Impact of Kanwar Mela on Water Quality Parameters of Ganga River at Haridwar, India: A Case Study

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Abstract: **The current study was done to investigate the water quality of the Ganga River during the Kanwar Mela 2024, with a focus on physicochemical properties at Haridwar. Water samples were collected from four sites: Sapta Rishi Ghat (SRG), Har ki Pauri (HKP), Daksh Mandir (DM), and Pul Jatwara (PJ). The study examined a variety of physicochemical characteristics, including temperature, pH, turbidity, transparency, TS, TDS, dissolved oxygen, BOD, and chlorides. The current analysis revealed that mass bathing and religious activities had a substantial impact on the water quality of the Ganga River and contributed to its contamination during the Kanwar Mela 2024.**

Key words: **Ganga River, Haridwar, Kanwar Mela, Water Quality**

Haridwar is a holy city and municipal board in the Haridwar District of Uttarakhand, India. In Hindi, Haridwar ('Hari' meaning god and 'dwar' meaning gate) means Dwar of Hari or Gateway to God. Haridwar is considered one of the seven holy destinations for Hindus (Charles, 1903). Haridwar is one of the first towns where the Ganga emerges from the Gangotri glacier in the Himalayan Mountains and reaches the plains. Throughout the year, Haridwar conducts various religious festivals, the most popular of which are the Maha Kumbh, Ardha Kumbh, Kavar Mela, Somvati Amavasya Mela, Ganga Dashara, and others, which attract millions of people.

The site where the nectar landed is known as the Brahma Kund at Har ki Pauri, Haridwar's most famous ghat; lakhs of devotees and pilgrims from all over India and worldwide come here during festivals to take a holy dip. Har ki Pauri, Chandi Devi Temple, Mansa Devi Temple, Maya Devi Temple, Daksha Mahadev Temple, Sapt Rishi Ashram, Prem Nagar Ashram, Ram Mandir, Sureshvari Devi Temple, Paavan Dham, Bharat Mata Mandir, Anandamayi Ma Ashram, and Piran Kaliyar are significant religious sites in Haridwar (Rupinder and Reeta, 2004). Every year in July and August, Haridwar hosts the Kanwar Mela celebration, which is dedicated to the adoration of the Almighty God Shiva.

Pilgrims travel to Haridwar, take holy baths in the Ganga River, and perform religious rites before returning to their destination with Ganga water to donate to the Shivlingam in God Shiva's temple (Reeta, 2004).

Rivers are extremely important and hold a special place in Indian civilization. These are seen as living entities with a role as mothers in the lives of people in India. The Ganga is regarded the most sacred river in the country. People bathe in the sacred river and perform various ceremonies (Srivastava, 2016). A variety of tourist picnic places, pilgrim centers, and religious points have been established to facilitate both religious and recreational activities (Thakur, 2017).

During this process, the water quality of these rivers deteriorates significantly. As a result of intensive religious and recreational activities, the majority of India's rivers are polluted. The quality of Ganga River water deteriorates during several festivals such as holy bath, Kanwar Mela, Kumbh Mela, and Ardhakumbha Mela, among others, as a result of the washing of a large number of visitors. During these celebrations, the physicochemical properties of Ganga River water exceeded allowed or desirable limits (BIS, 2012) for nearly all metrics.

Several studies have identified changes in the physicochemical and microbiological features of a

number of sacred rivers, lakes, streams, ponds, and other water bodies, recommending regular monitoring of these water courses (Oladeji, 2017). Therefore, continuous monitoring of the water quality of aquatic resources, particularly the Ganga river, is necessary to sustain their ecological, aesthetic, and recreational significance. Keeping this in mind, the current case study was conducted to examine the water quality of the Ganga River using physicochemical parameters during the Kanwar Mela 2024 in Haridwar, India.

MATERIALS AND METHODS

Description of sampling sites

Haridwar is located in the Shivalik foothills, which are part of the Himalayan mountain group. Haridwar is well connected by road to National Highway 58, which connects Delhi and Manapass. The nearest railway stations are in Haridwar, which has direct links to all of India's main cities. The nearest airport is Jolly Grant Airport in Dehradun, which is connected to Indira Gandhi International Airport in New Delhi. During Kanwar Mela 2024, Ganges water samples were collected from four sampling sites: Sapra Rishi Ghat, Har ki Pauri (HKP), Dash Mandir (DM), and Pul Jatwara (PJ). The average distance between these places is roughly 2.5 kilometers. All of these landmarks hold significant religious and recreational value in the city.

Collection of samples and their analysis

Every year, the Kanwar Mela takes place in July and August (Shrawan Mass according to the Hindu calendar). Devotees of God Shiva travel to Haridwar to take holy baths in the Ganga and perform religious rituals. They took a holy dip in the Ganga River to honor the God. Ganga River water samples were obtained from all four sampling sites before to the Kanwar Mela, during the peak days of the Kanwar Mela, and during the Kanwar Mela's ten days. The samples were tested for temperature, pH, turbidity, transparency, TS, TDS, dissolved oxygen, BOD, and chlorides using conventional procedures (APHA, 2012).

RESULT AND DISCUSSION

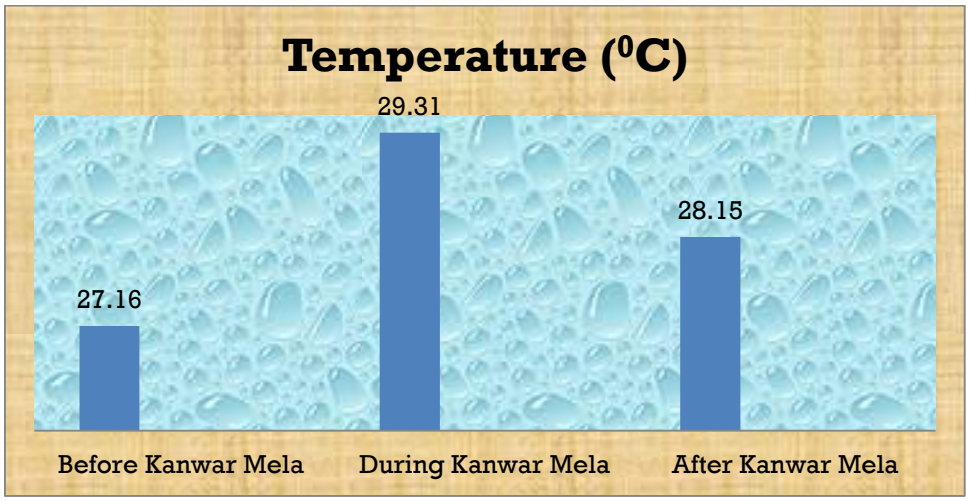
Physico-chemical characteristics of Ganga River water

The physico-chemical characteristics of Ganga River water at different sampling sites viz., Sapta Rishi Ghat, Har ki Pauri (HKP), Daksh Mandir (DM), Pul Jatwara (PJ) during Kanwar Mela-2024 at Haridwar are presented in Table 1. During the present study, the highest value of temperature was 29.31^0C during the Kanwar Month and lowest temperature was recorded before the Kanwar Mela. The pH is a measure of the amount of free hydrogen ions in water. Specifically, pH is the negative logarithm of the molar concentration of hydrogen ions. A pH of 7 is considered to be neutral. Acidity increases as pH values decrease, and alkalinity increases as pH values increase. Most natural waters are buffered by a carbon-dioxide-bicarbonate system, since the carbon dioxide in the atmosphere serves as a source of carbonic acid. The pH of water affects the solubility of many toxic and nutritive chemicals; therefore, the availability of these substances to aquatic organisms is affected. As acidity increases, most metals become more water soluble and more toxic. The highest value of value of pH was recorded as 7.8 during the Kanwar Mela. The lowest pH of Ganga River water was recorded as 7.6 before the Kanwar Mela. The turbidity is cloudiness and haziness of water. The highest value of turbidity was recorded as 809 during the Kanwar mela and lowest was recorded as 208 before Kanwar mela. Transparency is also indicates the clarity of water. The highest value of total solids recorded 3120 mg/l during the Kanwar fair and lowest value of total solids was recorded as 2012 mg/l before the Kanwar mela. This certainly due to the dumping of solid waste in Ganga river. Total dissolved solids were highest during the Kanwar Mela and lowest before the Kanwar Mela. All natural waters contain some dissolved solids due to the dissolution and weathering of rock and soil. Suspended solids are determined by filtering a known volume of water and weighing. Dissolved oxygen (DO) is the most important pollution assessment parameter of the receiving water bodies. Stabilization of organic matter, when discharged untreated or partially treated in receiving waters, leads to depletion of their DO. Nutrients (nitrogen and phosphorus) addition due to discharge of untreated or treated sewage may lead to algal growth in streams as a result depletion of DO in waters. Thus, it is observed that all the polluting constituents of sewage have their direct or indirect effect on DO of receiving waters. During our study the lowest value of dissolved oxygen was observed as 8.0mg/l during the Kanwar Mela and highest as 8.7 mg/l before the Kanwar mela. Biochemical oxygen Demand is

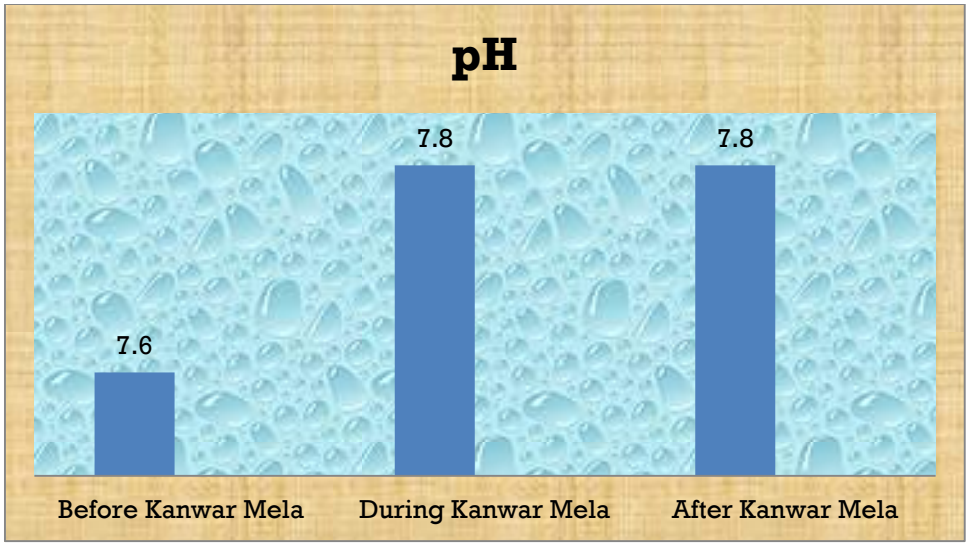
requirement of oxygen required by microorganism to decompose the organic matter. During our observation the lowest value of BOD was recorded as 3.0 mg/l during the prefestive days of kanwar Mela and highest as 4.5 mg/l during the Kanwar fair. It was observed that religio-touristic activities certainly degrades the water quality of Ganga river in Haridwar City.

Table: 1: Physico-chemical parameters of Ganga river water at Haridwar (Mean values)

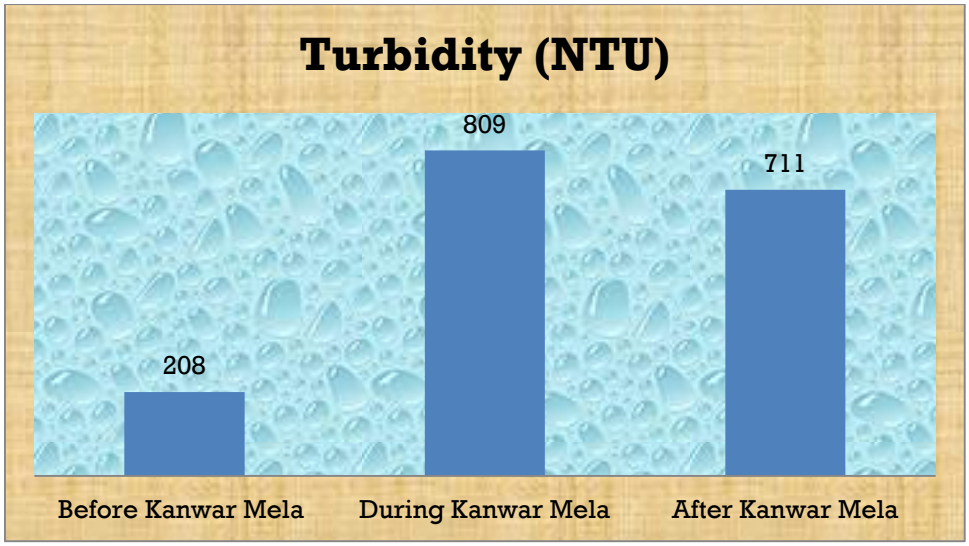
Parameters	Before Kanwar Mela	During Kanwar Mela	After Kanwar Mela
Temperature (^{0}C)	27.16 (±2.45)	29.31 (±4.32)	28.15 (±3.12)
pH	7.6 (±0.89)	7.8 (±0.91)	7.8 (±0.90)
Turbidity (NTU)	208 (±30.90)	809 (±76.20)	711 (±54.76)
Transparency (cm)	3.0 (±0.90)	0.5 (±0.09)	1.0 (±0.08)
Total solids (mg/l)	2012 (±110.75)	3120 (±214.75)	2300 (±0145.55)
Total dissolved solids (mg/l)	1090 (±90.50)	1650 (±100.75)	1312 (±95.70)
Dissolved Oxygen (mg/l)	8.7 (±0.75)	8.0 (±0.50)	8.3 (±0.55)
Biochemical Oxygen Demand (mg/l)	3.0 (±0.45)	4.5 (±0.75)	3.2 (±0.70)
Chlorides (mg/l)	28.23 (±1.75)	46.70 (±3.50)	32.90 (±2.75)



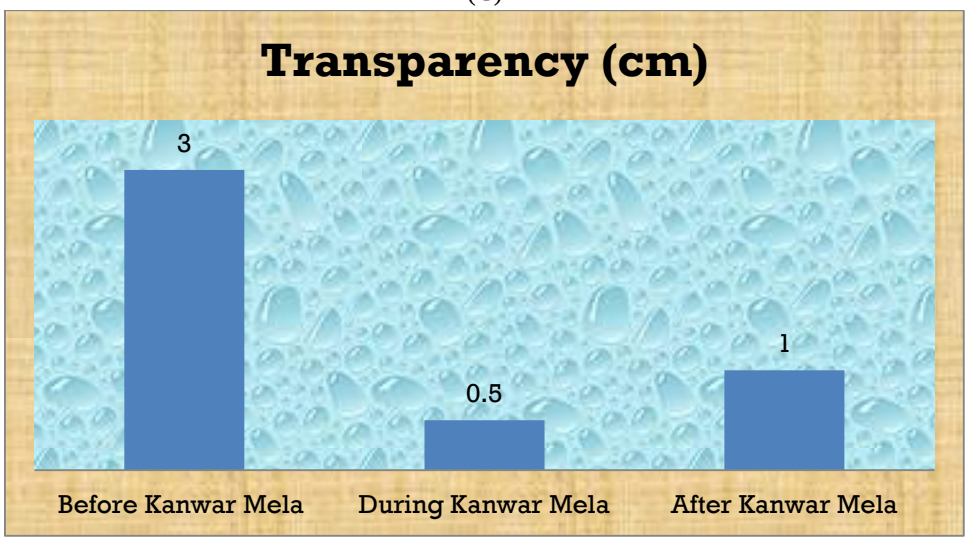
(A)


pH
7.6
7.8
7.8
Before Kanwar Mela
During Kanwar Mela
After Kanwar Mela

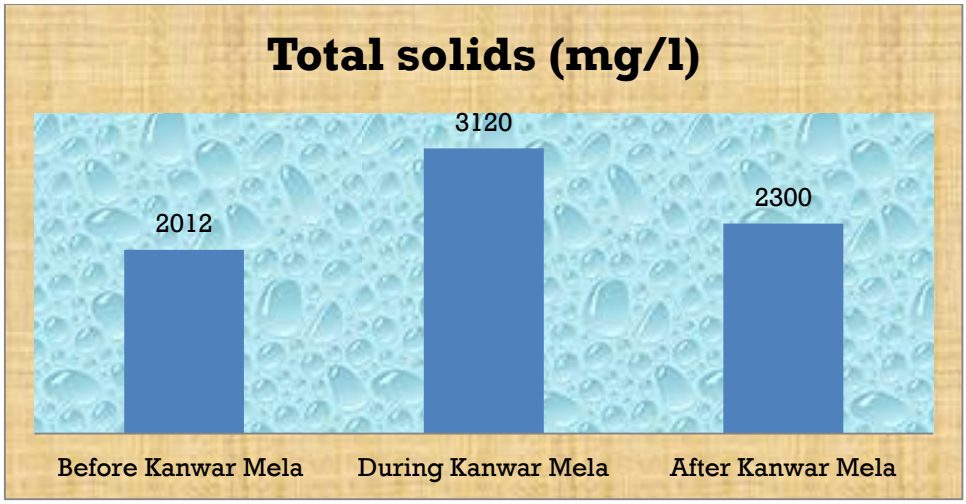
(B)


Turbidity (NTU)
208
809
711
Before Kanwar Mela
During Kanwar Mela
After Kanwar Mela

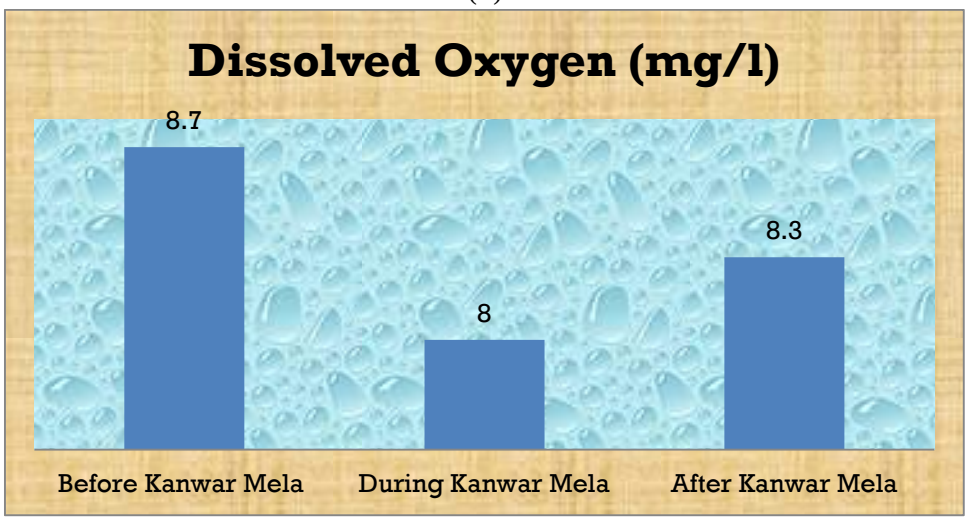
(C)


Transparency (cm)
3
0.5
1
Before Kanwar Mela
During Kanwar Mela
After Kanwar Mela

(D)



(E)



(F)

Graphs (A-F showing physico-chemical variations in Ganga River water before, during and after Kanwar Mela, 2024)

REFERENCES

[1] APHA, (2012). Standard Methods for the Examination of Water and Wastewater. American Public Health Association, 23st edition, Washington, DC.

[2] Brankov, J., Milijašević, D. and Milanović, A. (2012). The assess-ment of the surface water quality using the water pollution index: a case study of the Timok River (the Danube River basin), Serbia. *Archives of Environmental Protection*, 38(1): 49-61.

[3] BIS, Bureau of Indian Standards (2012). Specification for drink-ing water. 1S: 10500, *Bureau of Indian Standards*, New Delhi.

[4] Ghosh, D. and Biswas, J.K. (2017). Fish productivity: Assessing sustainability in a tropical oxbow lake of Nadia district, West Bengal, India. *Archives of Agriculture and Environmen-tal Science*, 2(1): 6-20.

[5] Haritash, A.K., Gaur, S. and Garg, S. (2016). Assessment of water quality and suitability analysis of river Ganga in Rishikesh, India. *Applied Water Science*, 6(4): 383-392, DOI: 10.1007/s13201-014-0235-1

[6] Jaji, M.O., Bamgbose, O., Odukoya, O.O. and Arowolo, T.A. (2007). Water quality assessment of Ogun River, South West Nigeria. *Environmental Monitoring and Assessment*, 133(1): 473-482. DOI: 10.1007/s10661-006-9602-1

[7] Kansal, A., Siddiqui, N.A. and Gautam A. (2013). Assessment of heavy metals and their interrelationships with some physi-co-chemical parameters in eco-efficient rivers of Himala-yan Region. *Environmental*

Monitoring and Assessment, 2013 185(3): 2553-63. DOI: 10.1007/s10661-012-2730-x

[8] Kamboj, N., Aswal, R.S. and Singh, P. (2017). Occurrence of heavy metals in Ganga canal water at Haridwar (Uttarakhand), India: A case study. *Archives of Agriculture and Environmental Science*, 2(2): 119-123.

[9] Kamboj, N. (2012). Evaluation of some water quality parameters of river Ganga during Kanwer Mela-2011 at Haridwar, India. *Journal of Sustainable Environmental Research*, 1(2): 125-128.

[10] Kumar, V. and Chopra, A.K. (2012). Monitoring of physico-chemical and microbiological characteristics of municipal wastewater at treatment plant, Haridwar (Uttarakhand) India. *Journal of Environmental Science and Technology*, 5(2):109-118, DOI: 10.3923/jest. 2012.109.118

[11] Kumar, V., Jogendra Singh, Roushan K. Thakur and Rohit Kumar (2016). Hydrobiological characteristics of pond water at Jamalpur Kalan, Haridwar (Uttarakhand), India. *Journal of Environmental Science, Computer Science, and Engineering & Technology*, 5(3): 546-557.

[12] Kumar, V. and Thakur R.K. (2017). Pollution load of SIDCUL effluent with reference to heavy metals accumulated in sediments using pollution load index (PLI) and geoaccumulation index (I-Geo) at Haridwar (Uttarakhand), India. *Journal of Environment and Biosciences*, 31(1): 163-168.

[13] Okendro, S.N., Surinder, K., Mahantpal, P.C., Pande, M.K. and Gopimohon, S.N. (2007). Evaluation of water quality from Gaula River by factor analysis. *Journal of Ecophysiology and Occupational Health*, 7: 3-4.

[14] Oladeji, S.O. (2017). Evaluation of nickel levels in wastewater, soil and vegetable samples grown along Kubanni stream

[15] channels in Zaria, Kaduna State, Nigeria. *Archives of Agricul-ture and Environmental Science*, 2(3): 141-147.

[16] Rizwan Mudathir Khandi and Sachin Srivastava (2016). Impact of tourism on water quality characteristics of Lidder Stream at Pahalgam, (J&K), India. *Archives of Agriculture and Environmental Science*, 1(1): 37-42.

[17] Khullar, R. and Khullar, R. (2004). Gateway to the Gods: Harid-war-Rishikesh. UBS Publishers ISBN 8174764607.

[18] Sati, S. and Paliwal, P.C. (2008). Physico-chemical and bacterio-logical analysis of Kosi River Water Central Himalaya. *Pollution Research*, 27(1): 179-183.

[19] Seth, R., Mohan, M., Singh, P., Singh, R., Dobhal, R., Singh, K.P. and Gupta, S. (2016). Water quality evaluation of Himala-yan Rivers of Kumaun Region, Uttarakhand, India. *Applied Water Science*, 6(2): 137-147, DOI: 10.1007/s13201-014-0213-7

[20] Simeonov, V., Stratis, J.A., Samara, C., Zachariadis, G., Voutsa, D., Anthemidis, A., Sofoniou, M. and Kouimtzis, T. (2003). As-sessment of the surface water quality in northern Greece. *Water Research*, 37(17): 4119-4124, doi.org/10.1016/S0043-1354(03)00398-1.

[21] Shamrukh, Mohamed and Abdel-Wahab, Ahmed (2011). Water pollution and riverbank filtration for water supply along River Nile, Egypt. In: *Riverbank Filtration for Water Security in Desert Countries*, 5C. Ray and M. Shamrukh (eds.), pp: 1-25, DOI 10.1007/978-94-007-0026-0_2

[22] Vega, M., Pardo, R., Barrado, E. and Deban, L. (1998). Assess-ment of seasonal and polluting effects on the quality of river water by exploratory data analysis. *Water Research*, 32: 3581-3592.

[23] Yasir and Srivastava, S. (2016). Monitoring of ground water quality in the province of district Dehradun, (Uttarakhand), India. *Archives of Agriculture and Environmental Science*, 1(1): 43-48.