CWC/2025/49

सत्यमेव जयते

GOVERNMENT OF INDIA
Ministry of Jal Shakti
Department of Water Resources
River Development and Ganga Rejuvenation

WATER QUALITY REPORT- KUMBH MELA 2025

2025

CENTRAL WATER COMMISSION

April 2025

CONTRIBUTIONS

GUIDANCE:

Dr. Mukesh Kumar Sinha, Chairman, Central Water Commission, New Delhi

Shri Anupam Prasad (River Management), Central Water Commission, New Delhi

Shri D.P. Mathuria, Chief Engineer (Planning & Development Organization), CWC, New Delhi

Shri Pankaj Kumar Sharma, Director, RDC-II Directorate, CWC, New Delhi.

Shri Satish Jain, Deputy Director, RDC-II Directorate, CWC, New Delhi.

PREPARED BY:

Dr. Jakir Hussain, Research Officer, RDC-II Directorate, CWC, New Delhi

Shri Rajesh Kumar, Research Officer, RDC-II Directorate, CWC, New Delhi

Shri Nitish Singh, Assistant Research Officer, RDC-II Directorate, CWC, New Delhi

Shri Lalit Kumar Morya, Assistant Research Officer, RDC-II Directorate, CWC, New Delhi

Shri Rajat Sharma, Senior Research Assistant, RDC-II Directorate, CWC, New Delhi

ANALYSIS BY:

Dr. Sandeep Kumar Shukla, Research Officer, NRWQL, YBO, CWC, New Delhi

Shri A.K. Trivedi, Assistant Research Officer, UMGWQL, LGBO, CWC, New Delhi

Shri Shashi Kant Meena, Assistant Research Officer, HGWQL, UGBO, CWC, New Delhi

Ms. Malika Kumar, Assistant Research Officer, NRWQL, YBO, New Delhi

Ms Madhuri Saroj, Senior Research Assistant, UMGWQL, LGBO, CWC, New Delhi

Shri Angad Kumar, Senior Research Assistant, UMGWQL, LGBO, CWC, New Delhi

Shri Vikrant Babu, Senior Research Assistant, HGWQL, UGBO, CWC, New Delhi

Shri Neeraj Kumar, Senior Research Assistant, HGWQL, UGBO, CWC, New Delhi

Ms. Anisha, Senior Research Assistant, NRWQL, YBO, New Delhi

Ms. Kavita, Senior Research Assistant, NRWQL, YBO, New Delhi

Shri Deepesh Kumar, Senior Research Assistant, UMGWQL, LGBO, CWC, New Delhi

SAMPLE COLLECTED BY:

Shri Deepak Kumar, Skilled Work Assistant, LGBO, CWC, New Delhi

Shri Vinay Kumar, Skilled Work Assistant, LGBO, CWC, New Delhi

Shri Amit Kumar, Skilled Work Assistant, LGBO, CWC, New Delhi

Shri Prahlad Singh Yadav, Skilled Work Assistant, YBO, CWC, New Delhi

Shri Prem Pal, Skilled Work Assistant, YBO, CWC, New Delhi

Shri Abad Alam, Skilled Work Assistant, YBO, CWC, New Delhi

Also thankful to the Chief Engineer (UGBO, LGBO,YBO), Superintending Engineers (HOC), Executive Engineer (UYD, New Delhi; LYD, Agra; MGD-3, Varanasi and HGD, Haridwar) and other supporting staff.

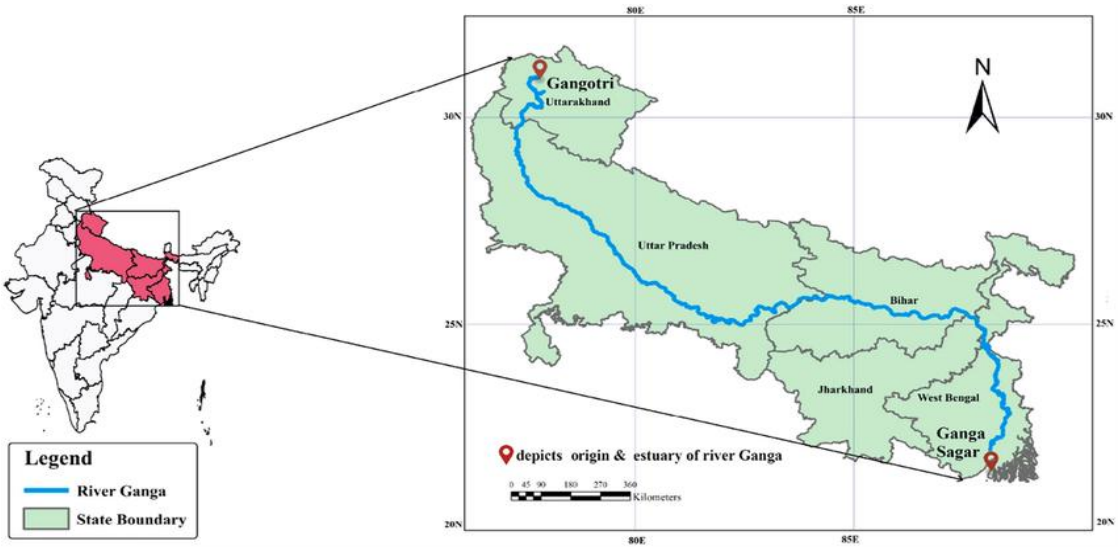
Table of Contents

1. Salient Features of River Ganga 2
2. Kumbh Mela 2025 3
3. Objective of the Study 4
4. Water Quality Monitoring by CWC 4
5. Water Quality Standards 5
6. Result and Discussion: 6
6.1 Water Quality during Major Festivals (Mauni Amavasya (Somvati), Basant Panchami, Maghi Purnima, and Mahashivratri): 6
6.2 Water Quality during the initial day (17.01.2025) and after Kumbh (27.02.2025) 11
6.3 Before and After during Major Events 14
7. Conclusion: 20
8. References 22

Water Quality Report - Kumbh Mela 2025

1. Salient Features of River Ganga

The Ganga is not just a River; the mythological importance associated with the River is deeprooted in the Indian culture and is considered a "Holy River". The status and recognition which River Ganga has attained, in India and worldwide, is a wondrous one. If a person deliberately makes up his mind to clear all his conceptions about the reverence towards River Ganga, its glory and its mystic characteristics; and decides to ponder about what really makes the River outstanding, there is a logical path on which his thoughts can tread on (NMCG, & NEERI, 2019). The Ganga River basin is spread over 8, 62,769 km^2 and drains about 26 % of the geographical area of India (CWC, WRIS, 2014). The Ganga is the 20th longest river in the Asia and the 41st longest in the world. The Ganga flows through the Gangetic plain of north India in Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal and finally joins the Bay of Bengal. The total length of river Ganga (measured along the Bhagirathi and the Hooghly) up to its outfall into Bay of Bengal is 2,525 km with 631 km navigable length. Main tributaries of river Ganga are Yamuna, Ramganga, Gomti, Ghaghara, Gandak, Damodar, Kosi & Kali-East and main sub tributaries are Chambal, Sindh, Betwa, Ken, Tons (beyond Five States), Sone & Kasia-Haldi. Major Cities located on the bank are Srinagar, Rishikesh, Haridwar, Roorkee (in Uttarakhand), Bijnor, Narora, Kannauj, Kanpur, Prayagraj, Varanasi, Mirzapur (in Uttar Pradesh), Patna, Bhagalpur (in Bihar) and Berhampur, Serampore, Howrah and Kolkata (in West Bengal) (CPCB, 2019).



2. Kumbh Mela 2025

The Kumbh Mela is a monumental event that attracts millions of pilgrims, devotees, and curious visitors to the holy riverbanks for mass bathing and spiritual gatherings. The Kumbh Mela is the biggest religious congregation in the world. UNESCO has recognized Kumbh Mela as a "Cultural heritage of humanity" and held up as the world's largest peaceful gathering of pilgrims at Sangam (confluence of the holy rivers Ganga, Yamuna and Saraswati) in Prayagraj district of Uttar Pradesh. Kumbh Mela, the world's largest peaceful gathering, draws millions of pilgrims who bathe in sacred rivers seeking to purify themselves from sins and attain spiritual liberation. The Maha Kumbh Mela, a sacred pilgrimage celebrated four times over the course of 12 years, is deeply embedded in Hindu mythology and represents one of the most significant gatherings of faith in the world. This sacred event rotates between four locations in India—Haridwar, Ujjain, Nashik, and Prayagraj—each situated by a holy river: from the Ganges to the Shipra, the Godavari, and the confluence of the Ganges, Yamuna, and the mythical Sarasvati in Prayagraj.

The 45-day religious gathering is significant for Hindu pilgrims and devotees as it marks the completion of 12 Kumbh Mela cycles, occurring over 144 years. The 2025 Maha Kumbh Mela began on January 13, 2025, and was completed on February 26, 2025. Over 64 crore people took a holy dip in the Ganga, Yamuna, and Saraswati rivers at the Triveni Sangam during the 2025 Maha Kumbh Mela, making it one of the largest religious gatherings in history.

The following are the important festival dates during the 2025 Maha Kumbh Mela:

S.No.	Name of Festival	Date/Day
1	Paush Purnima	13-01-2025 / Monday
2	Makar Sankranti	14-01-2025 / Tuesday
3	Mauni Amavasya (Somvati)	29-01-2025 / Wednesday
4	Basant Panchami	03-02-2025 / Monday
5	Maghi Purnima	12-02-2025 / Wednesday
6	Mahashivratri	26-02-2025 / Wednesday

Mass bathing at Kumbh Mela 2025

3. Objective of the Study

1. To evaluate both physicochemical and microbiological water quality parameters to ensure the water is safe for drinking and bathing
2. To assess and monitor the water quality during Maha Kumbh 2025, focusing on the impact of mass bathing on river water contamination.
3. To provide recommendations for effective water quality management strategies to prevent disease outbreaks and ensure water safety during such events.

4. Water Quality Monitoring by CWC

Monitoring of river Ganga and its tributary (Yamuna) was carried out during January 15, 2025, to March 07, 2025 different auspicious mass bathing occasions for assessment of water quality for pH, conductivity, turbidity, dissolved oxygen, biochemical oxygen demand (BOD), chemical oxygen demand and Fecal coliform parameters.at six locations i.e. Varanasi, Chhatnag, Shastri Bridge, Naini, Garhmukteshwar, and Haridwar. All water samples were maintained in a refrigerator at 0°C during transportation to the laboratory, and then later for processing and analysis. The pH, electrical conductivity (EC), and DO of each water sample were measured at the sampling points by a mercury thermometer, digital pH, EC and DO meter or titration method, respectively. Other parameters biochemical oxygen demand, chemical oxygen demand, and fecal coliform were carried out at Level II and Level III water quality laboratories of CWC by using the APHA 23rd edition, 2023. All water samples were analysed within 48 h of collection.

Sampling during Maha Kumbh 2025 at Haridwar

5. Water Quality Standards

Water quality data is compared with the CPCB's Designated Best Use Water Quality Standards and the primary water quality criteria for outdoor bathing, as per the Environment (Protection) Amendment Rules, 2000, which set standards for river water quality used for organized outdoor bathing.

Table 1: Designated Best Use Water Quality Standard

Designated-Best-Use	Class of water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	• Total Coliforms Organism MPN/100ml shall be 50 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 6mg/l or more • Biochemical Oxygen Demand 5 days 20C 2mg/l or less
Outdoor bathing (Organised)	B	• Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5 Dissolved Oxygen 5mg/l or more • Biochemical Oxygen Demand 5 days 20C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	• Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9 Dissolved Oxygen 4mg/l or more • Biochemical Oxygen Demand 5 days 20C 3mg/l or less
Propagation of Wild life and Fisheries	D	• pH between 6.5 to 8.5 Dissolved Oxygen 4mg/l or more • Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	• pH between 6.0 to 8.5 • Electrical Conductivity at 25C micro mhos/cm Max.2250 • Sodium absorption Ratio Max. 26 • Boron Max. 2mg/l
	Below-E	Not Meeting A, B, C, D & E Criteria

Source: CPCB (https://cpcb.nic.in/wqm/Designated_Best_Use_Water_Quality_Criteria.pdf)

Primary water quality criteria for outdoor bathing: As per Environment (Protection) Amendment Rules, 2000, standard for river water quality used for organized outdoor bathing are as follows;

Table 2 Primary water quality criteria for outdoor bathing Parameter

Water Quality Parameter	Standard
pH	6.5 - 8.5
Dissolved Oxygen	5 mg/l or more
Biochemical Oxygen demand 3 day,27°C:	3 mg/1 or less
Fecal Coliform	2500 MPN/100

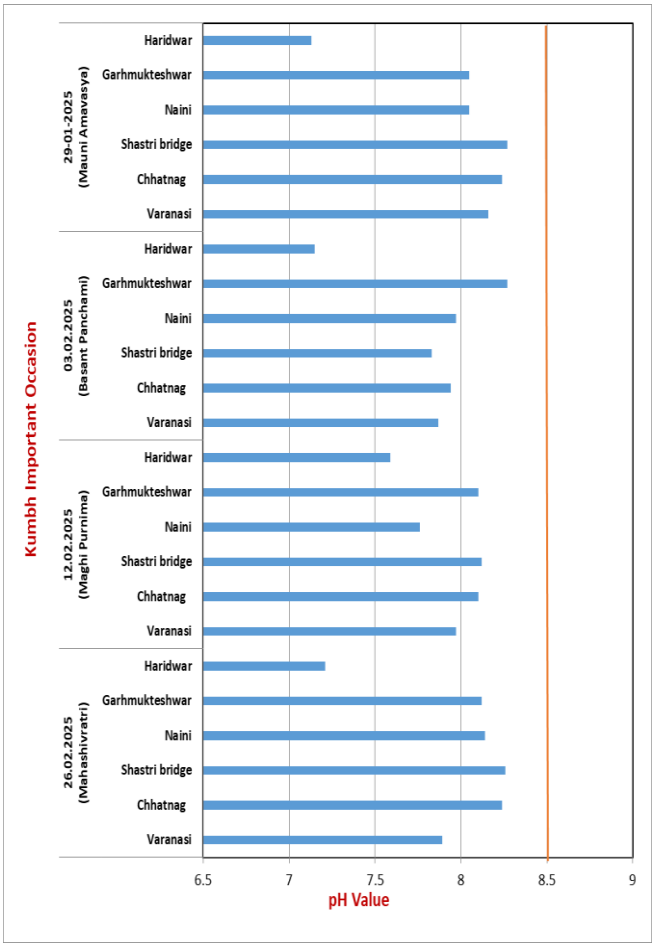
6. Result and Discussion:

6.1 Water Quality during Major Festivals (Mauni Amavasya (Somvati), Basant Panchami, Maghi Purnima, and Mahashivratri):

Water quality during key festivals—Mauni Amavasya (Somvati), Basant Panchami, Maghi Purnima, and Mahashivratri—during the 2025 Maha Kumbh Mela is presented graphically, showing parameters such as pH, electrical conductivity, turbidity, dissolved oxygen, biochemical oxygen demand, and chemical oxygen demand at six locations: Varanasi, Chhatnag, Shastri Bridge, Naini, Garhmukteshwar, and Haridwar on river Ganga and Yamuna.

6.1.1 pH

The term pH stands for 'power of hydrogen', and is a measure of the acidity or alkalinity of a solution. The pH of water can be affected by a number of natural and man-made factors. Changes in pH naturally occur as a result of the interaction of surrounding rocks, especially carbonate materials, and other materials. In addition, precipitation, especially acid rain, and chemical emissions from wastewater or mining activities can also affect the pH level of water. Also, the amount of carbon dioxide (CO2) in water can change the pH (Hickin, 1995). The Bureau of Indian Standards (BIS) recommends a pH value of 6.5 to 8.5 for drinking water. The limit prescribed by CPCB for class-A; Drinking water source without conventional treatment but after disinfections, class B: Outdoor bathing Organized, class D: Propagation of wild life and class E: Fisheries and Irrigation; all are defined from 6.5 to 8.5.

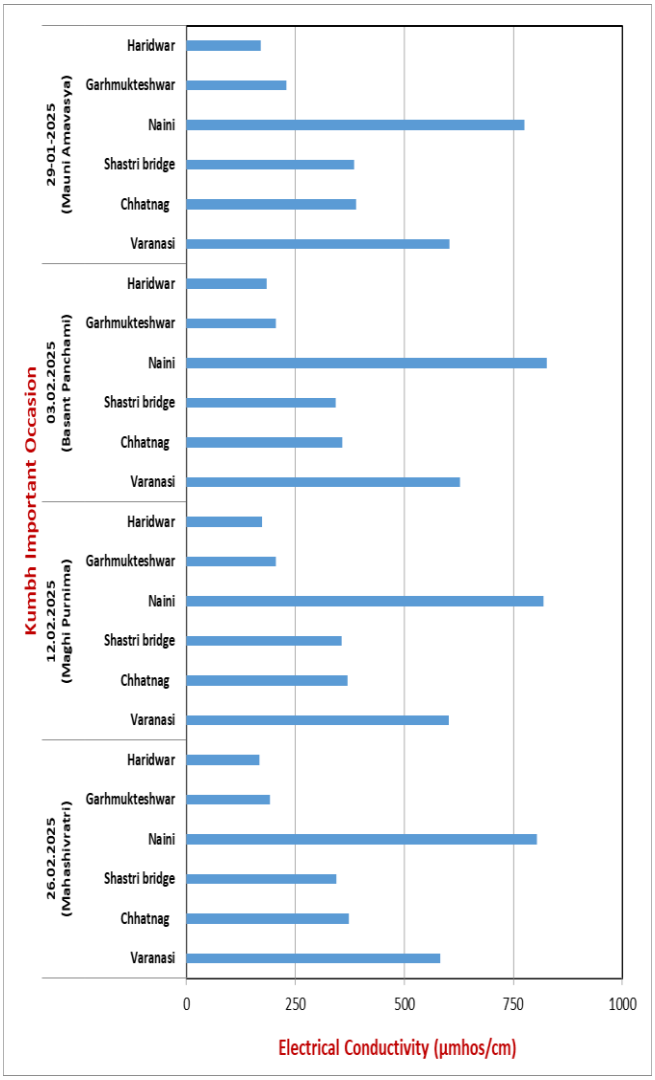


pH values observed during the 2025 Maha Kumbh Mela at different locations revealed that the water was predominantly alkaline across all locations, with values generally ranging from 7.13 at Haridwar during on Mauni Amavasya to 8.27 at Garhmukteshwar and Shastri bridge during Basant Panchami and Mauni Amavasya respectively. These values are consistent and pH is usually slightly alkaline. No significant trend was noted between the pH levels and the specific festivals (Mauni Amavasya, Basant Panchami, Maghi Purnima, Mahashivratri). During the important festival dates pH value within the acceptable limit (pH between 6.5 and 8.5) for CPCB designated best uses for outdoor bathing (Organised). In conclusion, the pH levels remained generally within limits during the 2025 Maha Kumbh Mela, the slight variations in values between locations and festivals suggest that local factors, including human activity, water volume, and environmental conditions, play a role in determining the water quality.

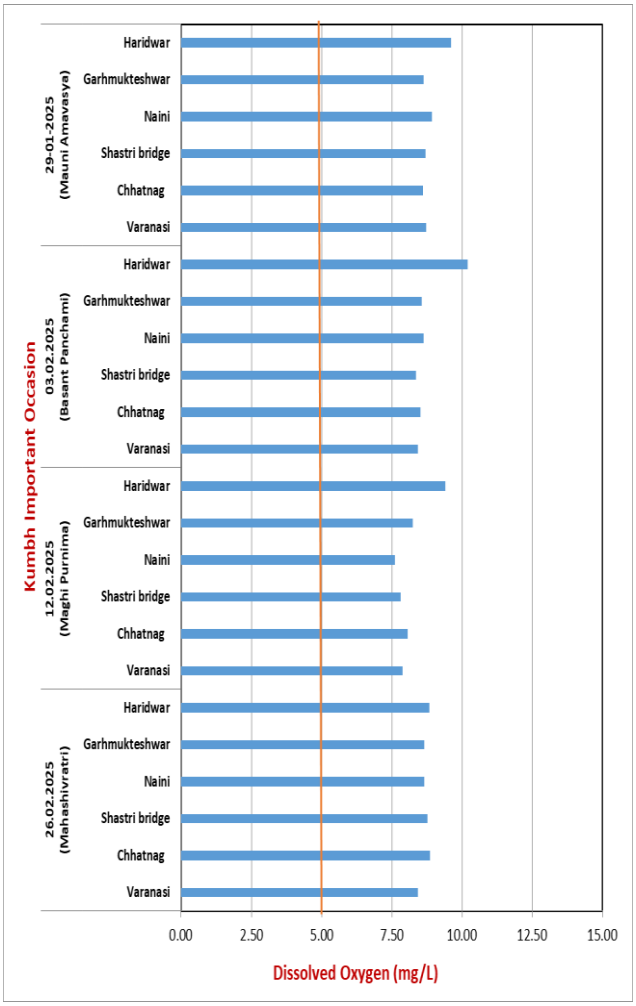
6.1.2 Electrical Conductivity

Electrical conductivity is a measure of water's ability to conduct an electrical flow, and it is directly related to the concentration of ions present in the water (Wetzel, 2001). These ions come from dissolved salts and inorganic materials like alkalis, chlorides, sulphates, and carbonate compounds. The more ions present in the water, the higher its conductivity (Langland & Cronin, 2003). Conversely, the fewer ions in the water, the lower its conductivity. Compounds that dissolve into ions are known as electrolytes (Palermo, 2008).

During the Basant Panchami at Naini water quality site recorded highest EC value at 826 µS/cm, and Haridwar had the lowest EC value at 167 µS/cm during Mahashivratri. Naini water quality sites on river Yamuna recorded the highest range of electrical conductivity (775 to 826 µS/cm), Haridwar consistently recorded the lowest EC values, ranging from 167 - 174 µS/cm, during the specific festivals (Mauni Amavasya, Basant Panchami, Maghi Purnima, Mahashivratri).



6.1.3 Dissolved Oxygen



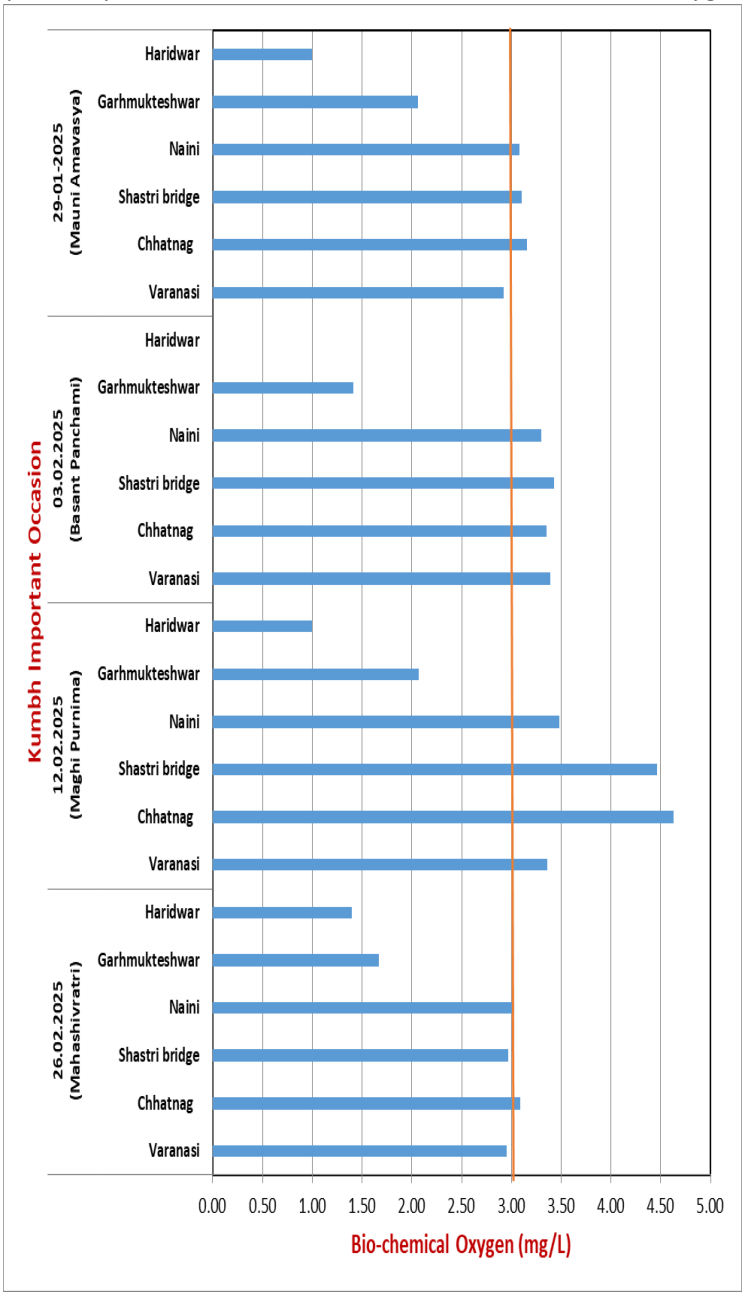
The amount of gaseous oxygen dissolved in water is known as dissolved oxygen, which enters the river water through diffusion from the atmosphere and as a by-product of aquatic plants' photosynthesis (Wetzel, 2001). The presence of dissolved oxygen in the aquatic habitat is crucial for the survival of organisms living in water bodies, including fish and invertebrates. animals require oxygen to survive, and fish, for instance, can't survive for long in water with less than 5 mg/L of dissolved oxygen (EPA, 2014). Most aquatic plants, fish and zooplankton need oxygen in water in order to breathe. Good oxygen levels are critical for the health of a river system. Slow flowing, polluted river water is often associated with low oxygen level, usually supports very little aquatic life.

The low level of dissolved oxygen in water indicates contamination and is an important factor in determining water quality, pollution control, and treatment processes. The level of dissolved oxygen (DO) is affected by a variety of physical, chemical, and biochemical factors that occur in water, both in natural waters and in wastewater. Oxygen is in short supply in water, and it is vulnerable to the effects of temperature and pressure. When organic wastes, such as household and livestock wastes from industrial plants, such as paper mills and the leather industry, old water from slaughterhouses, and agricultural runoff enter rivers, solid oxygen levels are significantly reduced. The wastes from these industries cause oxygen demand, and they're broken down and decomposed by bacteria into oxygen. Most oxygen-demanding waste is organic.

Water quality was measured at all six locations during the Maha Kumbh Mela, at Haridwar water quality site on river Ganga consistently recorded the highest dissolved oxygen concentration compared to all other sites Varanasi, Chhatnag, Shastri Bridge, Naini, Garhmukteshwar. DO values at Haridwar ranged from 8.84 mg/l during Mahashivratri to 10.20 mg/l during Basant Panchami, which were above the acceptable limit of 5.0 mg/l, which is considered suitable for aquatic life and bathing. During the study period at all six water quality sites maximum DO value was recorded 10.20 mg/L at Haridwar during Basant Panchami and minimum recorded 7.60 mg/L at Naini during Maghi Purnima. Other monitoring stations such as Varanasi, Chhatnag, Shastri Bridge, and Garhmukteshwar observed DO levels that remained within the acceptable range (> 5 mg/L), typically around 8 mg/L to 9 mg/L across all key festival dates. Data reveals that DO levels at all locations during the Maha Kumbh Mela 2025 indicate that the water quality was mostly stable and within the acceptable limit for the bathing purposes.

6.1.4 Biochemical Oxygen Demand :

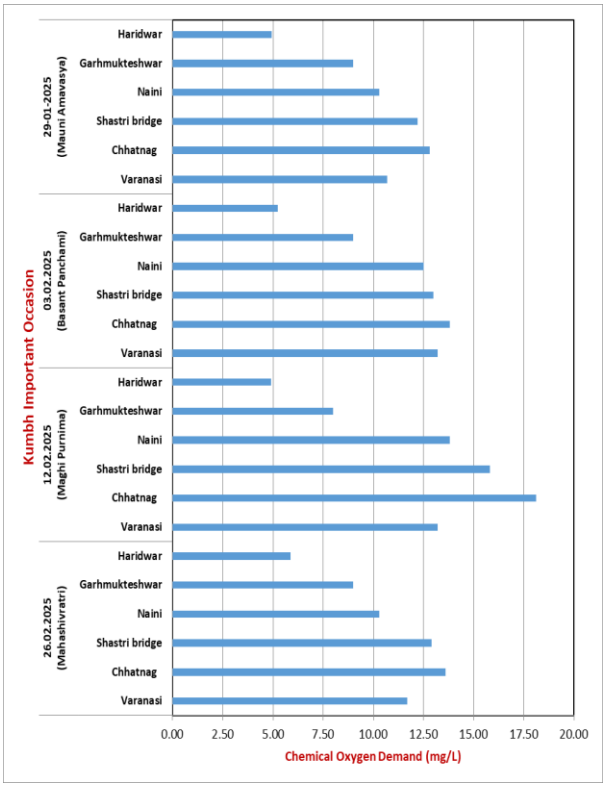
Biochemical oxygen demand (BOD) is an important parameter that measures how much dissolved oxygen is required by aerobic (oxygen-requiring) organisms to break down organic matter in river water (Armiento, 2016). BOD has various sources, such as urban and industrial wastewater, agricultural runoff, and landfill runoff. Oxygen in rivers is consumed by various processes such as respiration of aquatic organisms, decomposition of organic matter, and chemical reactions. Discharge from sewage treatment plants often contains organic matter that is broken down by microorganisms, causing oxygen consumption. In addition, rainwater flowing from agricultural fields or urban streets and poorly functioning septic systems can also lead to oxygen-consuming polluted water. Several factors affect BOD, such as: type and amount of organic matter, water temperature, pH level, concentration of dissolved oxygen, presence of bacteria.



Central Pollution Control Board (CPCB) has set the BOD standard for outdoor bathing at 3.0 mg/l. If the BOD in water is more than 3.0 mg/l, it is not considered suitable for outdoor bathing. As per water quality standards, the maximum limit of BOD is 3.0 mg/L or less, and if the BOD is more than this, there may be water quality problems. The lowest BOD values were found in Haridwar, which was 1.00 mg/L, and this value was the same during both Maghi Purnima and Mauni Amavasya. This low BOD value indicates that the water in Haridwar was relatively less polluted and also had a low load of organic matter. This may be due to the fast flow of water and good oxygen levels. BOD levels were also low at Gairmukteshwar, ranging from 1.41 mg/L to 2.06 mg/L, indicating good water quality. During the 2025 Maha Kumbh Mela, BOD levels were within acceptable limits at most sites, although at some locations they exceeded the limit. The highest values of BOD were found at Chhatnag and Shastri Bridge during Maghi Purnima. The BOD value at Chhatnag was 4.63 mg/L, and at Shastri Bridge it was 4.46 mg/L. This increase in BOD indicates an increase in organic load in the water, which may be due to increased human activities there, such as religious rituals and bathing.

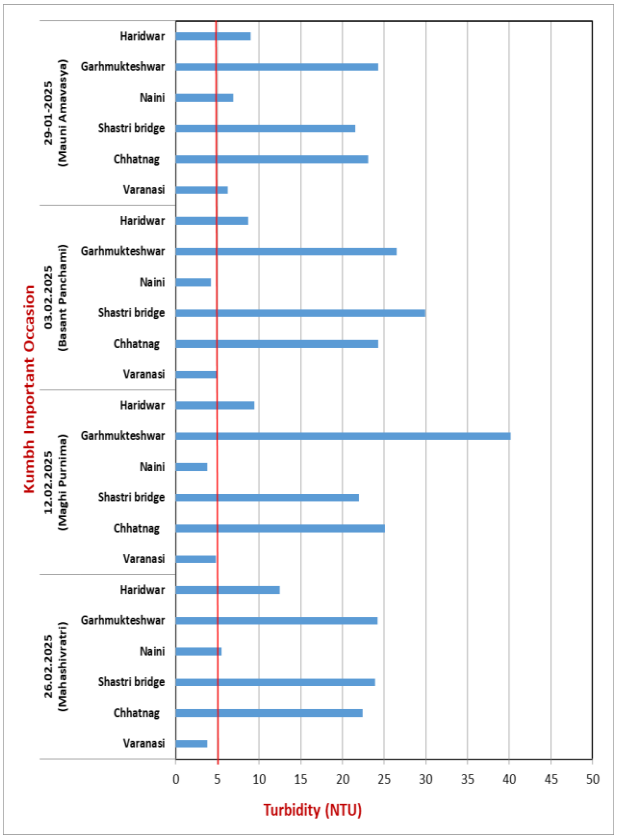
6.1.5 Chemical Oxygen Demand

Chemical Oxygen Demand (COD) is one of the important indicators of organic pollution in aquatic system. COD measures how much oxygen is needed to chemically oxidized the amount of oxygen needed to oxdized organic load in the water. Throughout all sampling dates, Haridwar consistently recorded the lowest COD levels, with values ranging from 4.90 mg/L to 5.89 mg/L. Similarly, Garhmukteshwar exhibited relatively low COD values, with a range between 8.00 mg/L and 9.00 mg/L. In contrast, Chhatnag and Shastri Bridge recorded some of the highest COD values during festival periods. Chhatnag had COD values consistently above 12 mg/L, ranging from 12.80 mg/L to 18.10 mg/L. Shastri Bridge also had a high COD value of 15.80 mg/L during Maghi Purnima. Additionally, COD values at Naini water quality sites ranged from 10.30 mg/L to 13.80 mg/L, indicating moderate to high levels of organic load in the water during Kumbh 2025.



6.1.6 Turbidity

River turbidity is an important indicator of water quality, which includes the cloudiness or turbidity of water due to sediments, total suspended soilds etc. As per IS 10500:2012, the desirable limit turbidity level is 5 NTU. Varanasi (3.8 to 6.2 NTU) and Naini (3.8 to 6.9 NTU) consistently recorded the lowest turbidity levels during Kumbh 2025 important days. Higher turbidity levels were observed at some locations, especially during Maghi Purnima and Basant Panchami.



Some water stations on river Ganag Chhatnag, Shastri Bridge, and Garhmukteshwar consistently recorded turbidity levels above the acceptable limit of 5 NTU during the all-important occasions during the Kumbh. The highest turbidity was recorded at Garhmukteshwar during Maghi Purnima (40.2 NTU) and at Shastri Bridge during Basant Panchami (29.9 NTU). These high turbidity values were attributed to the disturbance of sediment particles on the riverbed, which was mainly generated during bathing. Thus, these high turbidity levels indicate significant amounts of suspended particles, which were probably generated by the disturbance of sediment particles on the river bed due to bathing during Kumbh 2025.

6.2 Water Quality during the initial day (17.01.2025) and after Kumbh (27.02.2025)

6.2.1 pH

pH levels at the six monitoring stations showed various changes from the initial monitoring day (17.01.2025) and after Kumbh Mela (27.01.2025). The pH value at Haridwar decreased from 7.48 to 7.26, which may be due to change in water composition or changes in the alkalinity. A slight increase in pH was observed at Garhmukteshwar, from 8.06 to 8.21, and at Naini (on Yamuna River) also had an increase in pH. This increase can be seen as an increase in alkalinity, which may be due to change in water composition or presence of pollutants. The pH at Varanasi decreased slightly from 7.99 to 7.76, indicating a slight change in water quality. Overall, an increase in alkalinity was observed at most stations, while a slight decrease was observed at Haridwar and Varanasi, indicating fluctuations in water quality after the Kumbh Mela. pH levels remained within acceptable limits at all locations during the study period. Shastri Bridge and Chhatnag also shown pH increases, rising from 7.68 to 8.15 and from 7.65 to 8.19, respectively.

S. No.	Water Quality Monitoring Stations	(Initial Day) 17.01.2025	(After Kumbh) 27.02.2025
1	Haridwar	7.48	7.26
2	Garhmukteshwar	8.06	8.21
3	Naini	7.46	8.1
4	Shastri bridge	7.68	8.15
5	Chhatnag	7.65	8.19
6	Varanasi	7.99	7.76

6.2.2 Electrical Conductivity

At Haridwar and Garhmukteshwar water quality stations, conductivity decreased from 214 to 165.4 µmhos/cm and from 237.5 to 192 µmhos/cm, respectively. However, Naini water quality station on river Yamuna a slight increase in conductivity was recorded from 776 to 792 µmhos/cm. Shastri Bridge and Chhatnag both experienced significant decreases in conductivity, dropping from 491 to 329 µmhos/cm and from 497 to 354 µmhos/cm, respectively. This suggests either a dilution of the water or a reduction in ion concentration in the Ganga River. This decrease indicates a decrease in ion concentration in water or dilution of water. A decrease in conductivity was also observed at Varanasi, from 624 µmhos/cm to 555 µmhos/cm. This decrease could be due to the destruction of pollutants or a decrease in their presence. Overall, the decrease in conductivity at most monitoring stations indicates a decrease in dissolved solids, which indicates an improvement in water quality, while the increase in conductivity at Naini water quality station indicates that there may be accumulation of pollutants or ions.

S. No.	Water Quality Monitoring Stations	(Initial Day) 17.01.2025	(After Kumbh) 27.02.2025
1	Haridwar	214	165.4
2	Garhmukteshwar	237.5	192
3	Naini	776	792
4	Shastri bridge	491	329
5	Chhatnag	497	354
6	Varanasi	624	555

6.2.3 Turbidity

Turbidity patterns exhibited mixed trends across all six stations. Water quality stations at Haridwar showed a decreasing trend in turbidity, dropping from 13.7 NTU to 8.3 NTU, and a similar trend was observed at Garhmukteshwar, where turbidity decreased

S. No.	Water Quality Monitoring Stations	(Initial Day) 17.01.2025	(After Kumbh) 27.02.2025
1	Haridwar	13.7	8.3
2	Garhmukteshwar	45.1	28.2
3	Naini	4.6	5.2
4	Shastri bridge	4.1	20.8
5	Chhatnag	16.6	21.5
6	Varanasi	20.9	4.6

from 45.1 NTU to 28.2 NTU. At Naini (River Yamuna), a slight increase in turbidity was noted, rising from 4.6 NTU to 5.2 NTU, likely due to a minor rise in suspended particles from bathing activities. Shastri Bridge experienced a sharp increase in turbidity, rising from 4.1 NTU to 20.8 NTU, while at the Chhatnag water quality station, turbidity increased from 16.6 NTU to 21.5 NTU, indicating a rise in suspended particles, likely due to increased bathing activities and river sediment disturbance. At the Varanasi water quality monitoring station, a significant improvement was observed, with turbidity decreasing from 20.9 NTU to 4.6 NTU.

6.2.4 Dissolved Oxygen

Dissolved oxygen levels showed slight declines at some stations, suggesting possible organic loading or microbial activity. Data reveals that at Haridwar water quality monitoring station, dissolved oxygen decreased from 10.6 mg/L to 9.2 mg/L, similarly, Garhmukteshwar decrease from 8.94 mg/L to 8.19 mg/L trend is observed. However, Naini stations an improvement in dissolved oxygen from 7.52 mg/L to 8.71 mg/L is observed. Shastri Bridge and Chhatnag showed slight increases in dissolved oxygen, from 8.3 mg/L to 8.59 mg/L and from 8.2 mg/L to 8.67 mg/L. Varanasi stations showed a slight decrease in dissolved oxygen, from 8.71 mg/L to 8.39 mg/L..

S. No.	Water Quality Monitoring Stations	(Initial Day) 17.01.2025	(After Kumbh) 27.02.2025
1	Haridwar	10.6	9.2
2	Garhmukteshwar	8.94	8.19
3	Naini	7.52	8.71
4	Shastri bridge	8.3	8.59
5	Chhatnag	8.2	8.67
6	Varanasi	8.71	8.39

6.2.5 Bio-chemical Oxygen

BOD levels increased at most stations, indicating a rise in organic pollution or microbial activity post-Kumbh Mela. Haridwar's BOD increased from 0.8 mg/L to 1.2 mg/L, reflecting a slight rise in organic contamination. At the Garhmukteshwar water quality station marginal increase from 1.83 mg/L to 1.91 mg/L, and at Naini BOD slightly increases from 2.73 mg/L to 2.92 mg/L, due to organic material or microbial activity. Shastri Bridge also showed a slight increase in BOD from 2.87 mg/L to 3.0 mg/L, indicating organic matter decomposition. At Chhatnag water quality station BOD remained stable with a slight increase from 3.01 mg/L to 3.04 mg/L. Varanasi showed a more noticeable rise in BOD from 2.68 mg/L to 3.1 mg/L. Overall, the increase in BOD across most stations suggests a rise in organic pollution or microbial activity after the Kumbh Mela.

S. No.	Water Quality Monitoring Stations	(Initial Day) 17.01.2025	(After Kumbh) 27.02.2025
1	Haridwar	0.80	1.20
2	Garhmukteshwar	1.83	1.91
3	Naini	2.73	2.92
4	Shastri bridge	2.87	3.00
5	Chhatnag	3.01	3.04
6	Varanasi	2.68	3.10

6.2.6 Chemical Oxygen Demand

The COD values recorded before and after the Maha Kumbh Mela show varying levels of organic pollution across different monitoring stations. The data indicates that, in general, there was a noticeable change in COD values following the events associated with the Kumbh Mela, particularly at locations with heavy human activity, such as Naini, Shastri Bridge, and Chhatnag. The water discharge in the river Ganga likely contributed to the dilution of the organic load. At Naini,

S. No.	Water Quality Monitoring Stations	(Initial Day) 17.01.2025	(After Kumbh) 27.02.2025
1	Haridwar	4.9	5.4
2	Garhmukteshwar	7.0	9.0
3	Naini	17.7	9.8
4	Shastri bridge	15.9	12.1
5	Chhatnag	18.5	14.0
6	Varanasi	15.2	12.0

there was a significant drop in COD from 17.7 mg/L on the initial day to 9.8 mg/L after the Kumbh Mela. Similarly, at Shastri Bridge, COD values decreased from 15.9 mg/L initially to 12.1 mg/L after the festival. Chhatnag exhibited the highest initial COD value of 18.5 mg/L, which decreased to 14.0 mg/L after the Kumbh Mela.

6.2.7 Fecal Coliform (MPN/100 ml)

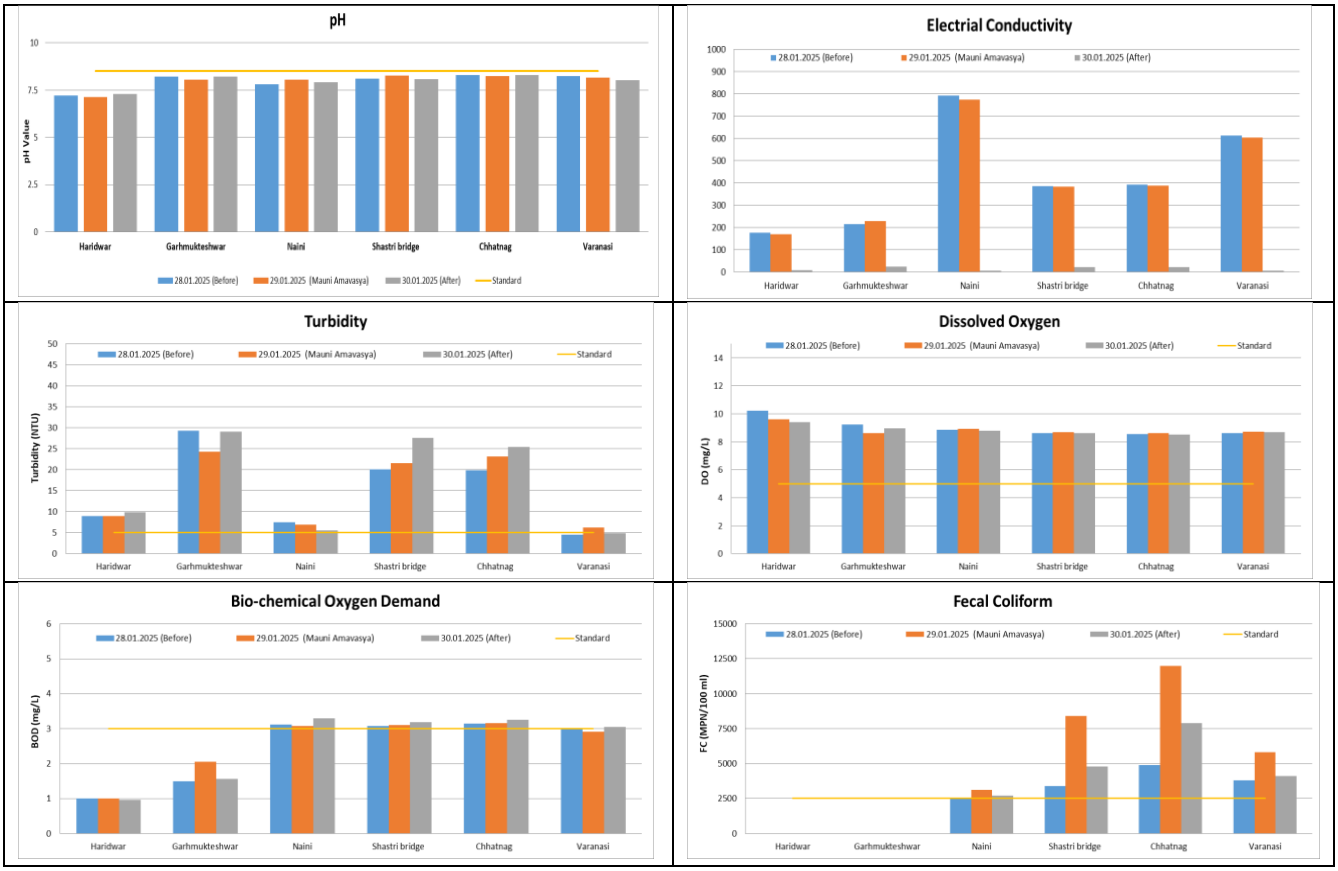
S. No.	Water Quality Monitoring Stations	(Initial Day) 17.01.2025	(After Kumbh) 27.21.2025
1	Haridwar	-	-
2	Garhmukteshwar	-	-
3	Naini	4900	1700
4	Shastri bridge	21000	2600
5	Chhatnag	34000	3100
6	Varanasi	17000	2300

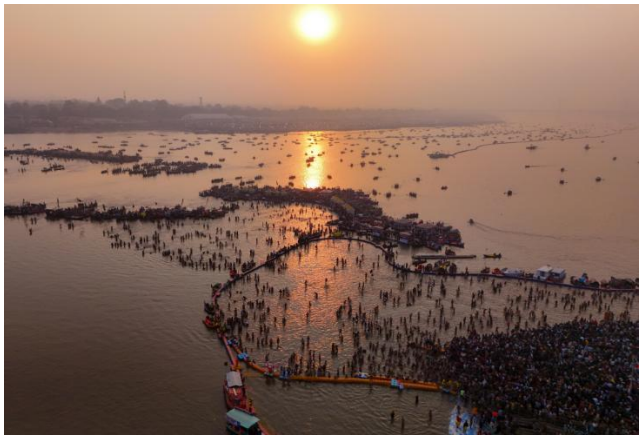
Fecal coliform bacteria are used as indicators of water contamination by human or animal feces. The presence of high levels of fecal coliform bacteria in water is a concern, as it suggests potential contamination and poses health risks, especially in recreational or potable water. The acceptable limit for fecal coliform levels in surface water for safe recreational use is generally < 2500 MPN/100 ml. At Naini significant reduction in fecal coliform levels from 4900 MPN/100 ml on the initial day to 1700 MPN/100 ml after the Kumbh Mela. At Shastri Bridge, fecal coliform levels decreased from a very high value of 21,000 MPN/100 ml on the initial day to 2,600 MPN/100 ml after the Kumbh Mela. Chhatnag exhibited the highest initial fecal coliform count of 34,000 MPN/100 ml, which decreased to 3,100 MPN/100 ml after the Kumbh Mela. In Varanasi, fecal coliform levels decreased from 17,000 MPN/100 ml on the initial day to 2,300 MPN/100 ml after the Kumbh Mela. During the Maha Kumbh Mela, there was a notable reduction in fecal coliform levels across the monitoring stations, suggesting some degree of dilution or improvement in water quality after the festival activities.

6.3 Before and After during Major Events

The water quality before and after major events during key festivals—Mauni Amavasya (Somvati), Basant Panchami, Maghi Purnima, and Mahashivratri during the 2025 Maha Kumbh Mela is illustrated in bar graphs. These graphs display parameters such as pH, electrical conductivity, turbidity, dissolved oxygen, biochemical oxygen demand, and chemical oxygen demand at six locations: Varanasi, Chhatnag, Shastri Bridge, Naini, Garhmukteshwar, and Haridwar.

6.3.1 Mauni Amavasya (Somvati) 29-01-2025

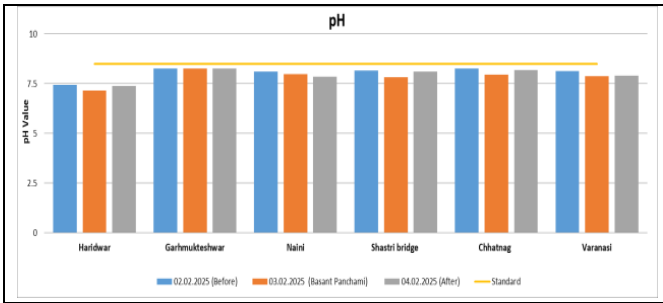


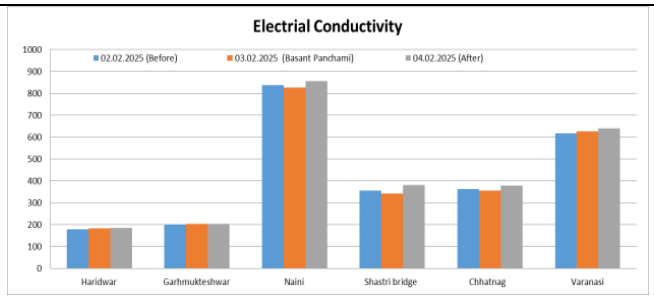


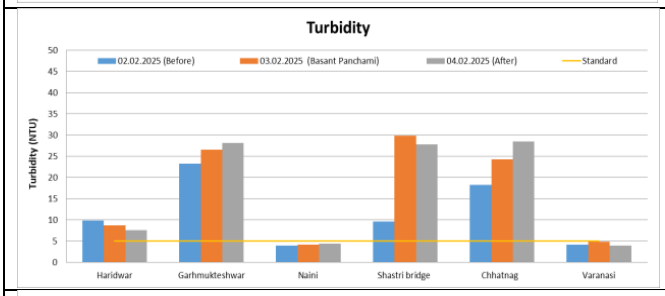
Mauni Amavasya - Second Amrit (Shahi) Snan

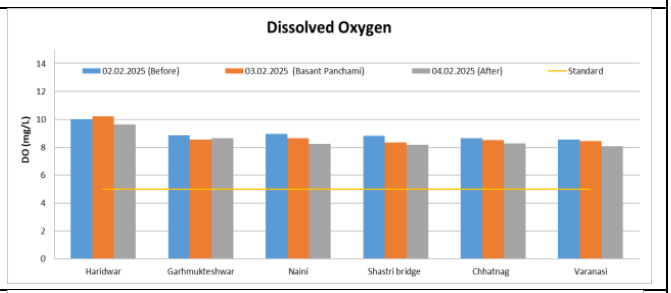
Mauni Amavasya - Second Amrit (Shahi) Snan

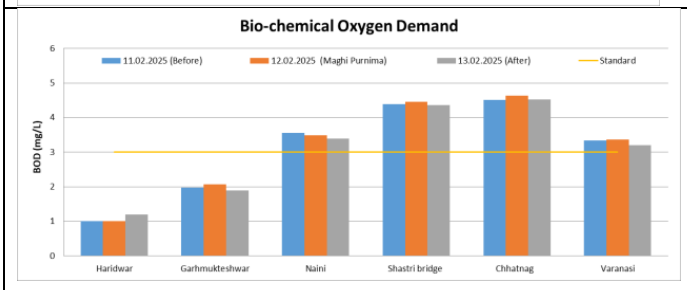
6.3.2 (Basant Panchami) 03-02-2025

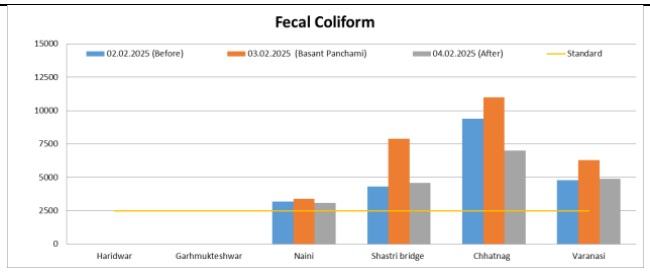






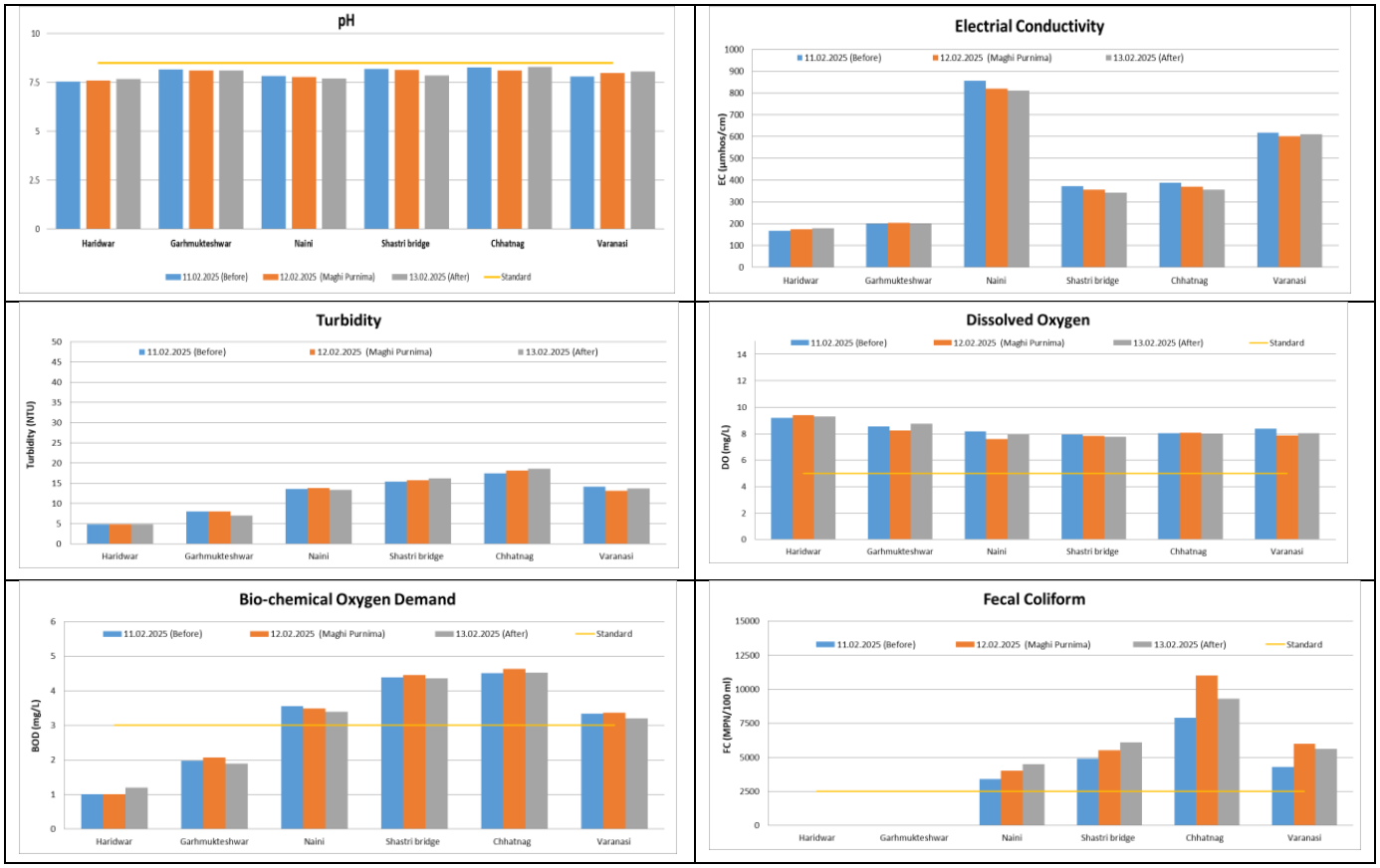


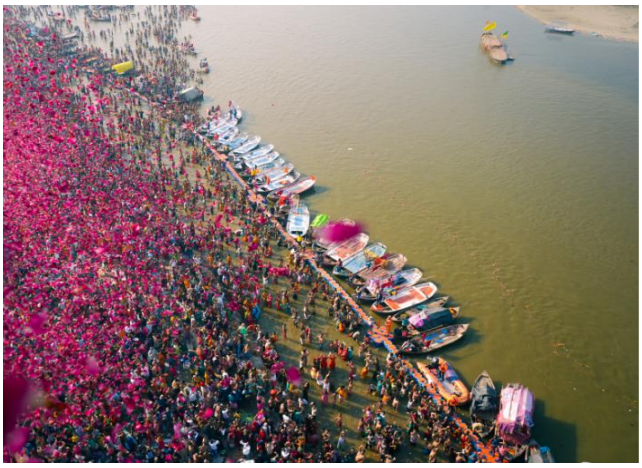




Basant Panchami - Amrit (Shahi) Snan

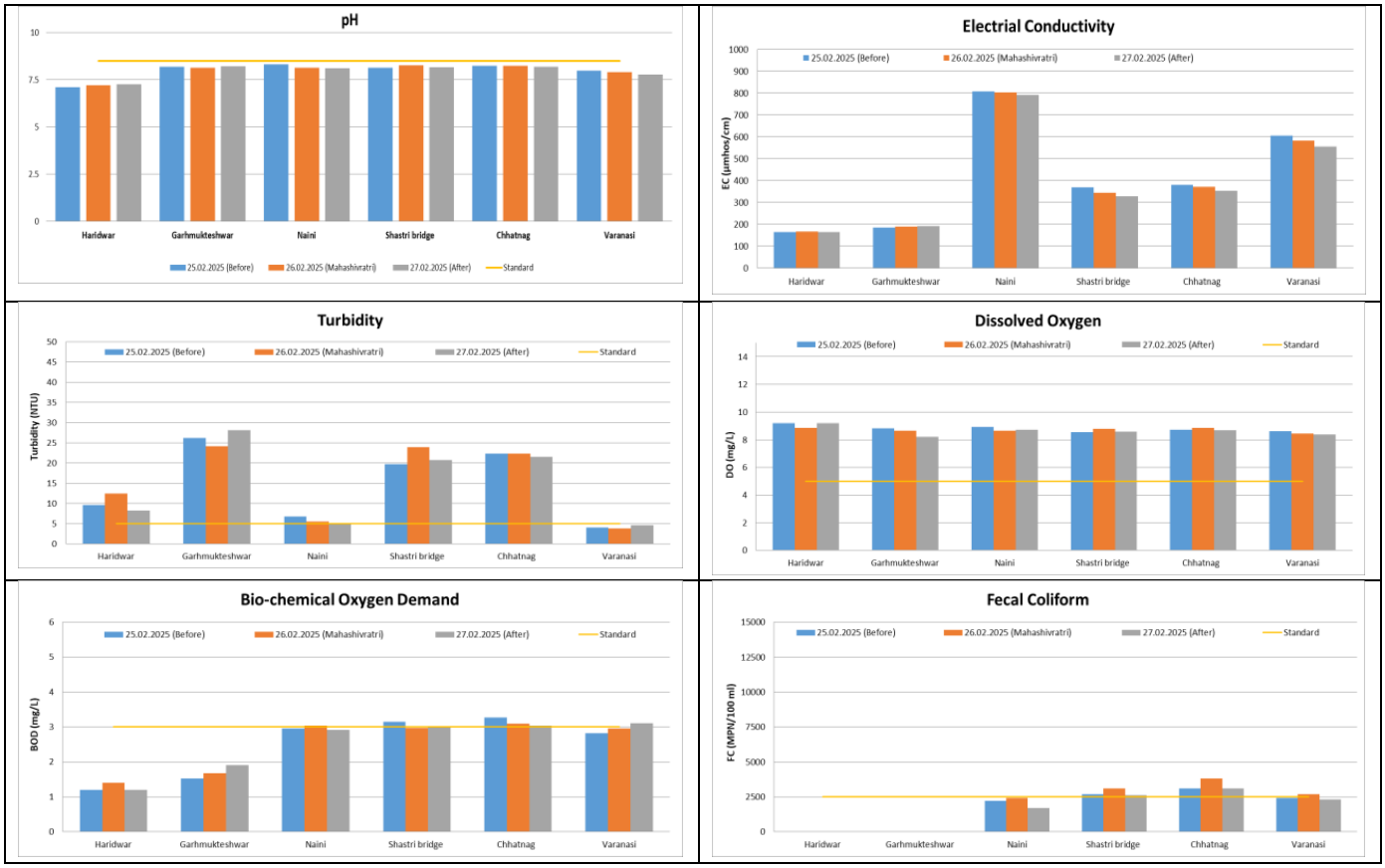
6.3.3 (Maghi Purnima) 12-02-2025





Maghi Purnima Snan

6.3.4 (Mahashivratri) 26-02-2025



Mahashivratri

The water quality at various monitoring stations across the river Ganga was assessed before and after the major festival events during the 2025 Maha Kumbh Mela. Parameters including pH, Electrical Conductivity (EC), turbidity, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Fecal Coliform levels were monitored at key locations, including Haridwar, Garhmukteshwar, Naini, Shastri Bridge, Chhatnag, and Varanasi. The results shown in Table 1.

Table 3. Water Quality Variation Before and After the Major Festival Events during the Kumbh Mela

Date of sampling	Water Quality Monitoring Stations	pH	EC	Turbidity	DO	BOD	COD	Fecal Coliform
28.01.2025	Haridwar	7.22	176.4	8.9	10.2	1	5.09	-
	Garhmukteshwar	8.22	216	29.3	9.22	1.49	8	-
	Naini	7.81	792	7.5	8.84	3.12	10	2500
	Shastri bridge	8.12	385	20.1	8.62	3.08	11.8	3400
	Chhatnag	8.29	393	19.9	8.54	3.14	12	4900
	Varanasi	8.24	612	4.5	8.62	2.98	10.2	3800
29.01.2025 Mauni Amavasya (Somvati)	**Haridwar**	**7.13**	**170.6**	**8.98**	**9.6**	**1**	**4.95**	**-**
	Garhmukteshwar	**8.05**	**229**	**24.3**	**8.63**	**2.06**	**9**	**-**
	Naini	**8.05**	**775**	**6.9**	**8.93**	**3.08**	**10.3**	**3100**
	Shastri bridge	**8.27**	**384**	**21.5**	**8.69**	**3.1**	**12.2**	**8400**
	Chhatnag	**8.24**	**389**	**23.1**	**8.61**	**3.16**	**12.8**	**12000**
	Varanasi	**8.16**	**604**	**6.2**	**8.73**	**2.92**	**10.7**	**5800**
30.01.2025	Haridwar	7.29	172.8	9.9	9.4	0.96	5.11	-
	Garhmukteshwar	8.22	222	29.1	8.97	1.57	8	-
	Naini	7.91	805	5.5	8.8	3.29	10.6	2700
	Shastri bridge	8.09	372	27.6	8.6	3.19	13	4800
	Chhatnag	8.29	381	25.4	8.52	3.25	13.5	7900
	Varanasi	8.03	612	4.9	8.68	3.05	11.1	4100
02.02.2025	Haridwar	7.45	178.6	9.9	10	1	4.95	-
	Garhmukteshwar	8.26	201	23.3	8.86	1.14	8	-
	Naini	8.11	838	3.9	8.95	3.08	13	3200
	Shastri bridge	8.16	355	9.6	8.81	3.14	14.3	4300
	Chhatnag	8.26	362	18.3	8.65	3.26	15.5	9400
	Varanasi	8.13	617	4.2	8.54	3.32	12.8	4800
03.02.2025 Basant Panchami	Haridwar	7.15	184.1	8.7	10.2	1.05	5.23	-
	Garhmukteshwar	8.27	205	26.5	8.56	1.41	9	-
	Naini	7.97	826	4.2	8.64	3.3	12.5	3400
	Shastri bridge	7.83	343	29.9	8.35	3.43	13	7900
	Chhatnag	7.94	357	24.3	8.51	3.35	13.8	11000
	Varanasi	7.87	627	4.9	8.43	3.39	13.2	6300
04.02.2025	Haridwar	7.38	186.8	7.6	9.65	1	5.18	-
	Garhmukteshwar	8.26	203	28.2	8.65	1.26	8	-
	Naini	7.84	855	4.4	8.23	3.22	13.2	3100
	Shastri bridge	8.1	382	27.8	8.17	3.36	14.9	4600
	Chhatnag	8.18	378	28.5	8.29	3.44	14.1	7000
	Varanasi	7.89	641	3.9	8.07	3.56	15.3	4900
11.02.2025	Haridwar	7.55	166.8	8.9	9.2	1	4.88	-
	Garhmukteshwar	8.16	200	26.3	8.56	1.97	8	-
	Naini	7.82	856	4.4	8.18	3.56	13.6	3400
	Shastri bridge	8.19	373	17.2	7.92	4.39	15.4	4900
	Chhatnag	8.27	389	22.9	8.02	4.51	17.5	7900
	Varanasi	7.79	617	3.7	8.38	3.34	14.2	4300
12.02.2025 Maghi Purnima	Haridwar	7.59	173.5	9.4	9.4	1	4.9	-
	Garhmukteshwar	8.1	205	40.2	8.25	2.07	8	-
	Naini	7.76	819	3.8	7.6	3.48	13.8	4000
	Shastri bridge	8.12	356	22	7.82	4.46	15.8	5500
	Chhatnag	8.1	369	25.1	8.06	4.63	18.1	11000
	Varanasi	7.97	602	4.8	7.88	3.36	13.2	6000
13.02.2025	Haridwar	7.66	179.3	8.6	9.3	1.2	4.83	-
	Garhmukteshwar	8.1	200.1	28.1	8.74	1.89	7	-
	Naini	7.69	811	4.3	7.93	3.39	13.4	4500
	Shastri bridge	7.86	342	16.1	7.77	4.36	16.2	6100
	Chhatnag	8.28	355	21.7	7.95	4.52	18.6	9300
	Varanasi	8.06	611	3.8	8.05	3.2	13.7	5600

Date of sampling	Water Quality Monitoring Stations	pH	EC	Turbidity	DO	BOD	COD	Fecal Coliform
25.02.2025	Haridwar	7.09	164.6	9.6	9.2	1.2	5.8	-
	Garhmukteshwar	8.18	186	26.2	8.81	1.52	8	-
	Naini	8.32	808	6.8	8.92	2.96	10.5	2200
	Shastri bridge	8.14	369	19.7	8.53	3.15	12.4	2700
	Chhatnag	8.23	381	22.3	8.7	3.27	14	3100
	Varanasi	7.98	606	4.1	8.61	2.82	10.1	2400
26.02.2025 Mahashivratri	Haridwar	7.21	166.9	12.5	8.84	1.4	5.89	-
	Garhmukteshwar	8.12	191	24.2	8.66	1.67	9	-
	Naini	8.14	804	5.5	8.65	3.03	10.3	2400
	Shastri bridge	8.26	344	23.9	8.77	2.97	12.9	3100
	Chhatnag	8.24	373	22.4	8.85	3.09	13.6	3800
	Varanasi	7.89	583	3.8	8.43	2.95	11.7	2700
27.02.2025	Haridwar	7.26	165.4	8.3	9.2	1.2	5.4	-
	Garhmukteshwar	8.21	192	28.2	8.19	1.91	9	-
	Naini	8.1	792	5.2	8.71	2.92	9.8	1700
	Shastri bridge	8.15	329	20.8	8.59	3	12.1	2600
	Chhatnag	8.19	354	21.5	8.67	3.04	14	3100
	Varanasi	7.76	555	4.6	8.39	3.1	12	2300

7. Conclusion:

The evaluation of water quality during the 2025 Maha Kumbh Mela provided valuable insights into the physicochemical and microbiological parameters at six monitoring sites along the Ganga and Yamuna rivers. This study aimed to assess the safety of the water for both drinking and bathing, particularly during significant festivals such as Mauni Amavasya, Basant Panchami, Maghi Purnima, and Mahashivratri. Overall, the water quality generally met the acceptable limits for outdoor bathing according to CPCB standards and primary water quality criteria for outdoor bathing although some fluctuations were observed due to human activities associated with mass bathing.

- **pH levels:** pH values were predominantly within the recommended range, indicating stable water quality. The maximum pH observed was 8.39 at Naini (Yamuna) on 21.02.2025, and the minimum was 7.08 at Haridwar (Ganga) on 27.01.2025. During the major events, the pH ranged from 7.13 (Haridwar) to 8.27 (Garhmukteshwar & Shastri Bridge). Variations in pH were observed between the initial monitoring (17.01.2025) and after the Kumbh Mela (27.02.2025). Haridwar showed a slight decrease, while Garhmukteshwar, Naini, Shastri Bridge, and Chhatnag exhibited increases, suggesting changes in water composition and alkalinity.
- **Electrical conductivity (EC**): EC levels showed variations, with the highest levels recorded at Naini in the Yamuna River. The EC values ranged from a minimum of 170.6 µmhos/cm at Haridwar (Ganga) on 29.01.2025 to a maximum of 861 µmhos/cm at Naini (Yamuna) on 01.02.2025. During the Maha Kumbh at Prayagraj, the EC ranged from 170.6 to 527 µmhos/cm, indicating ionic concentrations in the Ganga River.
- **Turbidity:** Turbidity levels during the 2025 Kumbh Mela varied significantly across different monitoring sites, with several locations exceeding the desirable limit of 5 NTU as per IS 10500:2012. Varanasi and Naini consistently recorded the lowest turbidity levels, while locations like Chhatnag, Shastri Bridge, and Garhmukteshwar saw high turbidity, particularly during key events like Maghi Purnima and Basant Panchami. These high levels were mainly caused by sediment disturbance from mass bathing activities. Shastri Bridge and Chhatnag experienced a sharp increase, indicating the impact of mass bathing and human activities on water quality
- **Dissolved oxygen (DO):** DO levels remained stable across all monitoring locations, ensuring favorable conditions for aquatic life and recreational activities. Data indicates that DO levels at all locations during the Maha Kumbh Mela 2025 remained within the acceptable limit for bathing (>5.0 mg/L), suggesting that water quality was mostly stable.
- **Biochemical Oxygen Demand (BOD):** BOD levels were mostly within acceptable limits; however, higher values were detected at certain sites due to organic loading from mass bathing activities.
- **Chemical Oxygen Demand (COD):** Chemical Oxygen Demand (COD): COD levels indicate some organic pollution, particularly at high-activity locations like Chhatnag and Shastri Bridge, which is typical during large gatherings.

- **Fecal coliform**: Fecal coliform levels indicates fecal contamination in water which is found in reducing trend since the start of event and till its conclusion. However, during major “Snan events” of Mahakumbh-2025, fecal coliforms levels were on higher side in reference to bathing standard criteria of MoEFCC.

In conclusion, the results highlight the importance of continued monitoring, effective sanitation practices, and public awareness to protect the quality of river water during large-scale events.

8. References

Central Pollution Control Board (2019). Environmental Footprints of Mass Bathing on Water Quality of River Ganga During Kumbh Mela. Retrieved from https://cpcb.nic.in/ngrba/reports/Report_5.pdf.

Central Water Commission (2014). Ganga Basin Report. Ministry of Water Resources, Government of India. Retrieved from https://indiawris.gov.in/downloads/Ganga%20Basin.pdf.

National Mission for Clean Ganga (NMCG) & National Environmental Engineering Research Institute (NEERI). (2019). Assessment of Water Quality and Sediment to Understand the Special Properties of River Ganga. Ministry of Jal Shakti, Government of India.

Wetzel, R. G. (2001). Limnology: Lake and River Ecosystems (3rd ed.). Academic Press.

Hickin, E. J. (Ed.). (1995). River Geomorphology. Wiley.

Langland, M., & Cronin, T. (Eds.). (2003). A Summary Report of Sediment Processes in Chesapeake Bay and Watershed. Water-Resources Investigations Report 03-4123. U.S. Geological Survey, New Cumberland, PA.

Palermo, M. R., Schroeder, P. R., Estes, T. J., & Francingues, N. R. (2008). Technical Guidelines for Environmental Dredging of Contaminated Sediments. U.S. Army Corps of Engineers, Engineer Research and Development Center, ERDC/EL TR-08-29.

U.S. Environmental Protection Agency (EPA). (2014). Sediments. In Water: Pollution Prevention & Control.

Armiento, M. (2016). The Sustainable Welfare Index for Italy, 1960–2013 (Working Papers).

****


महाकुंभ
2025
mygov
मेरी सरकार