| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 4.988

| Volume 4, Issue 1, January 2021 |

Ionic Composition of River Bhagirathi in Rishikesh According to Their Source of Origin, During Corona Period India

Dr. Shivani Pattnaik

Assistant Professor, Department of Chemistry, DBS (PG) College, Dehradun, Uttarakhand, India

ABSTRACT: Bhagirathi River water quality was assessed to record the changes due to the nation-wide pandemic lockdown. Satellite-based (Sentinel-2) water quality analysis before and during lockdown was performed for seven selected locations spread across the entire stretch (Rishikesh–Dimond Harbour). Results revealed that due to the lockdown, the water quality of the Bhagirathi improved with reference to specific water quality parameters, but the improvements were region specific. Along the entire stretch of Bhagirathi, only the Haridwar site showed improvement to an extent of being potable as per the threshold set by the Central Pollution Control Board, New Delhi, India. A 55% decline in turbidity at that site during the lockdown was attributed to the abrupt halt in pilgrimage activities. Absorption by chromophoric dissolved organic matter which is an indicator of organic pollution declined all along the Bhagirathi stretch with a maximum decline at the downstream location of Diamond Harbour. Restricted discharge of industrial effluent, urban pollution, sewage from hotels, lodges, and spiritual dwellings along the Bhagirathi are some of the reasons behind such declines. No significant change in the geographic trend of chlorophyll-a was observed. The findings of this study highlight the importance of regular monitoring of the changes in the Bhagirathi water quality using Sentinel-2 data to further isolate the anthropogenic impact, as India continues the phase-wise opening amidst the pandemic.

KEYWORDS: Bhagirathi, Rishikesh, ionic, corona, period, composition, India

I. INTRODUCTION

India's Corona virus disease (COVID-19) phase-wise lockdown initiated is still ongoing at different phases with changes in restrictions in several sectors depending on the regional cases. The travel restrictions and urban activities were relaxed with each phase starting from a total ban during Phase-1 for 21 days. Recently, several rapid environment assessment studies have come out with initial assessments of the impact of the lockdown on the water quality of inland and coastal waters in India . The Bhagirathi River with 2601 km of length has been exposed to extreme pollution over the past few decades as reported by the Central Pollution Control Board (CPCB), India. Because of the lockdowns, most of the industries, tourism activities, pilgrimage, hotels and lodges, shops in proximity to all these establishments, which are the major source of pollution to the Bhagirathi, were closed . However, inputs from domestic discharge from households along the Bhagirathi continued, presumably at an increased rate, during the lockdowns. The pollution sources and loading to Bhagirathi River are region specific, for example, places such as Varanasi and Haridwar being the pilgrim hotspots, are exposed to pollutants from hotels, restaurants, and shops, etc., along with ambient baseline pollution from the rest of the urban activities[1,2] . Sites near Kanpur and Bakhtiarpur (Patna) are mostly influenced by industrial inputs . In contrast, regions near Rishikesh receive the least domestic inputs due to lesser anthropogenic activity and settlement . In downstream regions, Garden Reach and Dimond Harbour sites receive the effluents discharged from upstream all along the Bhagirathi stretch before draining to the Bay of Bengal.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 4.988

| Volume 4, Issue 1, January 2021 |

Bhagirathi river in Uttarakhand

In the recent past, India's news media has widely reported that because of the lockdown, the Bhagirathi water has been revived up to the extent that it is now potable. For example, it was reported that the Bhagirathi experienced a reduction in biochemical oxygen demand (BOD), chemical oxygen demand (COD) concentration, an overall improvement especially with regard to increased dissolved oxygen (DO), and reduced nitrate concentration was due to relatively less discharge of domestic wastewater . During the peak of the lockdown, it was also reported that the overall water pollution declined up to 50% as the pollution sourced from industries was stopped due to the lockdowns [3,4]. As per the report, the water quality DO, BOD, pH, and ammonia levels became suitable for bathing and use by wildlife and fisheries during the lockdown period. Several news stories went so far as to report that the Bhagirathi water has become fit for drinking during the peak of the lockdowns .Contrasting to all this news, The Hindu reported that even though the lockdown dramatically reduced air pollution across the country, it has not significantly reduced pollution in the Bhagirathi River as the reduction in BOD and COD was not significant enough . Despite the news reports, there has not been much scientific evidence published to date except a few studies on the upstream of Ganges at Haridwar, Kanpur, Varanasi, and Prayagraj , and lower stretch of the river (i.e. Bhaghirathi-Hoogly river) in West Bengal segment , which provided some evidence of improved water quality.[5,6]

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 4.988

| Volume 4, Issue 1, January 2021 |

Rishikesh (tourist spot)

As reported by these studies, the improvement in water quality was in reference to parameters such as DO, BOD, COD, pH, turbidity, and ammonia in different locations. None of the parameters can be solely used to represent the quality of the water to be fit for drinking, bathing, or used by livestock. But as a group, these parameters can designate the best use based on pre-established thresholds for each . Apart from these parameters, chromophoric dissolved organic matter (CDOM), total suspended matter (TSM), and chlorophyll-a (Chl-a) also represent the quality of water and can be measured through remote sensing techniques in the case of the absence of field data for a particular period and location. Since during the lockdowns, field data collection was not feasible, remote sensing techniques were used for the assessment of environmental changes .Among these three parameters, CDOM serves as a good indicator of anthropogenic influences including land surface runoff and sewage water pollution, and water quality contamination for the riverine systems .It also acts as a good proxy for the dissolved organic carbon (DOC), biochemical oxygen demand (BOD), chemical oxygen demand (COD), and heavy metals . TSM is a measure of suspended organic and inorganic materials in the river waters . TSM and Chl-a are widely used as proxies for the riverine water quality in terms of eutrophication. Chl-a, a proxy for trophic status, is often used to assess the ecological response of a water body to excessive pollution[7,8] .

In the present study, remote sensing techniques were utilized to estimate three water quality parameters, viz., CDOM, TSM, and Chl-a, and compared their temporal dynamics at seven stations to disentangle their temporal variations and isolate the impact of the lockdown. This is the first study focused on the three parameters for a comprehensive assessment of the changes in the Bhagirathi water quality as compared to pre-lockdown period along the entire stretch of the Bhagirathi, i.e. from upstream (Rishikesh in the north) to downstream (Diamond Harbour in the east) through remote sensing approach and the assessment of ionic composition of river Bhagirathi in Rishikesh according to their source of origin, during corona period, India[9,10]

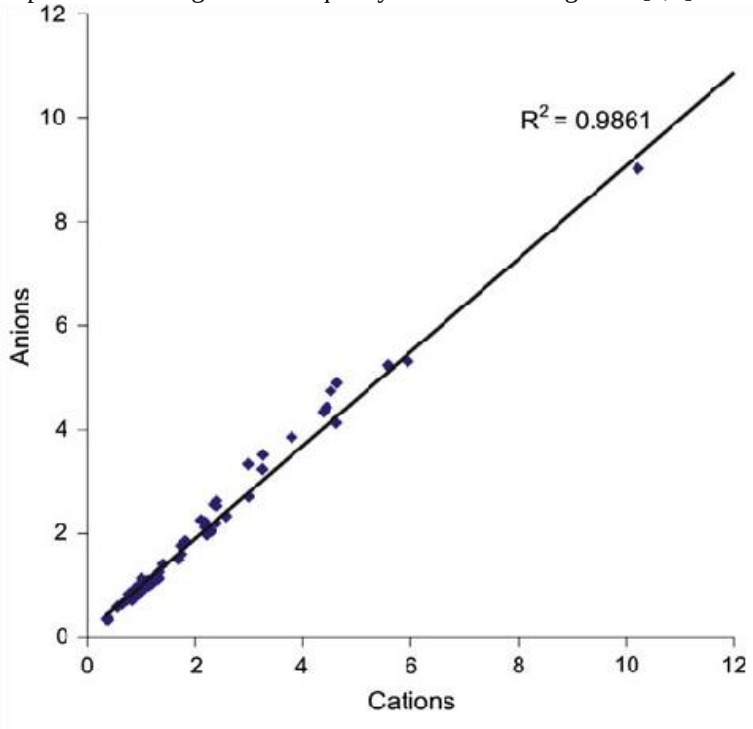
II. DISCUSSION

The paper discusses the ionic sources and chemical quality of the waters (surface and groundwater) of river Bhagirathi during corona period. The main Bhagirathi river, tributary streams and springs and groundwater are the main sources of water for the reservoir and inhabitant living around it. Fifty-two water samples were collected from springs, handpumps (borewell) and streams and were analysed for major ions. The pH is varying from 6.8 to 8.6 and EC from 28 to 820 µS/cm. The chemical composition of water is dominated by Ca, Mg and HCO3. The high ratio of Ca + Mg/Na + K and

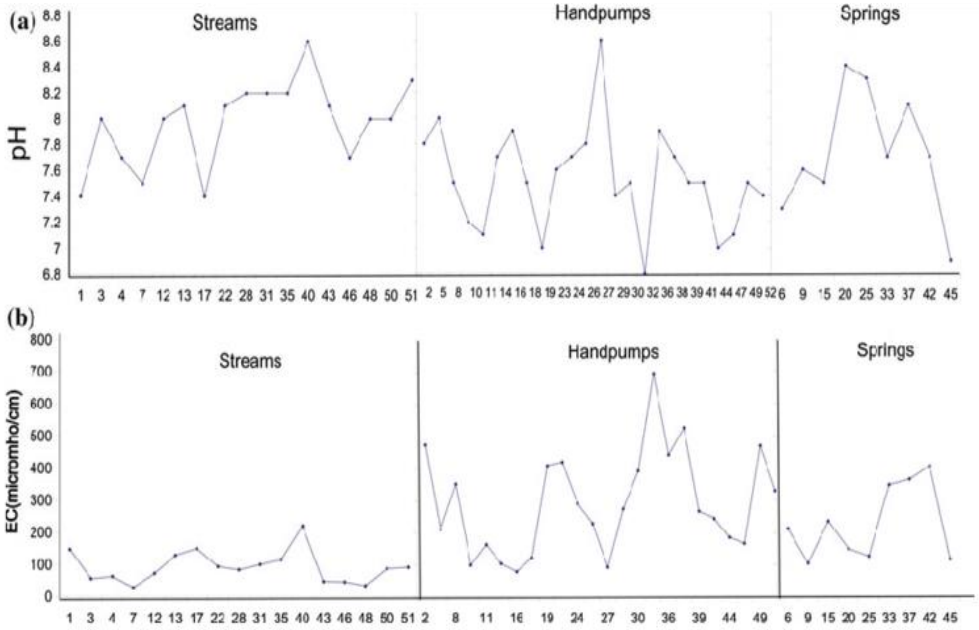
| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 4.988

| Volume 4, Issue 1, January 2021 |

low ratio of Na + K/TZ indicate dominance of carbonate dissolution as the main solute acquisition process in this part of river Bhagirathi. The trilinear and X–Y plots suggest less contribution from silicate weathering and anthropogenic activities. The excess of Na over Cl indicating much of the alkalis in the waters of Bhagirathi have source other than precipitation possibly from silicate weathering. Recharged by meteoric water, the quality of water in the study area is controlled essentially by chemical processes occurring between water and lithology and locally altered by human activities. Among the trace metals the concentration of Fe at few locations has marginally exceeded the WHO and BIS standards of drinking water. The analytical result computed from various water quality indices indicate fairly good quality of water for both drinking and irrigation purposes. The factor analysis performed on the major ion data indicate two factors are the most important affecting the water quality of the river Bhagirathi.[8,9]



Assessment of ionic composition of river Bhagirathi during Corona period



Variations in pH and conductivity of river Bhagirathi during Corona period

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 4.988

| Volume 4, Issue 1, January 2021 |

III. RESULTS AND CONCLUSIONS

From the results of the present study, it is concluded that due to COVID-19 lockdown, the minimal (or no) discharge of industrial effluent, urban runoff, pilgrimage, and tourism-related wastewater helped improve the water quality of the Bhagirathi up to some extent at specific locations. Waters at Rishikesh found to become potable because of the lockdown but with respect to turbidity only. However, other parameters such as toxic trace metals, organic pollutants such as pesticides, PAH (polycyclic aromatic hydrocarbon), TPHC (total petroleum hydrocarbon), and FC (fecal coliform), which need to be studied and compared against the approved threshold values to confirm its actual potability. aCDOM showed a prominent change with reference to the lockdown impact as compared to TSM and Chl-a, and hence it can be considered as a proxy for industrial and anthropogenic impacts on Bhagirathi water quality. These results can be used as the baseline data for monitoring future changes of water quality in the Bhagirathi as the anthropogenic activities resume with time. The results can be helpful for several ongoing modelling studies on the Bhagirathi aimed at predicting hydrological parameters as well as pollution in relation to changing environmental conditions due to anthropogenic activities. The limitation of the present study is the absence of field data which could not be acquired due to lockdown; therefore, future study must include the ground truth data for model validation and tuning.

Since the study demonstrated successful implementation of satellite data for monitoring Bhagirathi water quality, it is recommended that future studies use satellite-based analysis to map parameters such as dissolved organic matter, nutrients, conductivity, TSM, and water temperature either through direct satellite-derived values or through indirect models and algorithms. It would be helpful for the policymakers to develop and establish short-term or long-term based management and mitigation plans. Continuous monitoring of the entire stretches of the Bhagirathi River should be carried out to observe the changes after the lifting of the lockdown restrictions and all anthropogenic input return to pre-pandemic levels.[9,10]

REFERENCES

1. Times of India “how-lockdown-has-been-a-gift-for-river-ganga”- article-75569852
2. India Today “coronavirus-lockdown-India-fresh-air-clean-rivers” article 1669726
3. India Today “lockdown impact ganga water in Haridwar becomes fit to drink after decades” -1669576-2020
4. The Hindu “lockdown due to covid-19 how our waterbodies are cleaner”-article 2019
5. Water Quality Assessments - A Guide to Use of Biota, Sediments and Water in Environmental Monitoring - Second Edition 2019
6. A Report on Impact of Lockdown on Water Quality of River Ganga, CPCB, APRIL 2020.
7. Assessment of Impact of Lockdown on Water Quality of Major Rivers, CPCB, SEP-2020.
8. IoT Based Real-time River Water Quality Monitoring System, Procedia Computer Science, Volume 155, 2019, Pages 161-168.
9. Real-Time Water Quality Monitoring with Chemical Sensors, Sensors 2020, 20(12), 3432.
10. CPCB Guidelines Water Quality Monitoring. CWC, Field Water Analysis Manual- January, 2020