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Original Article

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Change in Physiochemical Parameters of Shipra River before Covid -19 Pandemic to Present Status

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Abstract

Shipra water is commonly employed for irrigation, domestic and industrial purposes. Important places in Shipra river, such as Ram Ghat, Triveni Ghat, Siddhwat Ghat, Gau Ghat and near Dewas were selected for the collection of samples in different seasons. Important parameters that decide the qualities of water for domestic purposes, as per WHO and CPCB were selected. Samples were analyzed in a laboratory using standard procedure and advanced instruments such as pH meter, TDS meter, and spectrophotometer. The study showed that pH values in the sample ranging from 6.9 to 7.3, and BOD values varied from 2.7 to 10.5 mg/L. The nitrate value in the sample ranged from 2 to 11.75 mg/L and range of DO value was 6.3 to 7.9 mg/L and also conductivity value varied from 545 to 1250 µmhos/cm. Ammonia content ranged from 0.12 to 0.4 mg/l, and total hardness value varied from 280 to 330 mg/L and also fluoride content ranged from 1.7 to 3.1mg/L. The presence of heavy toxic metals such as mercury (Hg), arsenic (As) and lead (Pb) in samples were 0.0002, 0.001, and 0.001, respectively, indicating that they contain in below-detection limit means in the permissible range as per Indian standard Parameters such as BOD, conductivity and fluoride content range in the sample are higher than permissible range as per WHO.

Keywords: - Shipra water, pH, BOD, BIS, CPCB

Introduction

Water is most important for economy. It is used as a solvent for various chemical pharmaceutical and textile industries and used as a cooling agent as well as for transportation (Manderia and Manderia, 2014). River water is main source of freshwater in different regions of India. In world we focus on quality of freshwater because maximum sources of water are polluted so problem of water is more severe in future. Quality of surface water generally decline due to contamination of domestic waste, animal and human excretion, industrial and farming activities (Sonune et al., 2015). Ecosystem of surface water maintained by quality of water which save the life of living organism of it, so quality of water is very sensitive issue in the world. In India most towns and cities are situated Bank of the river but most of the reason they do not have safe drinking water. River water is generally polluted due to discharging of sewage water, domestic and industrial waste water on it. In India most of the river and their tributaries are reported to be polluted because of mixing of untreated industrial and domestic effluent directly into the rivers. Human activities affect the qualities of river water by discharging their domestic waste material directly into river as a result of variation in quality of it occurs (Rizwan et al.,2016). Domestic effluent contains organic materials, detergent and various chemicals such as phosphate nitrate etc (Rathore et al., 2014).

River Shipra is also known as Kshipra. River as water bodies play important role in development of human civilization. It is a main source for supply of portable water that fulfill demand of water to some extent. The flow area of river is north region of Malwa Plateau across Ujjain city then finally join the Chambal River (Gangwar et al., 2017). Two main tributaries of River Shipra are Khan river and Gambhir river (Kumar et al.,2015).

Shipra river cover mainly maximum regions of Ujjain city. River Shipra faces same adverse effect of rise of urban population and industrialization due to mixing of domestic and municipal wastewater into it by uncontrolled way. Organic/biological material such as Pooja Samagri flown into the river due to religious activities Narmada Shipra link project maintain the quality of water to some extent. Contamination of river due to mixing of Khan river the parameter of water for analysis of quality of river was analyzed using standard procedure as per APHA (APHA, 2012 ; Dalal, 2016 ; Bharti et al.,2014).

The main source of contamination of river Shipra is its tributary river Khan which carries high organic material, heavy and toxic metals and various chemicals from industrial zone of Indore city and mix directly into it (Gupta et al., 2012).Tributary river Khan has many pollutants because of directly discharging of flow of municipal, sewage waste water, industrial effluent and agriculture run off into it (Chaudhari et al., 2017; Dohare et al., 2018; Dwivedi et al., 2015; Pawar & Bhatia, 2016). The quality of river water is considered as class E standard. Parameters of quality of river water are out of acceptable range of Indian standard due to high load of pollution which received by river through industrial untreated water, agricultural activities and flow of municipal (Gupta et al.,2018). As per CPCB norms water of river Shipra is categorized as D class.

Many Pilgrims generally take bath at important Ram Ghat of River Shipra daily. The water quality of river Shipra is categorized as class D but after Narmada Shipra link project the quality of river come under class B. Due to mixing of Narmada River water maintaining the flow of river that change the physical and chemical characteristic of river. The management of water qualities essential to observe future effect on variation of water quality of River system through the analyses data of all parameters (Subbarao et al., 2004).



Fig.1: Selected sites (Ghat) of River Shipra, Ujjain, Madhya Pradesh

The current work shows the change in physical as well as chemical parameters of quality of river before and after COVID pandemic, because in the pandemic the visit restricted due to lockdown, so quality of river water is different in comparison to before COVID-19 pandemic. We also focus on impact of mixing of Narmada River water in Shipra river through Narmada Shipra link project (source -MPPCB) and other projects by present research.

Sampling procedure

Depending on the activity of human and pilgrim pressure five sites of the river were selected. The fig 01 shows sample collecting sites such as Ram Ghat, Gau Ghat, Triveni Ghat, Siddhwat Ghat and near Dewas during May 2022 to December 2022 which cover important Ghats in Ujjain. The data in table indicate chemical and physical parameter of river Shipra in different month and different regions. The rate of decomposition of organic waste increase by microorganisms so more ammonia is produced during summer season due to this reason samples of river water were collected in every month sample were collected in morning as well as evening time in clean plastic bottle and prepared for analysis in laboratory after proper labeling.

Samples of river water were collected from about 52-60 CM below the surface. Collection of samples was also done from surface of river carefully avoiding solid impurities. Collection bottle was rinsed with 0.1N chromic acid than washed with distilled water. For analysis of water sample were collected in plastic bottle was washed thoroughly with distill water.

Various samples were prepared for the analysis of parameters such as BOD, COD, DO etc. in different bottles. Many parameters of river water were analyzed representing samples from different regions of river.

Parameters

The important parameters for quality of water for consumption purpose were analyzed in laboratory parameters such as pH, turbidity, TDS, total hardness, nitrate, sulphate, chloride, BOD, COD and heavy toxic metal with more emphasize on nitrogen containing compound such as urea, ammonia and nitrate. Limit of various level or tolerable range of quality of river water given by WHO, Indian standards and other agencies which required for drinking purpose were analyzed. The water of river Shipra is not fit for drinking purpose because of high level of BOD, COD and TDS value resulting of discharging of a fluent from several industries. The important physical parameters are pH,

temperature TDS and total solids . Chemical parameters that indicate pollution level of water are DO, COD, BOD and hardness (APHA,1998).

Results and Discussion

In the present study chemical and physical characteristic of water of Shipra River was analyzed with important parameters.

Color

Drinking water should have no visible color. The maximum permissible value of color for river water in Hazen unit is 15 but graphics showed that value higher than permissible value in selected sites indicate presence of impurities of colored compounds.

BOD and COD

Both BOD and COD test are helpful to find out the presence of biological and non-biological substance in river water. BOD is an Indicator of biological organic pollutant and measures oxygen level in the water that need of aerobic organism for decomposition of biological materials. Value of BOD is high in February indicate river water is highly polluted and contaminated with sewage and untreated municipal waste water. The BOD value of water samples was continuingly improving from 2018 to 2022 from CPCB data as shown in table 1. After analysis of samples in present status show that except site 1and site 3 the value is under permissible range as shown in fig 03.

Table.1: Variation in parameter BOD Year wise at different Sites before and after pandemic, River Shipra, Ujjain (M.P)

Year/Location	2022*	2021	2020	2019	2018	Source
site1	5.2	6	8	12.8	14	CPCB
site2	2.6	6	6	7	7	CPCB
site3	11	13	15	10	18	CPCB
site4	2.8	5	7	9	9	CPCB
site5	1.9	2	14	24	2.8	CPCB

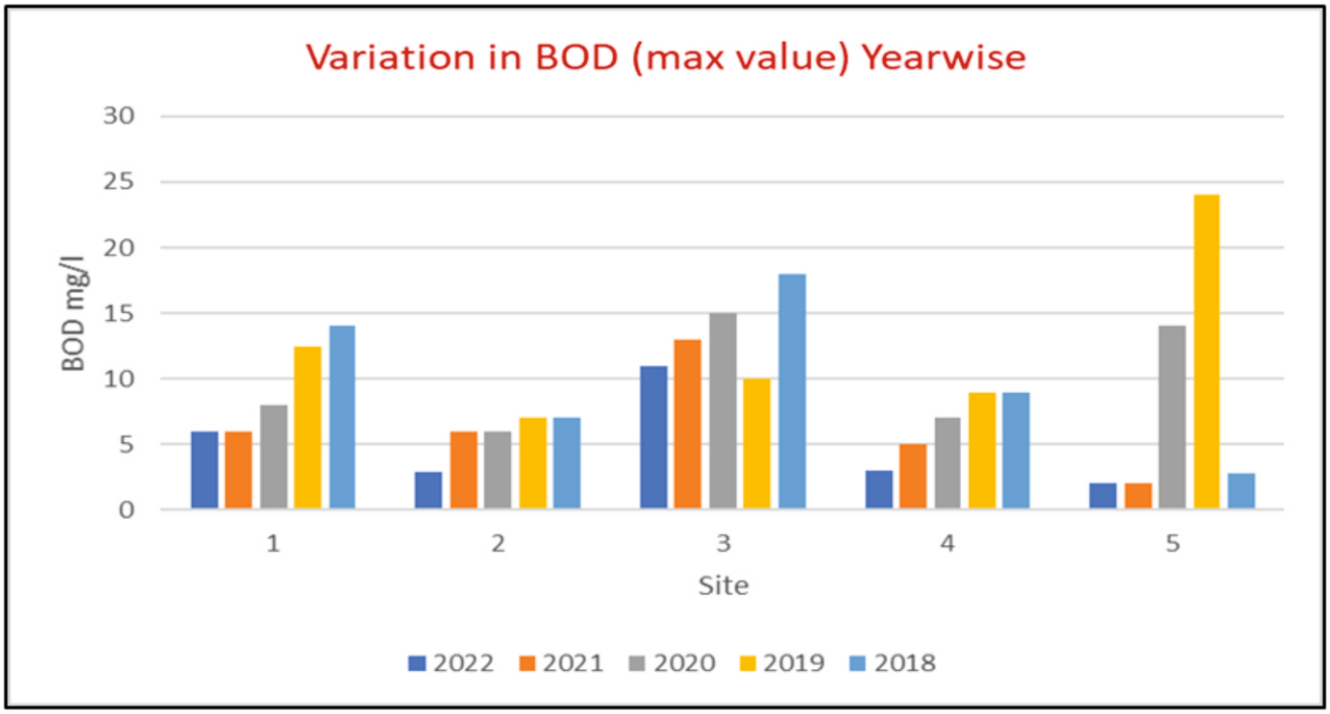


Fig.2

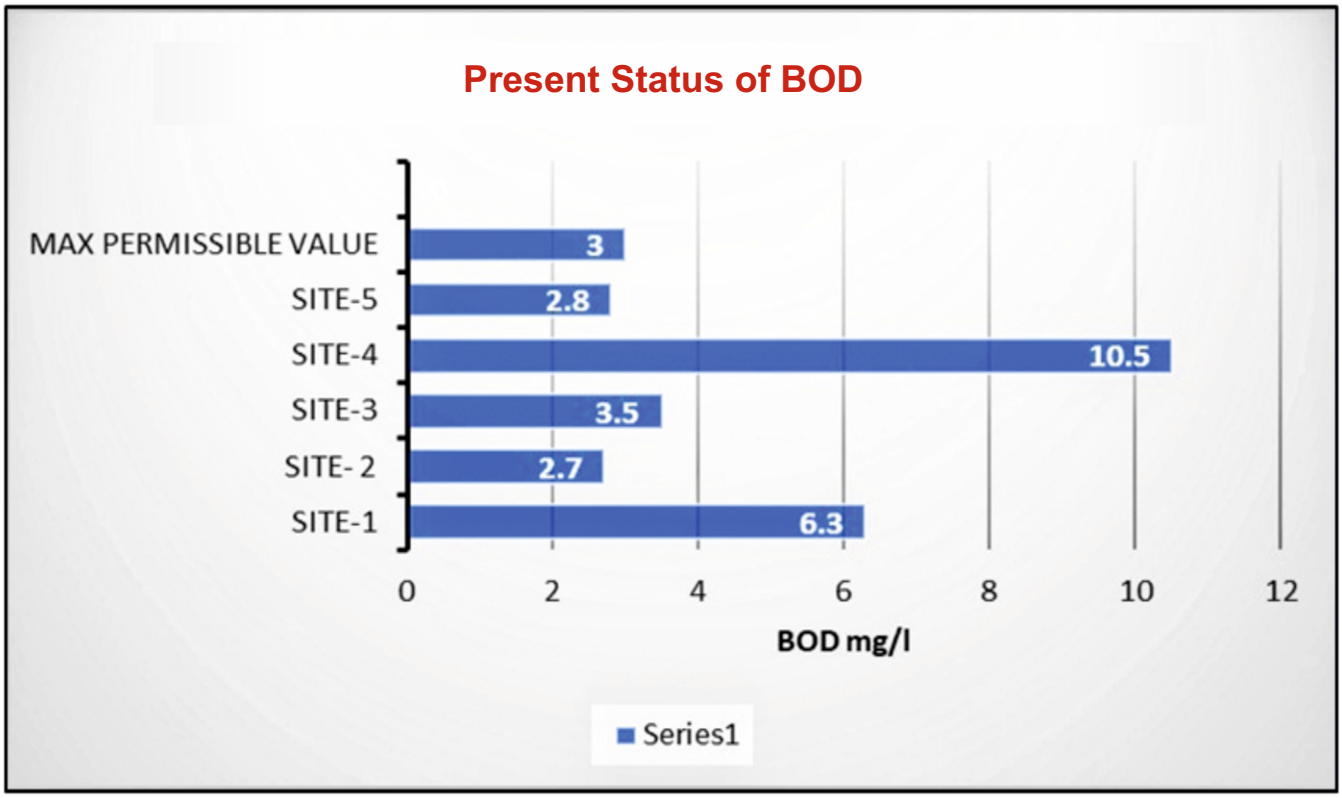


Fig. 03: Site 1-Shipra at Ram Ghat at Ujjain, Site 2 -Triveni Ghat at Ujjain, Site 3-Siddhwat at Ujjain, Site 4- Gau Ghat at Ujjain, Site-5 Intake point Dewas.

Table.02: Variation in parameter Nitrate Year wise at different Sites before and after pandemic River Shipra Ujjain Madhya Pradesh

Year/Location	2022*	2021	2020	2019	2018	Source
Site 1	1.7	1.92	2.5	3	3.87	CPCB
Site 2	0.7	1.0	2.01	3.2	3.65	CPCB
Site 3	2.5	2.87	2.81	4.1	4.55	CPCB
Site 4	1	1.12	2.7	3.1	3.69	CPCB
Site 5	1	1.11	1.70	0.9	0.98	CPCB

Nitrate

Nitrate is indicator of sewage pollution in the surface water. After the analysis of samples and earlier data as per CPCB reported the value of nitrate is under the permissible value. The concentration of compounds containing nitrogen element provide important indication of the level of pathogens and presence of micronutrient in the waste water. The oxidation of nitrogen containing compounds produce toxic material which is harmful for small babies so presence of ammonia and other nitrogen containing compound very harmful if present in higher than permissible value according to WHO. The fig 04 shows the variation in nitrate at different sites. The maximum limit of nitrogen containing compound for domestic water is 45 mg/L as per Indian Standards. Present status of river water showed that value of nitrate is within permissible range except site 3 and site 4 as shown in fig 05.

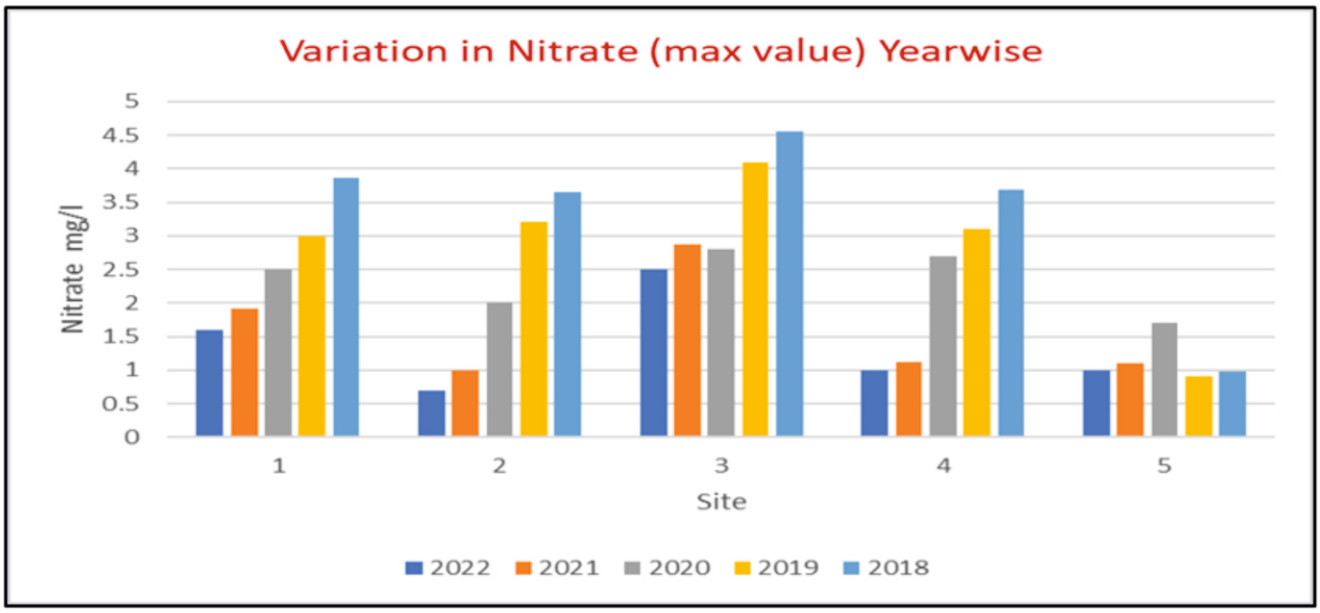


Fig.04

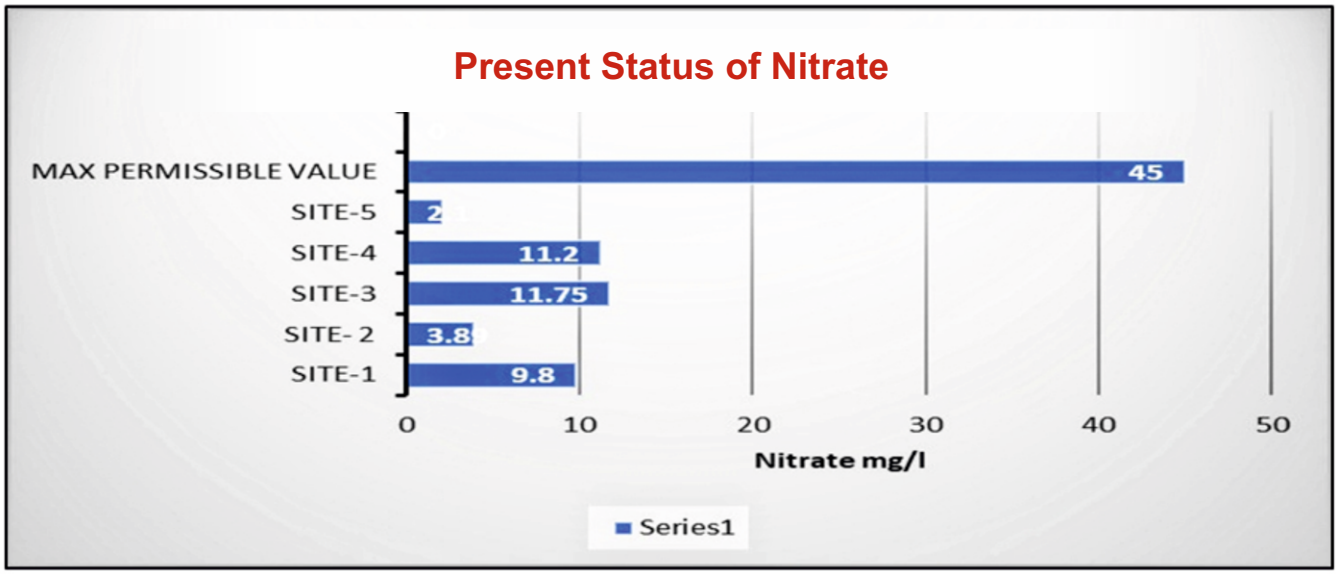


Fig. 05: Site 1-Ram Ghat 2-TriveniGhat 3-SiddhwatGhat 4- GauGhat 5-Intakpoint Dewas

Dissolve Oxygen

Dissolve oxygen is important indicator of biological process which takes place in the water source. Data of analyzed samples from graph showed that range of DO (6.3-7.9) is higher than acceptable range (>6) as per CPCB but not higher means, river water contains sewage and biological materials.

The water quality index value of 2022-23 is better than 2018-19. Improvement in parameters of river water are a result of several schemes and new process to reduce the mixing of sewage and municipal waste water and increase the flow of river by mixing Narmada River so surface water is improved and level Still more improvements are needed so that quality of water become categorized as class A and can be used as drinking purpose.

pH

The pH of water samples between 7.1 to 8.5 indicate alkaline in nature. The range of pH vary in different seasons. Intensity of nature of any solution is expressed by pH value. Observed pH value of samples of river water found to 6.8 to 8.5 of all the selected sites and in every seasons which are within the permissible level as per WHO standard as shown in table 03. The fig 06 shows pH value under the permissible range indicate river water is less contaminated with domestic effluent industrial waste and agriculture. The Fig 07 shows variation in pH at different sites in present status.

Table. 03: Variation in parameter pH Year wise at different Sites before and after pandemic River Shipra Ujjain Madhya Pradesh

Year/Location	2022	2021	2020	2019	2018	Source
Site1	6.8	7.9	8.4	8	8.1	CPCB
Site2	7	8.5	8.3	8.6	8.2	CPCB
Site3	8	8.3	8.5	8	8.1	CPCB
Site4	8.1	8.5	8.5	8.4	8.3	CPCB
Site5	7.2	7.8	7.9	8.1	8.4	CPCB

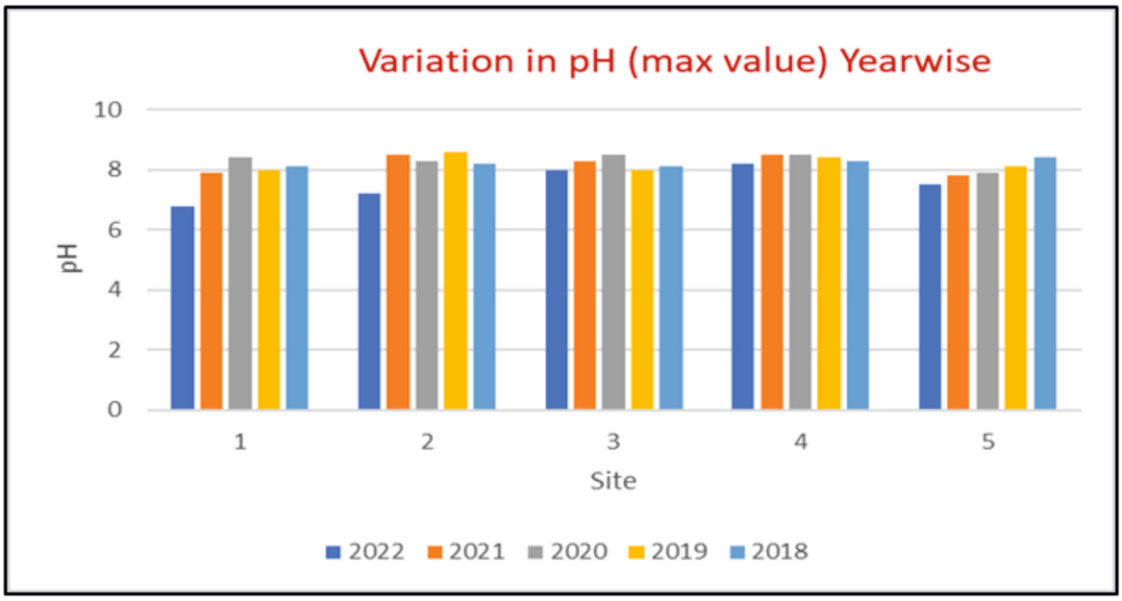


Fig.06

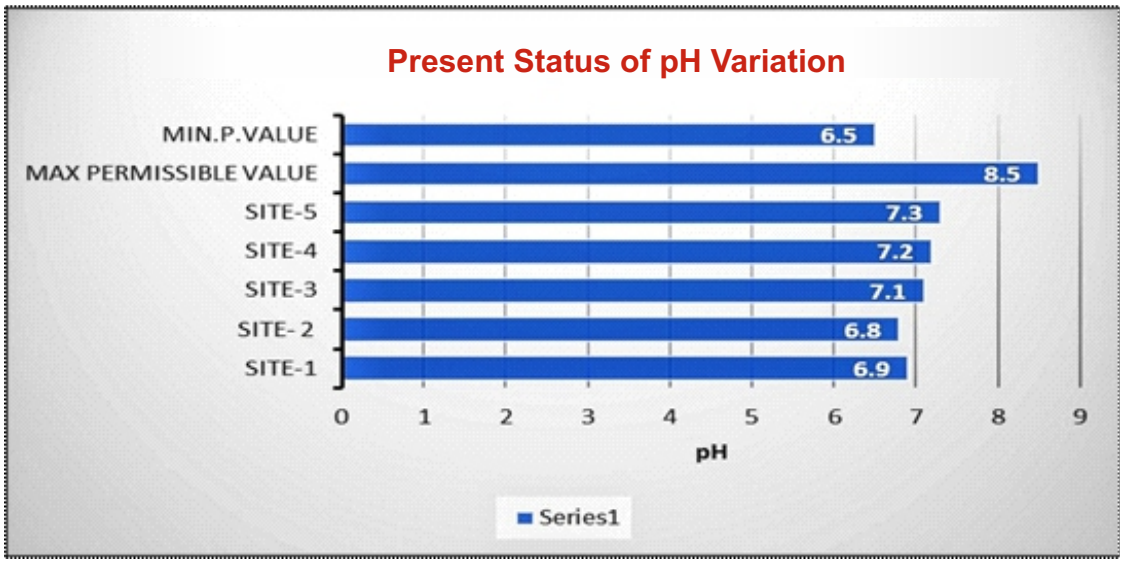


Fig.07: Site 1-RamGhat 2-TriveniGhat 3-SiddhwatGhat 4- Gau Ghat 5-Intakpoint Dewas

Temperature

The change of temperature from May to December were analyzed and found small variation in temperature. The range of temperature of all samples were generally 25°C to 37°C which represents acceptable range and favorable for aquatic life. Variation in quality of river water was studied due to natural and human activities in different region of Ujjain city several places that covers the most parts of the river.

Conductivity

Conductivity value indicate salinity of water sample. Before Pandemic the value of conductivity of all the selected sites were high and range of parameter was improved after pandemic. But range of parameter (545-1250 µmhos/cm) of river water even now are higher than permissible range of all selected sites indicate that presence of salt and ionic compounds in large amounts in river water as shown in fig 08.

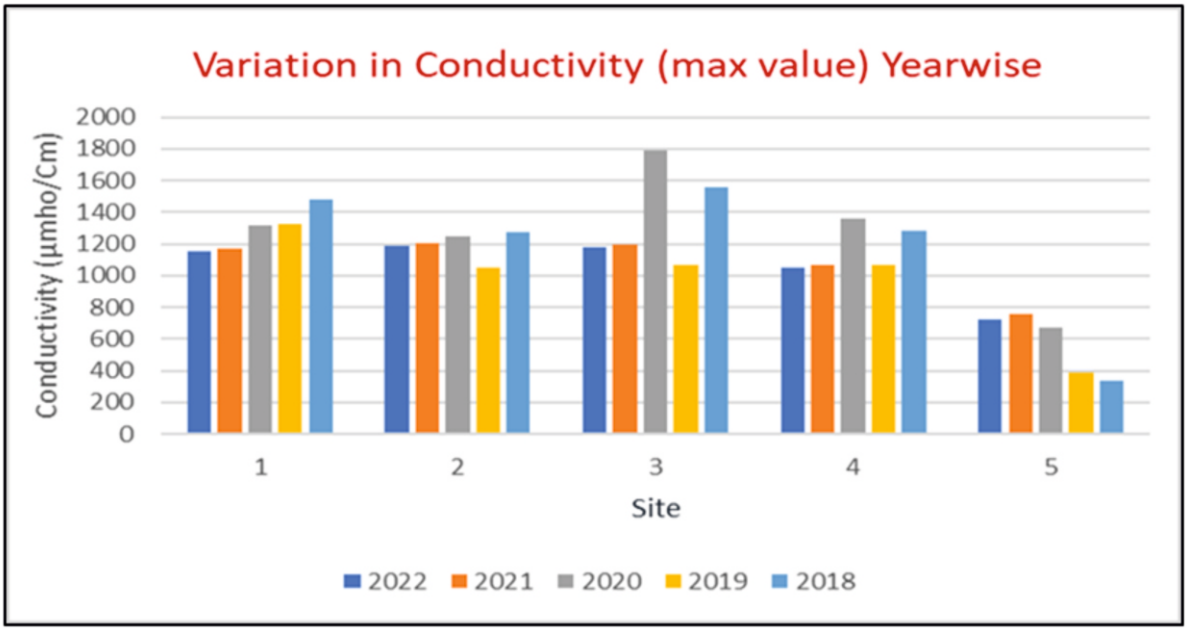


Fig.08

Ammoniacal Nitrogen

The range of concentration of ammoniacal nitrogen was observed from May to December and study showed that value of parameter (0.1 to 0.4 mg/L) is within the permissible label (0.5 mg/l) as per CPCB. Depending on pH, ammonia exist in water in two forms ammonium form and free ammonia. Ammonia shows more toxic effect at higher pH for aquatic life [23]. The observed value of samples is favorable for aquatic life and human health as shown in fig 09.

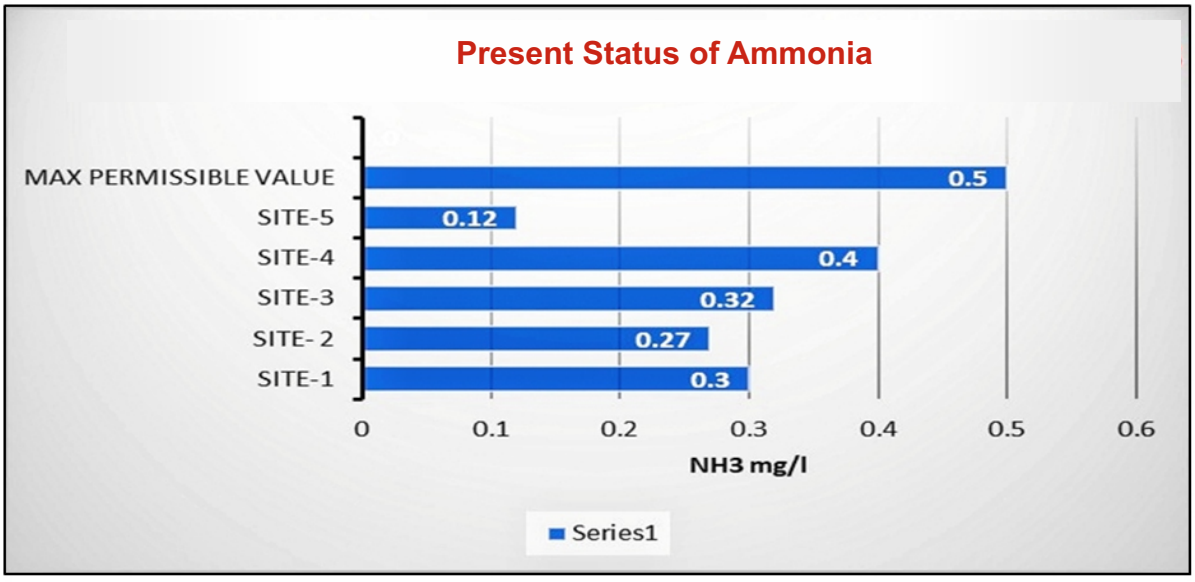


Fig.09

Alkalinity

Alkalinity is measurement of carbonate, hydroxide and bicarbonate present in water sample. Study of alkalinity parameter indicates that small variation in alkalinity and the range (175-290 mg/L) is within the acceptable level (600 mg/L) from all the selected sites.

Hardness

Hard water is generally decided by capacity to produce foam with soap and form scale in boiler, water supply pipes and heater. Hard water is not appropriate for human consumption because it produce adverse effect. Hard water is unsuitable for use of domestic and industrial purpose because of formation of scale in boilers and supply of pipes. For cleansing process, it also produces adverse action. Surface water is normally soft water comparison with groundwater. Hardness is measurement of amount of calcium, magnesium and other metal salt that present in water as bicarbonate. result of present study indicate. Normally two elements calcium and magnesium are responsible for hardness of river water. Result of study showed that hardness average in October to December month. Table 05 shows the variation in hardness at different sites in present status. Analysis of water samples was done of all selected sites of River Shipra, the observed range (280-332mg/L) of hardness is within the permissible limit (600 mg/L) as prescribed by BIS standards as shown in fig 10.

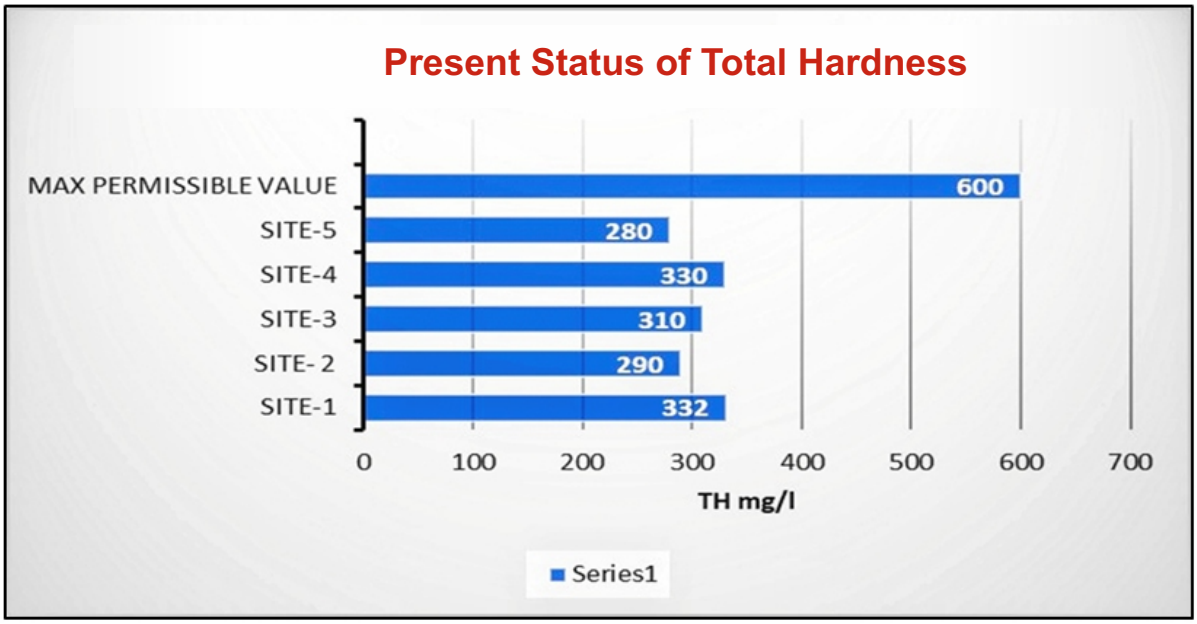


Fig.08

Turbidity

The range of turbidity from May to December (0.11-0.31NTU) indicates river water contain suspended particles and fine organic and inorganic compounds in permitted amount and the range vary from May to December, turbidity value maximum in monsoon region due to presence of suspended matter and run off sewage. Value of parameter is lowest in site 5 and highest value in site 4 comparison to acceptable range (1NTU).

Fluoride and Chloride

The value of chloride content of river water from table indicate concentration (79 mg/l) is under the permissible value (250 mg/L max) as per BIS standards. Normally higher value of chloride is due to contamination of industrial waste and domestic sewage in river water. The acceptable range of fluoride as per WHO is 1.5 mg/l and study showed that value of fluoride (1.7- 3.1mg/L) in all selected sites are higher than the permissible limit as shown in table 04. Fluoride present in water higher than normal limit, causes fluorosis problem.

Sulfate and Other Parameters

From analysis results of samples of all selected sites it was found that the range of sulphate is (30-45 mg/L) which is under the permissible range in all the months. It is harmful if present in in large scale because it causes diarrhea. In household activity using detergent and other cleansing agent are main cause of sulphate in wastewater. Metals such as Al, Ni and other metals are present in within prescribed range in river water as shown in table 04.

Heavy Toxic Metals

Arsenic, Mercury and Lead are toxic metal. If concentration of these metals are slightly higher than acceptable then it is harmful and causes cancer and other diseases through ingesting water. Data of present work showed that all these metals are present in river water below detection level means water is safe for consumption purpose taking this parameter.

Table 04: Physical Parameters of Shipra River water (2022)

S. No.	Test	Unit of Measurement	Limit	Results	Test Method Ref. AOAC/ISO
1	Color	Hazen units	5/15* Max	**15**	IS:3025 (Pt.-4):2021
2	Odor		Agreeable	**Disagreeable**	IS:3025 (Pt.-5):2018
3	pH		6.5-8.5	**6.90**	IS:3025 (Pt.-11):1983, RA 2017
4	Turbidity	NTU	1 Max.	**0.25**	IS:3025 (Pt.-10):1984,RA 2017
5	Total Dissolved solids	mg/L	500/2000* Max	**572**	IS:3025 (Pt.-16):1984, RA 2017
General Parameters Concerning Substance Undesirable in Excessive Amounts					
1	Aluminum (Al)	mg/L	0.03 Max.	**0.020**	APHA: 3113 B (23rd Edition)
2	Ammonia (as total ammonia-N)	mg/L	0.5 Max.	**0.30**	IS: 3025 (Pt.-34):1988, RA 2019
3	Anionic detergents (as MBAS)	mg/L	0.2 Max.	**BDL (DL-0.01)**	Annex K of IS: 13428:2005, RA 2018
4	Calcium as Ca	mg/L	75 Max.	**70**	IS:3025 (Pt.-40):1991, RA 2019
5	Chloride	mg/L	250 Max.	**79**	IS:3025 (Pt.-32):1988, RA 2019
6	Fluoride	mg/L	1.0/1.5* Max	**3.0**	IS:3025 (Pt.-60):2008, RA 2019
7	Sulphate	mg/L	200 Max.	**30**	IS:3025 (Pt.-46):1994, RA 2019
8	Nitrate (as NO3)	mg/L	45 Max.	**32**	IS: 3025 (Pt.- 34):1988, RA 2019
9	Total alkalinity as calcium carbonate	mg/L	200/600* Max.	**258**	IS:3025 (Pt.-23): 1986, RA 2019
10	Total hardness as CaCO3	mg/L	200/600*Max.	**332**	IS:3025 (Pt.-21):2009, RA 2019
Parameters Concerning Toxic Substances					
1	Mercury (as Hg)	mg/L	0.001 Max.	**BDL (DL-0.0002)**	IS:3025 (Pt.-48):1994, RA 2019
2	Lead (as Pb)	mg/L	0.01 Max	**BDL (DL- 0.001)**	APHA: 3113 B (23rd Edition)
3	Total Arsenic (as As)	mg/L	0.01 Max	**BDL (DL-0.001)**	IS: 3025 (Pt.-37): 1988, RA 2019

Note: * Permissible limit in absence of alternate source

Table 05: Mean, Variance and Standard Deviation in Parameter of River Shipra at selected sites

Parameters	pH	Hardness (mg/l)	BOD (mg/l)	Ammonia (mg/l)	Nitrate (mg/l)	Temperature ℃
Site- 1	6.8	332	6.3	0.3	9.8	29
Site- 2	7	290	2.7	0.27	3.8	30
Site- 3	8	310	3.5	0.32	11.75	30
Site- 4	8.1	330	10.5	0.4	11.2	31
Site- 5	7.2	280	2.8	0.12	2	30
Mean	7.42	308.4	5.16	0.28	7.71	30
Variance	0.352	542.8	11.048	0.01052	20.1905	0.5
Standard Deviation	0.593	23.298	3.323	0.102	4.493	0.707

BDL- Below Detection Limit DL-Detection Limit

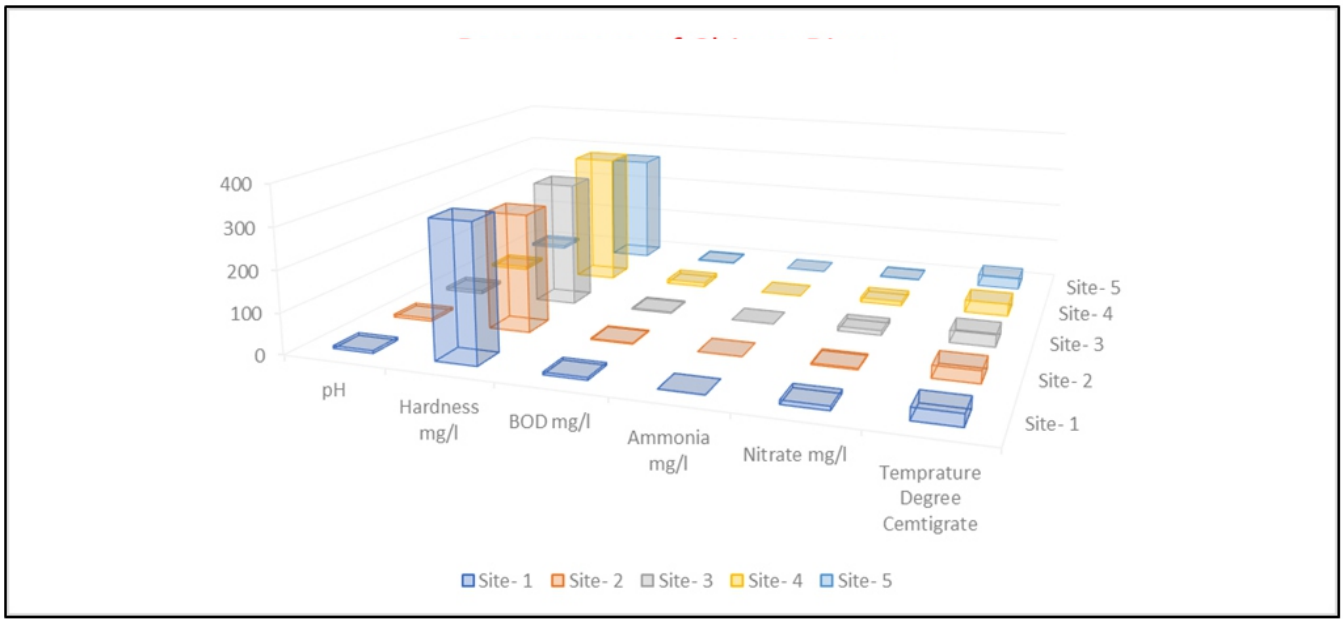


Fig.11: Variation in important parameters of Shipra River on selected sites

Conclusion

The study of the chemical and physical qualities of river water provides effective information related to health and visibility also. The changing in the concentration of various chemicals in river water by discharging directly into it affect the range of the parameter and finally create health issues for living organisms. Analysis of water quality is a very sensitive issue for assessment of the level of water pollution. The result of the study from before the pandemic to the present status showed that physical parameters are in the permissible range except in some sites. Before COVID pandemic value of all parameters of river water were higher than considerable level. In present status chemical parameters such as BOD, Conductivity value and Fluoride content in river water have been improved but are still high in value and more than permissible range. Other chemical parameters such as pH, ammonia content, and nitrate value are in the permissible range as per CPCB. Heavy toxic metals such as As, Pb and Bi are present below the detection limit, indicating the quality of river water is satisfactory. The study of all important physical and chemical parameters indicates that the quality of river water is satisfactory and classified as category B as per CPCB after various projects such as the Narmada Shipra link project and sewage treatment plant.

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