer (Minimum), 0.036±0.06 mg/L (maximum) in winter and 0.029±0.011 mg/L in rainy of 2020 (Table 4). Fe status was higher in winter as compared to other weather. The sampling year 2020 expressed additional Fe content compared to 2019. Results intimated gradual development according to yearly seasonal alter. The order of Fe mg/L as per the seasonal changes was summer (Minimum) > Rainy > winter (maximum).

Health studies have shown that the addition of F^- to water supplies in levels above 0.6 mg/L of F^- could lead to a reduction in tooth decay especially in growing children. On the other hand, consumption of water with F^- concentration above 1.5 mg/L leads to dental fluorosis and in extreme cases skeletal fluorosis (Kumar and Puri 2012).The fluoride (mg/L) concentrations from surface water of Bansagar dam was observe, findings were incorporated in Tables 4. Fluoride (mg/L) status was examined, Station A (Mahadev temple) ranged from 0.12 to 0.31 mg/L with a mean of 0.20±0.04mg/L, whilst levels recorded in station B (Vijay Sota Railway station) ranged from 0.021 to 0.039 mg/L with a mean concentration of 0.30±0.05mg/L, similarly for Station C (Maingate Bansagar dam) ranged of fluoride from 0.019 to 0.036 mg/L with a mean of 0.27±0.07mg/L. The level of fluoride for three seasons was exhibited as exceeding results in concern stations during 2019. Mean fluoride status for station A (Mahadev temple) 0.12±0.006 mg/L in summer, 0.19±0.03 in winter, and 0.31±0.10 in rainy, fluoride concentration were recorded as maximum level in rainy seasons. Similarly station B (Vijay Sota Railway station) 0.21±0.004 mg/L in summer, 0.32±0.05 in winter and 0.39±0.11 in rainy, the station C (Maingate Bansagar dam) was represent 0.19±0.010 fluoride level in summer (Minimum), 0.28±0.07 mg/L in winter and 0.36±0.06 mg/L in rainy (Maximum) during 2019 (Table 4). Fluoride concentrations were recorded as higher level in winter, as compared to rainy and summer. The order of fluoride concentration as per the seasonal changes was summer (Minimum) > Rainy > winter (maximum). In 2020 fluoride status in Station A (Mahadev temple) ranged from 0.12 to 0.31mg/L with a mean of 0.20±0.04mg/L was recorded, even as station B (Vijay Sota Railway station) ranged 0.021 to 0.39mg/L with a mean concentration of 0.030±0.005mg/L, and in station C (Maingate Bansagar dam) 0.019 to 0.036mg/L ranged with 0.27±0.07mg/L mean were accounted. Status of fluoride for seasons was exhibited as elevated results in concern to stations. Mean fluoride status for station A (Mahadev temple) 0.12±0.006mg/L in summer, 0.19±0.03 in winter, and 0.031±0.04 in rainy, fluoride status were found as maximum in rainy season in 2020. Similarly station B Vijay Sota Railway station 0.21±0.004mg/L in summer, 0.32±0.005 in winter and 0.39±0.11 in rainy weather, similarly station C (Maingate Bansagar dam) was represent 0.19±0.010 fluoride in summer (Minimum), 0.027±0.07 mg/L (maximum) in rainy and 0.028±0.07 mg/L in winter of 2020 (Table 5). Fluoride status was higher in rainy as compared to other weather. The sampling year 2020 expressed additional fluoride content compared to 2019. Results intimated gradual development according to yearly seasonal alter. The order of fluoride mg/L as per the seasonal changes was summer (Minimum) > winter > Rainy (maximum).

Conclusion

For a detailed analysis of water quality in terms of heavy metals and minerals content, the monitoring and analysis should be carried out for a longer period of time. The minimum time for such monitoring should be two year in order to have a series of data or trends to confirm the study consistency. Standardization of the sampling locations would also help in making the obtained data more comparable with scientific findings. The concentrations of heavy metals were also measured and found to be well below the standard maximum concentrations. Fluoride in water samples were accounted more in winter and rainy season, Therefore, the quality of water is good in but partially affected during winter and monsoon weather, gradual development possibly due to yearly seasonal alter and geological structures.

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