

Comparitive Study of Physio Chemical Parameters of Ganga and Yamuna River at Allahabad

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Abstract

Water quality assessment is key to the conservation and management of rivers. Rivers have a very important role in the economy of a country and welfare of its society. Water quality of the river is one of the major factors in determining the health status of peoples and environment; as water is an essential ingredient for health and hygiene. In the present paper an attempt has been made to assess the physico-chemical parameters of selected sites of Allahabad viz: Phaphamau and Dashashumedh Ghat near river Ganga and Kydganj and Mahewa ghats on the banks of the Yamuna. In the present study samples from river Yamuna and Ganga were studied for the various parameters such as PH, TDS, Electrical conductivity(EC), Acidity, Alkalinity, Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), chlorine concentration and Turbidity of water. Most of the assessed parameters were found to be above than permissible limits of WHO showing high pollution level in rivers.

Keywords: River Ganga, Physico-chemical properties, Correlation, Water quality index (WQI).

Introduction

Ganges river, the largest river of India, is the major source of drinking water in cities, towns and villages in Allahabad area. Present study was done to evaluate water quality of the rivers Ganga and Yamuna in Allahabad. People living on the bank of these rivers, apart from drinking, use its water for industrial, agricultural and other purposes, such as, cattle bathing and cloth washing etc.[1] After the usage, water is generally discharged into the river from industrial, agricultural and sewage systems. Besides, run off from the rural settlements, open defecations, dumping of carcasses and disposal of

dead bodies also increase the degree of pollution view of this, evaluations of quality of river water with respect to location along the stretch and in different weather conditions. This study evaluates the changes in the water quality of the River Ganga and the Yamuna in Prayagraj district, Uttar Pradesh, India, by using multivariate statistical techniques. Sangam, the confluence point of sacred Indian rivers Ganga and Yamuna, is an important site for different religious and cultural events. Surface water was collected from these ghats in April 2023 and the samples were investigated for selected physicochemical parameters. Prayagraj city, formerly known as Allahabad, in the state Uttar Pradesh of Northern India, is known for the confluence point of two sacred rivers Ganga and Yamuna, consequently making it a venue for various large-scale religious and cultural programs. The observed values of different physico-chemical parameters like PH, TDS, Electrical conductivity(EC), Acidity, Alkalinity, Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), chlorine concentration and Turbidity of water of samples were compared with standard values recommended by world health organization (WHO). [2-5]

Study Area

Allahabad is one of the largest cities of North Indian state of Uttar Pradesh. It is spread across an area of 3, 424 km² and lies between North latitudes 24°47' and 25°47' and East longitudes 81°09' and 82°21'. Allahabad is considered a very sacred place as it is located where rivers Ganges, Saraswati and Yamuna unite. Rivers Ganga and Yamuna are selected as a case area to study for water quality parameters. These rivers have also served as a livelihood for the local population in the form of tourism and aquaculture being a major source of income.[6]





Figure 1: Location of Ganga and Yamuna rivers

Materials and Methods

Sampling and analysis Prayagraj city (25.4358°N 81.8463°E) is among the ancient most cities of India with immense religious importance for Hindus, because of the confluence of two sacred rivers Ganga and Yamuna. The city is often known as “Tiratharaj” in the language Hindi, which means “king of all pilgrimages”, and is a major site for various religious and cultural programs. The Water samples were brought in to Physics Laboratory for the Estimation of various Parameters like TDS, Ultrasonic velocity and refractive index. TDS was recorded at the time of Sample Collection by using Digital TDS meter. Ultrasonic velocity of samples was measured by Ultrasonic Interferometer. An ultrasonic interferometer is a simple and direct device to determine the ultrasonic velocity in liquids with a high degree of accuracy. The principle employed in the measurement of velocity (v) is based on the accurate determination of the wavelength (λ) in the medium. Ultrasonic waves of known frequency (f) are produced by a quartz crystal fixed at the bottom of the cell.[7-8] These waves are reflected by a movable metallic plate kept parallel to the quartz crystal. If the separation between these two plates is exactly a whole acoustic resonance gives rise to an electrical reaction on the generator driving the quartz crystal and the anode current of the generator becomes a maximum. If the distance is now increased or decreased and the variation is exactly $\lambda/2$ or multiple of it, anode current becomes maximum. Using the value of λ , the velocity (v) can be obtained by $v = \lambda \times f$. [7] Refractive index of water samples was measured by Abbe Refractometer in the wavelength range of 6300 Å to an accuracy of 10^{-4} . The Abbe refractometer is a standard tool for measuring refractive index n of a specimen in the visible range. The instrument is precise and easy to use but it cannot be applied to radiation invisible to human eye such as IR or UV light. The measuring principle of Abbe refractometer is Total Internal Reflection.[9-10] The water samples were brought to the laboratory in ice boxes and subjected to the analysis of

BOD (by incubating diluted samples at 25° C for 5 days in dark), COD (by dichromate reflux method using a ferroin indicator), Alkalinity (estimated by titration with standard sulphuric acid using phenolphthalein and methyl orange as indicator), Hardness (done by titration with EDTA solution using Erichrome black-T dye as indicator), TDS (analysed by Evaporation method), Turbidity (studied by Nephelometer) [11-13]



Figure 2: Confluence of Ganga and Yamuna river at Allahabad

RESULTS AND DISCUSSION

Table 1: Statistics of various parameters for river water of Ganga and Yamuna

River	Ghats	Parameters						
		PH	TDS	EC	DO(mg/l)	Alkalinity	BOD (mg/l)	COD (mg/l)
Ganga	Dashashumedh	8.2	189	5.6	8.46	113.4	7.78	85
	Phaphamau	7.9	269	6.3	11.4	147.6	7.7	22.9
Yamuna	Kydganj	7.65	554	12.5	5.65	124	7.02	62
	Mahewa	8.34	654	13	6.01	145	7.56	31.2

Table 2: Statistics of various parameters for river water of Ganga and Yamuna

River	Ghats	Parameters					
		Acidity (mg/l)	Chlorine	Turbidity (NTU)	WQI	Ultrasonic velocity	Refractive index
Ganga	Dashashumedh	135	113.9	9.5	196	0.7	1.36
	Phaphamau	155	116.3	13.2	214	0.82	1.4
Yamuna	Kydganj	156	156	12	237	0.56	1.36
	Mahewa	165	147.5	15	256	0.62	1.38

Table 1 and 2 show statistics of Ghats of two rivers Ganga and Yamuna at Allahabad. The physico-chemical characteristics of river Ganga at two sites viz: Phaphamau and Dashashumedh Ghat and Kydganj and Mahewa ghats of Yamuna are shown in table (1) and (2). Sculthorpe (1967) has reported that pH, free CO₂ and NH₃ are more critical factors in the survival of aquatic plants and fishes than the oxygen supply. The higher concentrations of DO was recorded Phaphamau ghat of 11.4 mg/l of Ganga river followed by Dashashumedh ghat with value of 8.46 mg/l which may be due to low turbidity & increased photosynthetic activity of the green algae found on the submerged stones and pebbles. The BOD ranged from 6.01 mg/l to 5.65 mg/l at Yamuna ghat.

COD is a measure of the oxygen required for the chemical oxidation of organic matter with the help of strong chemical oxidant. Yamuna ghat at Mahewa had highest COD ranged of 31.2 mg/l to 62 Kydganj mg/l. High COD may cause oxygen depletion on account of decomposition of microbes to a level detrimental to aquatic life.

pH of solution is taken as –ive logarithm of H⁺ ions for many practical practices. Value range of pH from 7 to 14 is alkaline, from 0 to 7 is acidic and 7 is neutral. The result shown that the pH values are alkaline in all three sites and are very close to permissible limits.

TDS ranges from 654 at Mahewa ghat to 169 Dashashumedh ghat. TDS (Total dissolved salts) is above 100 for all samples showing water is unfit for consumption. Total Alkalinity (TA) ranged from 147.6 mg/l at Phaphamau to 113.4 mg/l at Dashashumedh.

Turbidity is caused by wide variety of Suspended particles. Turbidity can be measured either by its effect on the transmission of light which is termed as Turbiditymetry or by its effect on the scattering of light which is termed as Nephelometry. As per IS the acceptable and permissible limits are 1 and 5 NTU respectively. In these ghats Turbidity ranges from 9.5 to 15.

Standard refractive index of pure water is 1.33, here all samples are showing values higher than the standard value indicating polluted water. Higher is refractive index higher is the pollution level.

Ultrasonic velocity for distilled water is 1.4×10^6 m/s. All sampling stations are showing values less than this value which shows suspended matter in water. Ultrasonic velocity in water is highest showing highest contamination level.

The chlorine varied from 147.5 mg/l at Mahewa to 113.9 mg/l at Dashashumedh ghat.

Water Quality Index (WQI) may be defined as the rating that reflects the composite influence of a number of water quality factors on the overall quality of water[14-15]. Numerical value can be obtained by reducing the large amount of water quality data. It is one of the most effective ways to communicate information on water quality trends to policy makers, to shape sound public policy and implement the water quality improvement programmes efficiently. Water quality index (WQI) is the most effective way to communicate water quality. Water quality index (WQI) = 0 means complete absence of pollutants. When $0 < 100$, indicates the water is under consideration & fit for human use and $WQI > 100$ reflects its unsuitability for human use At Phaphamau, the value of WQI observed as 256 and at Dashashumedh ghat as 196. It is analysed that DO showed negative correlation with all parameters. pH exhibited positive correlation with all parameters except DO, whereas DO showed negative correlation with all parameters. From the above analysis, it can be concluded that the water quality of river Ganga at Allahabad during study period, revealed that the water is not suitable for drinking purposes.[16-18]

Figure 3 and 4 shows variations in water quality parameters of two rivers.

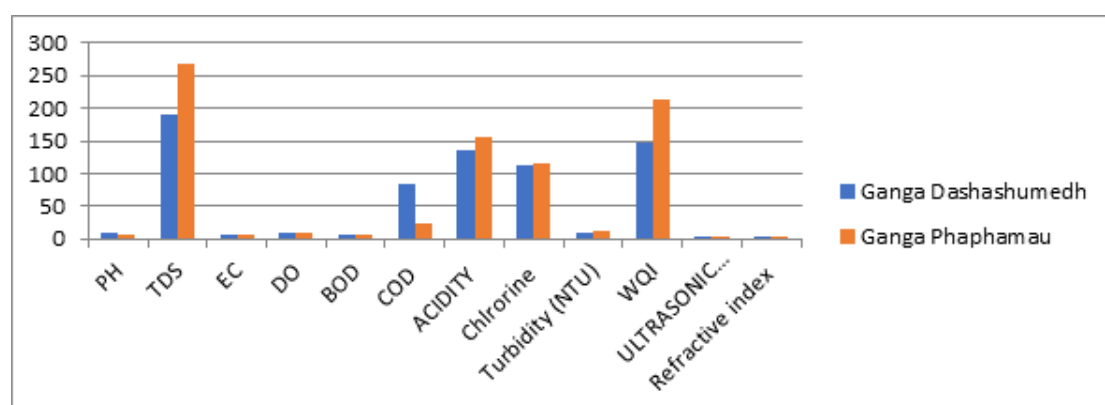


Figure 3: Changes in concentration of taken physico-chemical parameters of River Ganga at sites of Allahabad

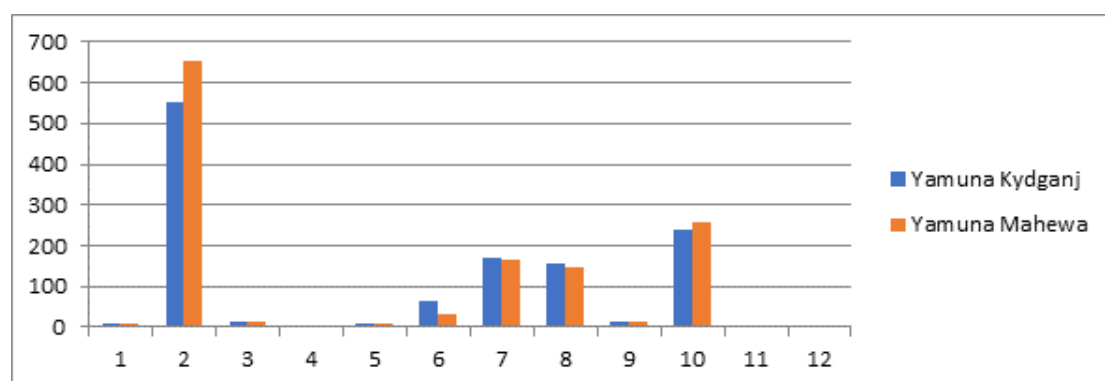


Figure 4: Changes in concentration of taken physico-chemical parameters of River Yamuna at sites of Allahabad

Conclusion

From the above analysis, it can be concluded that the water quality of river Ganga and Yamuna at Allahabad during study period, revealed that the water is not suitable for drinking purposes. Water quality index (WQI) showed Category (iv). Its evaluation will not only be helpful to understand the seasonal quality of water but also has advantages for government agencies and institutions where regular water quality data is required.

Conflicts of Interest:

The author declares that there are no conflicts of interest regarding the publication of this article.

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