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**ORIGINAL ARTICLE** **OPEN ACCESS**

# Hydrobiological Study of River Yamuna Water at Yamuna Nagar, Haryana, India during 2019-2020

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**ABSTRACT**
*The present research designed to work out monthly oscillations in the hydrobiological parameters of river Yamuna water at Yamuna Nagar, Haryana, India. The onsite Yamuna river water quality assessment and samples collection was done from three selected sites (Near Yamuna bridge, Dadwa-Fatehpur and Dadupur) in district Yamuna Nagar (HR), during July, 2019 to June, 2020. The assessments of water quality performed using digital thermometer, pH meter; however, dissolved oxygen, hardness, alkalinity and acidity by volumetric or titrimetric methods after APHA. The mean findings reflected that the water temperature (°C), dissolved oxygen (mg/L), pH, hardness (mg/L), alkalinity (mg/L) and acidity (mg/L) fluctuated between 11.6–30.2°C, 3.1–6.0mg/L, 6.4–7.5, 84.6–162.8mg/L, 67.9–121.9mg/L and 11.7–26.9mg/L respectively. The industrial effluents, agricultural pesticides, manmade activities and seasonality biased correlation in spatial fluctuations of hydrobiological parameters of river Yamuna water was noticed and substantiated using advanced numerical tools at significant level. The river Yamuna is an important perennial river of the Indo-Gangetic plains and largest tributary of river Ganges. Yamuna Nagar is a district of Haryana state located south-east of the state capital Chandigarh. The recent spurs in Industrial units in and around the city have resulted in severe pollution issues and public health concerns. The documented examination insisted for urgent necessary steps towards systematic and strategic management of river Yamuna to overcome these imperceptible scarce and restore the natural quality of incredible water resources.*
***Keywords:*** *Haydrobiology, River Yamuna, Physico-chemical attributes, Dissolved oxygen, Water pollution.*

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## INTRODUCTION

Water is one of the prime necessities of life and anyone can hardly live for a few days without water [13]. The physico-chemical parameter of any water body plays a very important role in management of the fragile ecosystem that maintains various life forms [40, 21]. Increasing population, anthropogenic activities and its necessities have led to the deterioration of surface and sub surface water leads to vulnerability of aquatic habitats [27, 20]. The quality of inland, surface and subsurface water is of serious concern as it is sincerely linked with societal welfare and sustainable development [39, 12]. The largest source of water pollution in India is untreated sewage, agricultural runoff and effluents of unregulated small scale industries, etc. [16, 36]. The most important freshwater resource is rivers on which most of the developmental activities dependent including agriculture, industry, aquaculture, public water supply, etc. [25, 26, 37].

The Yamuna river is one of the largest tributaries of the Ganges and originates from Champasar (Yamunotri) Glacier at height 6,387 metres, on the south western slopes of Banderpooch peak, in the lower Himalayas in Uttarakhand [30, 18]. The river Yamuna travels a total length of 1,376 kilometers (km) and has a drainage system of 366,223 $km^2$, 40.2% of the entire Ganga basin [41, 24]. During this long travel, river Yamuna runs through Uttarakhand, Himachal Pradesh, Haryana, Delhi and Uttar Pradesh, before merging with the Ganga at Triveni Sangam or Prayag of district Prayagaraj, U.P. [35, 36]. After passing Paonta Sahib (Himachal Pradesh), river Yamuna reaches Tajewala, Yamuna Nagar (Haryana), from where two important canals, the Western Yamuna Canal (WYC) and Eastern Yamuna Canal (EYC), originated to irrigate the states of Haryana and Uttar Pradesh both [40, 41, 23]. The quality of water is of vital concern for mankind since it is directly linked with human health, protection of the environment, plant growth and sustainable development [3, 11]. Any alteration in the physico-chemical characteristics of water adversely influences and disturbs the water quality which had a great impact on

aquatic life along the humanity [22]. The deterioration of the river water quality on large scale is due to huge loads of industrial effluents, domestic sewage and agricultural practices [16, 17, 31]. Yamuna Nagar is the second biggest industrial town of Haryana with many industries like paper-mill, sugar mill, distillery, cement, metal industries, ply board etc. [26, 39]. The industrial effluents contain appreciable amounts of inorganic and organic chemicals and their by products which may directly or indirectly discharged into the river Yamuna and resulted in the oscillations of hydrobiological parameters and population biology of aquatic fauna [25, 4]. Thus riverine water in turns affects distribution, richness, biology, ecology, health, and survival of aquatic flora and fauna of the river along with human beings [34-37].The physico-chemical analyses of river water provide a good indicator of the physical as well as chemical state of the river ecosystem [8, 15, 33]. Therefore qualitative and quantitative analyses of different types of water quality parameters can be used to assess the pollution status. The present investigation is designed to assess the physico-chemical properties of water in river Yamuna at different selected sites of district Yamuna Nagar (Haryana), India.

## MATERIAL AND METHODS

**Site of investigation:** Yamuna Nagar district of Haryana located in north-eastern part of Haryana State and lies between 29°55' to 30°31'N latitudes and 77°00' to 77°35'E longitudes. The district is bounded, in north by Himachal Pradesh, in the east by Uttar Pradesh, in west by district Ambala, in south by Karnal and Kurukshetra districts. The onsite Yamuna river water quality assessment and samples collection was done from three selected sites (Near Yamuna bridge, Dadwa-Fatehpur and Dadupur) in district Yamuna Nagar, Haryana (Fig. 1).

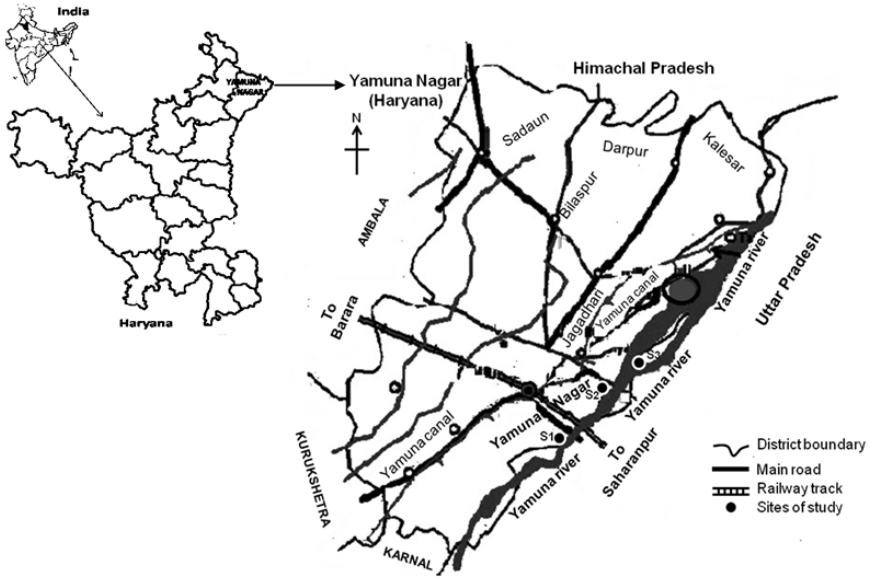


**Fig. 1.** The district map of Yamuna Nagar showing sites ($S_1$, Near Yamuna bridge; $S_2$, Dadwa-Fatehpur; $S_3$, Dadupur) of sample water collection from river Yamuna (*Map not to scale bar*).

**Plan of experiment:** The present study was carried out during July, 2019 to June, 2020 to assess the monthly oscillations in hydrobiological parameters of river Yamuna. The water samples were periodically collected at regular interval in sampling bottles and the date, time, and place recorded carefully to avoid any confusion among samples from different sites. The onsite pH and water temperature was enumerated by using digital pH meter and thermometer respectively. The samples were collected separately in DO sampling bottles for the estimation of dissolved oxygen (DO). For the assessment of river Yamuna hydrobiology, various attributes dissolved oxygen, hardness, alkalinity, and acidity was estimated in the Laboratory of Biotechnology Department, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala through titrimetric/ volumetric analysis after APHA [2].

**Statistical analysis:** The monthly data was tabulated for calculation of mean, standard deviation, standard error of mean after Snedecor and Cochran [29]. The month wise oscillations in physico-chemical parameters of river Yamuna water and its correlation were assessed using advanced numerical tools and SYSTAT-11.

## RESULTS AND DISCUSSION

The physicochemical attributes like dissolved oxygen, hardness, alkalinity and acidity of river Yamuna estimated in the laboratory using standard protocol, however onsite water temperature and pH analyzed during investigation provided in the Table 1. The highest water temperature (30.21±4.08$^{o}$C) using digital thermometer was recorded during early monsoon period (Fig. 2). However, the peak dissolved oxygen concentration in the riverine water (6.08±0.92mg/L) was documented in mid monsoon period and abrupt decline (3.14±1.69mg/L) was calculated during month of January (Fig. 2). The pH of river Yamuna water analyzed using digital pH meter and mean ph value ranged between 6.38–7.45 (6.90±0.52) with the peak pH was calculated during late summer (May, 2020) (Table 1, Fig. 2). Thus during observation it was evident that the quality of an aquatic ecosystem showed seasonality biased oscillations that might be dependent on the ecobiological diversity, quantity of water responsible the dilution of discharged agriculture and industry based effluents amalgamated and mass bathing on various religious occasions in river Yamuna from different upstream sites [5, 38]. It was noticed that the reduced dissolved oxygen concentrations inversely corroborated to the organic matter suspended in the water reservoirs, spatial and temporal niche expansion as well [1]. According to Central Pollution Control Board the recommended level of dissolved oxygen in river should be greater than 5.0mg/L [9]. However, Chopra *et al.* [10] were found the mean concentration of dissolved oxygen below 5.0mg/L in river Yamuna. Thus the dissolved oxygen decreases and biological oxygen demand (BOD) increases by the addition of pollutants in river water due to organic matter decomposition and *vice versa* by the self-purification process of river because of continuous streaming of riverine water [14, 36, 37]. The negative correlation with free $CO_2$ and water temperature to the dissolved oxygen was also evident during present investigation corroborated to the earlier findings [14, 15, 32-35]. The interactive interaction of pH, water temperature and dissolved oxygen was unbiased monthly but seasonality influenced the same noticed well investigation corroborated to Bhatnagar and Sanghwan [5] who found that pH decline if there is discharge of waste is into river and pH remains alkaline throughout their study period.

**Table 1:** Physico-chemical examination of river Yamuna water during July, 2019 to June, 2020 (Mean±SD).

| Months, Year | Wat. Temp. ($^{o}$C) | pH | DO (mg/L) | Hardness (mg/L) | Alkalinity (mg/L) | Acidity (mg/L) |
|---|---|---|---|---|---|---|
| July, 2019 | 30.21±4.08 | 6.38±0.12 | 5.35±0.32 | 130.63±16.57 | 93.13±17.51 | 11.71±1.80 |
| August, 2019 | 26.91±3.81 | 6.70±0.63 | 6.08±0.92 | 119.13±9.43 | 89.38±10.16 | 13.28±1.38 |
| September, 2019 | 25.81±4.21 | 6.49±0.11 | 5.91±0.69 | 137.25±7.50 | 79.75±13.11 | 16.43±3.05 |
| October, 2019 | 26.23±2.54 | 6.74±0.12 | 5.78±0.62 | 125.75±11.04 | 105.63±15.45 | 19.86±2.67 |
| November, 2019 | 22.36±3.52 | 6.85±0.18 | 5.38±0.59 | 142.50±30.24 | 100.65±7.80 | 19.00±3.65 |
| December, 2019 | 17.78±3.77 | 6.80±0.08 | 4.80±1.18 | 138.25±20.75 | 121.88±26.45 | 23.14±2.04 |
| January, 2020 | 11.61±2.87 | 6.87±0.23 | 3.14±1.69 | 127.00±12.33 | 115.65±15.90 | 20.43±2.64 |
| February, 2020 | 15.01±2.97 | 6.77±0.46 | 3.65±0.97 | 84.63±11.07 | 99.13±6.79 | 13.43±2.76 |
| March, 2020 | 17.19±2.42 | 7.24±0.16 | 4.65±0.51 | 89.63±7.60 | 94.38±11.16 | 16.14±2.91 |
| April, 2020 | 23.70±2.41 | 7.23±0.21 | 6.03±1.06 | 137.88±12.21 | 77.63±13.82 | 23.14±2.41 |
| May, 2020 | 22.06±1.77 | 7.45±0.17 | 4.78±0.20 | 162.75±8.12 | 67.88±14.11 | 56.99±3.60 |
| June, 2020 | 23.11±2.65 | 7.32±0.23 | 5.03±0.48 | 162.88±7.49 | 81.50±9.73 | 23.86±4.88 |

*Where: SD, Standard Deviation; Wat. Temp., Water Temperature, DO, Dissolved Oxygen; mg/L, Milligram per Liter*

The hardness was estimated between 84.63–162.88mg/L (130.03±10.83mg/L) with single peak during late summer (Table 1). The highest alkalinity 121.88±26.45mg/L was observed during the month of winter season and the abrupt decline started since early summer and (Fig. 3). On contrary the acidity hit the highest point (56.99±3.60mg/L) during summer period (May, 2020). The correlation among hardness, alkalinity and acidity worked out and showed remarkable contrast association to each other and well depicted (Fig. 3). According to Bhatnagar *et al.* [6], hardness and alkalinity decrease during June (heavy monsoon) while increase during July [7, 32]. Variation in total hardness was observed by different workers which showed that total hardness amount was high in rainy season than summer season [8, 10, 19]. It was evident that Ca and Mg amount is high during rainy season possibly positively influencing the total hardness well [5, 6, 28].

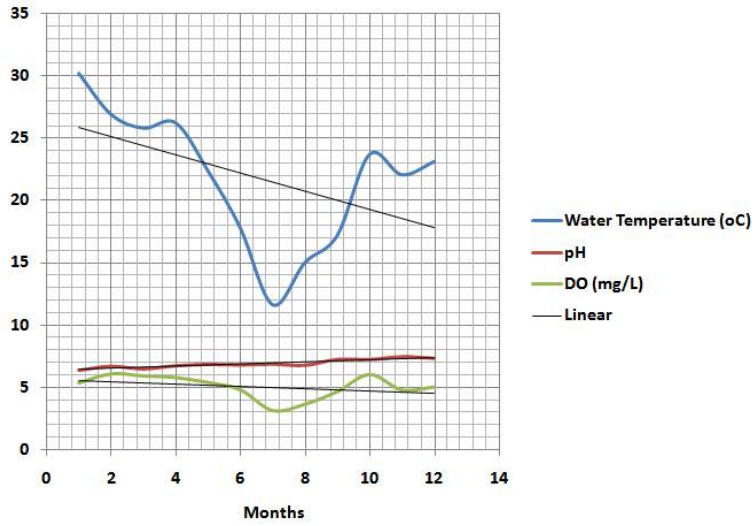


**Fig. 2.** Monthly variation patterns in water temperature (°C), pH and Dissolved Oxygen (mg/L) of river Yamuna.

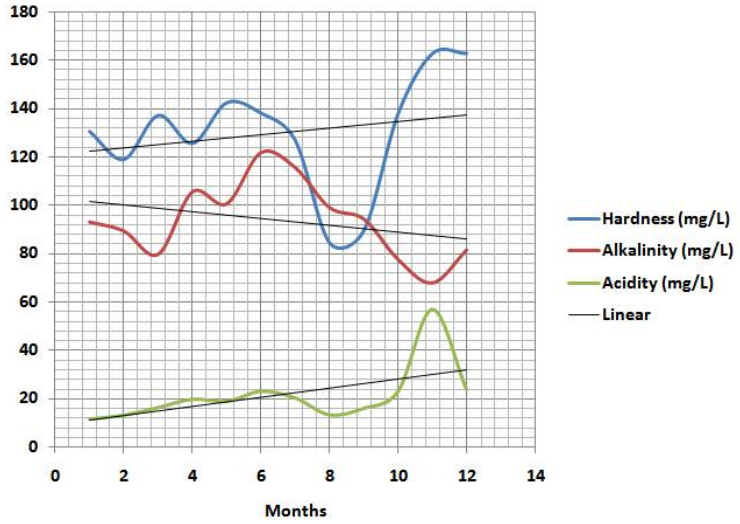


**Fig. 3.** Monthly variation patterns in Hardness (mg/L), Alkalinity (mg/L) and Acidity (mg/L) of river Yamuna.

## CONCLUSION

The twelve months consecutive study of river Yamuna water for six hydrobiological attributes from three different sampling locations at Yamuna Nagar (Haryana) showed seasonality biased association might be influence by the discharge of agricultural and untreated industrial effluents as well. The findings revealed that there was fluctuation in the physicochemical parameters to the desire prescribed limit of BIS (Bureau of Indian Standards). The limits of variability in the water quality corroborated to the upstream and local manmade activities along the spatial and temporal expansion of the water quantity, flow of water streaming as well some instant natural calamities as well. Therefore, the knowledge of relationships between aquatic fauna-water pollution and parasitic infra-community-human health is essential to carry out customary monitoring and surveillance of such important aquatic ecosystems *viz.* river Yamuna among the society nearby Yamuna Nagar (Haryana). Hence it is duty of all of us to try over utmost to make proper use of water as drop of water speaks "*Be the part of the solution, not the pollution*" as it is soul and hope of future.

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## CONFLICT OF INTEREST

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