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WATER QUALITY OF YAMUNA RIVER AT PRAYAGRAJ, U.P., INDIA

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ABSTRACT

Rivers are an essential part of our biosphere which is essential for the overall development of the present civilization. The present study was carried out to analyze the water quality at selected sites of river Yamuna in Prayagraj (Allahabad) city during January 2019 to May 2019. Samples were collected and analyzed for assessing the water quality characteristics as pH, turbidity, alkalinity, Ca 2+ hardness, Mg 2+ hardness, Cl- and Sulpate. The obtained results were compared to the standards limits of BIS. Analysis results showed that pH, turbidity, alkalinity, sulphate, Chloride of water was found within the permissible limits while Calcium and magnesium hardness values are higher than the permissible limits of BIS standards. The possible causes of deteriorating of Yamuna water due to discharged of untreated water and other human activity.

Keywords: Pollution, Water Quality, River Yamuna

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1. INTRODUCTION

Water is an important liquid for sustaining human life. About 97% water is present in the ocean which is not suitable for drinking and only the remaining 3% fresh water has 2.97% glacier and ice cover and now the remaining 0.3% water is left for human use on the surface and Available as Groundwater **(Miller, 1997; Nath *et al.*, 2015, Nafees *et al.*, 2015).** On the whole, rivers play an extremely important role as a watershed to carry industrial and municipal wastewater and runoff from the surrounding lands **(Shrestha and Kazam, 2007; Singh and Nath, 2019; Sebastian et al, 2018)**. Water resources are most important for human consumption, agricultural needs, recreational and industrial purposes.

Water pollution is a serious problem in all major rivers of India **(Bhargava, 1987; Singh *et al*, 2008; Singh and Nath 2019; Sebastian *et al.*, 2018).** Industrial waste water, sewage, waste from homes, and indiscriminate use of

fertilizers and pesticides containing heavy metals in agriculture have led to a decline in water quality which is leading to environmental problems endangering human and biodiversity **(Lantzi and McKenzie,1979; Nagu, 1979).** studied the impact of industrial waste and domestic sewage on the Ganges and Yamuna in Allahabad and reported that all parameters exceed the permissible limits of water quality and are unfit for human consumption. (**Singh *et al* 2008; Singh and Rai 2003)**

Yamuna River is the second largest tributary of Ganga (Ganga) and the longest tributary of India. It originates from the Yamunotri glacier at an altitude of 6,387 meters from the southwestern slope of the lower Himalayan peaks in Uttarakhand. It merges with the Ganges at Prayagraj (Allahabad), called the Triveni Sangam where the Kumbh Mela is held every 12 years. It passes through several states like Haryana, Uttar Pradesh, Uttarakhand and later Delhi, and meets its tributaries along the way. Yamuna merges several industrial cities such as New Delhi, Haryana, and Uttar Pradesh before merging with Ganga in Prayagraj (Allahabad). Yamuna River is one of the most polluted rivers in the world, especially around New Delhi. The capital flows 58% of its waste into the river. Due to which pollutants in river water are increasing at an alarming rate.

2. MATERIAL AND METHODS

Study area:

Prayagraj (Allahabad) is a religious place. Magh Mela is organized here every year in the month of January-feburary in hindi month of Magh, where devotees comes from every part of India to take holy bath at Sangam and around the ghat of ganga and Yamuna river.

Sampling sites:

The present study was carried out to analyze the water quality of Yamuna River at selected five different sites namely: Saraswati ghat, Gau ghat, Baluwa ghat, New Bridge and Akbar fort in Prayagraj (Allahabad). The selected sampling sites is near to the bathing ghats of river Yamuna.The details of sites with location given in table 1.

Table :1 Sampling sites with GPS location

Name of Sampling Site	GPS location
Saraswati Ghat	25º25.099'N, 081.52.132'E
Gau Ghat	25º25.223'N,081º50.626'E
Baluwa Ghat	25º25.630'N, 81º50.714'E
New Bridge	25º25.218'N, 81º51.976'E
Akbar Fort	25º25.230'N, 081º51.054'E

Preparation of water samples:

Water samples were collected in a clean plastic bottle without air bubbles. Prior to collection of the water sample, the bottle was washed with the sample water and tightly sealed at the same time after collection and preserved for further analysis in laboratory. To avoid contamination of water samples, samples were taken at some depth in the middle of the river.

Analysis of water samples:

The water samples were collected at five different sites of river Yamuna during January to May, 2019 with the interval of ten days. The analysis was performed in Environmental Science laboratory on various water quality parameters like pH, Turbidity, Alkalinity, Ca^{2+} hardness, Mg^{2+} hardness, sulphate, Chloride as per standards methods for examination of water and waste water (APHA/AWWA). The details of Water quality parameters, unit & technique used for the analysis and Indian Standards for Water (BIS) is given in Table 2 and 3.

Table 2: Water quality parameters, unit & Technique used for the analysis:

PARAMETES	UNIT	METHODS
pH	-	Digital pH Meter (Jackson, 1958)
Turbidity	NTU	Nephelometric Method (APHA 1995)

Alkalinity	mg/l	Titration Method (Moser, 1976)
Calcium hardness	mg/l	3500-Ca B. EDTA Titrimetric Method
Magnesium hardness	mg/l	3500-Mg Magnesium Methods
Sulphate (mg/l)	mg/l	4500-SO_4^{2-} Sulphate
Chloride	mg/l	Argentometric Titration (Mc Farland, 1983)

Table 3: Indian Standards for Water (BIS) (IS: 10500: 1991)

S.NO.	PARAMETERS	DESIRABLE LIMIT	PERMISSIBLE LIMIT
1	pH	6.5-8.5	No relaxation
2	Turbidity (NTU)	10	25
3	Alkalinity (mg/l)	200	600
4	Calcium hardness (as Ca), mg/l,	70	200
5	Magnesium hardness (as Mg), mg/l	30	100
6	Sulphate (mg/l)	250	400
7	Chloride (mg/l)	250	1000

3. RESULTS AND DISCUSSION

Analysis of river Yamuna water quality data presented in figure 1 to 7 and results were explained on the data collected during the experimental investigation of the study area and are presented through subjective analysis and graphs.

pH:

pH is the measurement of hydrogen ion concentration, which indicates the acidity or alkalinity of a solution. Figure 1 shows the monthly variations in pH of river Yamuna at different months. The pH values were observed in the range of 7.14-8.96. The minimum (7.14) and maximum (8.96) pH was found in the month of January and may at Akbar Fort. The average pH value at each site of river Yamuna was found between 7.1 to 8.7 which are under the permissible and desirable limit prescribed by BIS standards. It is necessary to investigate pH because little change in pH affects the solubility and availability of aquatic organisms and the nutrients present in water for them.

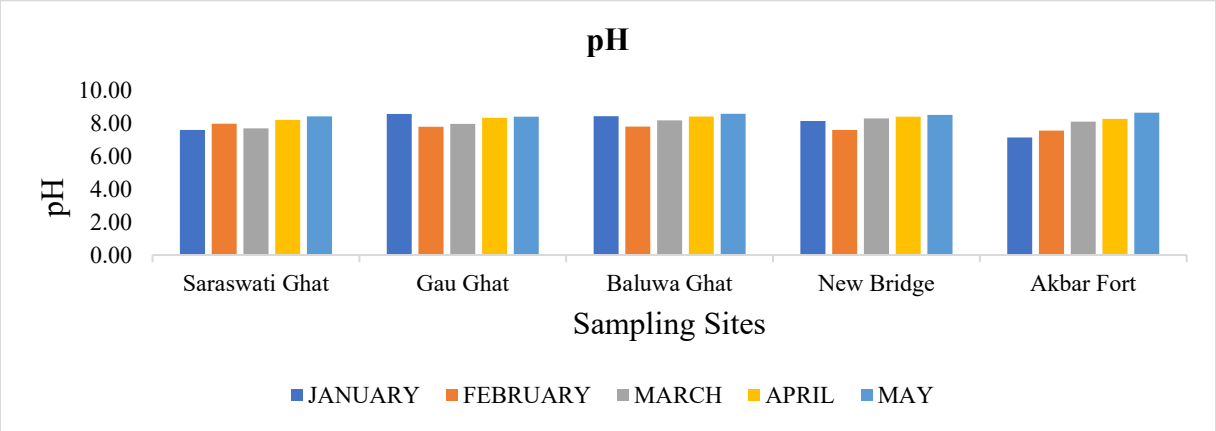

Figure 1: pH of Yamuna River water in different months

Turbidity

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulates. Due to the turbidity, water quality is reduced. Perusal of fig. 2, the observation reveals that the maximum

Turbidity value was found 8.2 NTU at New Bridge in the month of January 2019 and minimum was 4.9 NTU at Akbar Fort in the month of April 2019. The average value of turbidity of all the Sites of river Yamuna fall in the range of 4.9 NTU to 8.2 NTU.

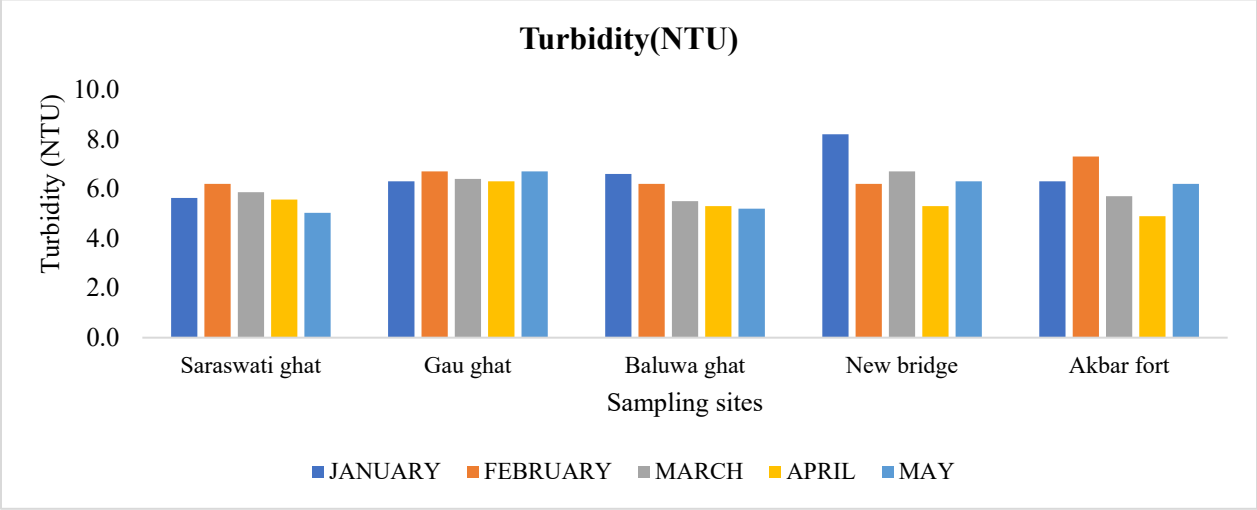

Figure 2: Turbidity of river Yamuna water in different months

Alkalinity

Alkalinity is a measure of the water's ability to neutralize acidity. An alkalinity test measures the level of bicarbonates, carbonates, and hydroxides in water. Perusal of fig. 3, the maximum alkalinity value was found 68 mgl^{-1} at New Bridge in the month of May2019 and minimum value was found 12 mgl^{-1} at Akbar Fort in the month of January 2019. The average alkalinity value of all the sites of River Yamuna fall in the range of 12 mgl^{-1} to 68 mgl^{-1}.

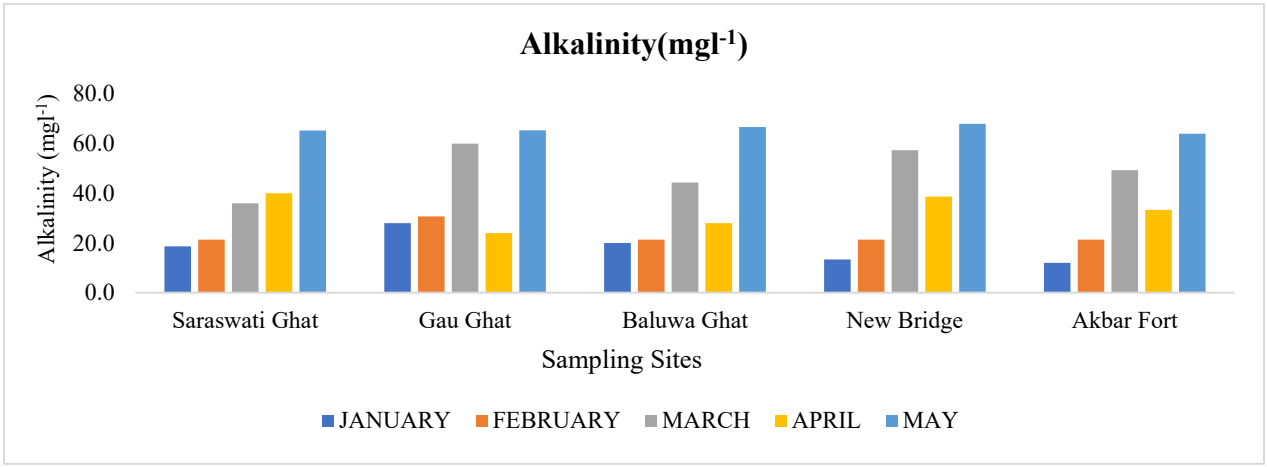

Figure 3: Alkalinity in river water Yamuna in different months

Calcium Hardness

Calcium is directly related to hardness and is the chief cation in the water. Perusal of fig. 4, the observation reveals that the monthly variation ranged from a minimum of 103.3 mgl^{-1}at Akbar fort in the month of February 2019 & maximum found to be 270 mgl^{-1} at Akbar Fort in the month of April 2019. Intermediate value of all sites of river Yamuna lie in the range of 103.3 mgl^{-1} to 265 mgl^{-1}. The value of calcium hardness exceed the permissible ranges in months of March, April and in all sites.

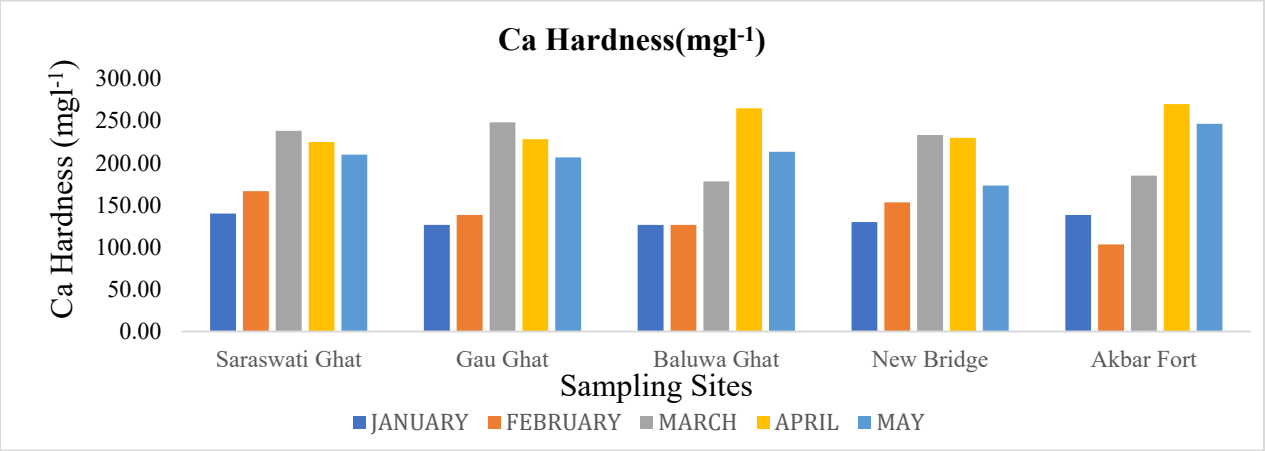

Figure 4: Calcium hardness in river water Yamuna in different months

Magnesium Hardness

Magnesium hardness plays a role in total water hardness, as water hardness is an important aspect in having balanced water and maintaining water quality. Perusal of fig. 5, the observation revealed that the monthly variation ranged from a minimum of 83.3 mgl^{-1} at Gau ghat in the month of January 2019 & maximum found 343.3 mgl^{-1} at Saraswati ghat in the month of January 2019. Intermediate value of all sites of river Yamuna lie in the range of 83.3 mgl^{-1} to 343.3 mgl^{-1}. The value of calcium hardness exceeds the permissible ranges in all the site during the monitoring periods.

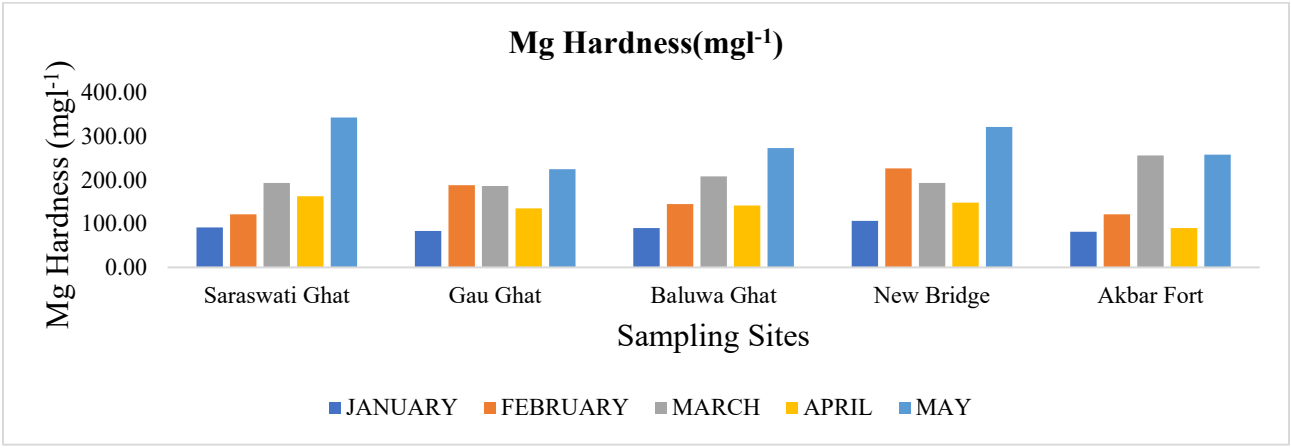

Figure 5: Magensium hardness in river water Yamuna in different months

Sulphate

Sulphate is a substance that occurs naturally in drinking water. It is one of the major dissolved components of rain. The sulphate content of natural waters is an important consideration in determining their suitability for public and industrial supplies. Perusal of fig. 6, the study reveals that the maximum Sulphate value was found 33.5 mgl^{-1} at New Bridge in the month of February 2019 and minimum value was found 24.1 mgl^{-1} at Akbar Fort in the month of April 2019. The average Sulphate value of all the sites of River Yamuna fall in the range of 24.1 mgl^{-1} to 33.5 mgl^{-1}. The Sulphate value gradually increases in the month of February of all the sites of river Yamuna.

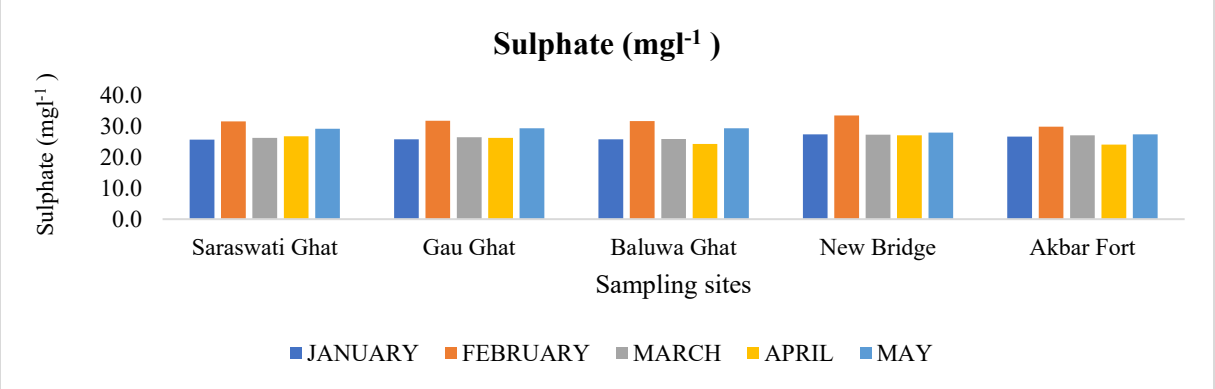

Figure 6: Sulphate in river water Yamuna in different months

Chloride:

Chloride is one of the major ions found in water and is usually combined with calcium, magnesium, or sodium. Chlorides are leached from various rocks into the soil and groundwater by weathering. Perusal of fig.8, the observation of chloride reveals that the maximum value of chloride was found 77.9 mgl^{-1}at Saraswati ghat in the month of May 2019 and minimum value was reported 18.4 mgl^{-1}at Baluwa ghat in the month of January 2019. The average chloride value at each sites of river Yamuna lies in the range of 18.4 $mgl^{-1}$to 77.9 mgl^{-1}. Results was supported by other authors (**Singh and Nath, 2019)**

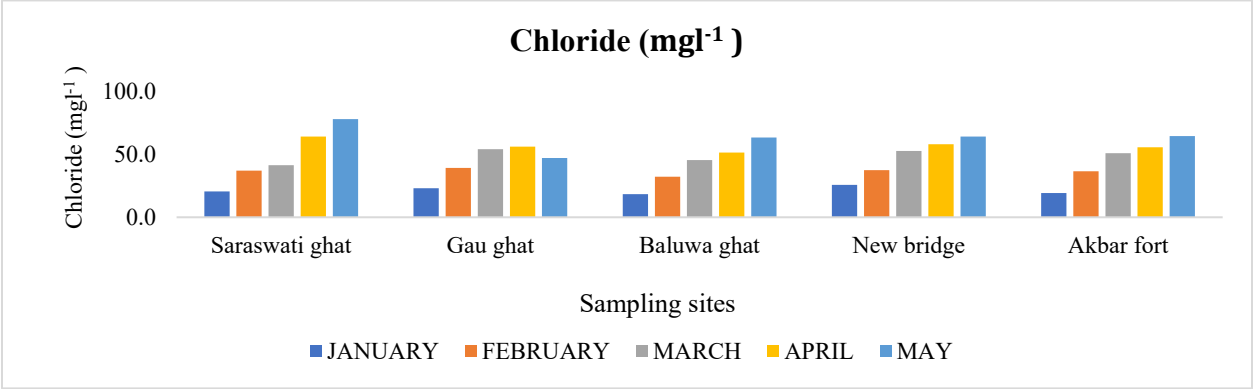

Figure 8: Chloride in river water Yamuna in different months

4. CONCLUSION

The result of the present study reveals that pH, Chlorides, Turbidity are found within the permissible limit prescribed by BIS standards at each site while Calcium and magnesium hardness values are higher than the permissible limits of BIS standards at all sites during monitoring periods. Direct consumption of Yamuna River water is not fit for the health. Purification and treatment is needed for before use of water.

CONFLICT OF INTERESTS

None.

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