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Assessment of Water Quality of Narmada River in COVID-19 pandemic and comparison with water quality of its tributaries in Mandla, Madhya Pradesh

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Abstract: In the present study, the quality of the surface water of the Narmada River (Mandla, Madhya Pradesh) was investigated. Mandla is situated in the eastern part of Madhya Pradesh, part Gondwana tract, a forest-dominated upper valley, and the plateau of the Maikal Hill Ranges. Recently, Mandla has experienced unregulated development activities and rapid population growth in recent decades, both of which have had negative impacts on its ecosystem and environment. Seven sample sites of the Narmada River and its tributaries were selected and water was collected and they were analyzed for a total of five different parameters. The observed data were analyzed using a portable multi-parameter and DO meter. We have undertaken water quality assessments for the Narmada River in Mandla City and its tributaries in the upper catchment area (Surpan, Matiyari, Halon Banjar, and Gour River). During the lockdown, the water quality of the Narmada River in Mandla City has been significantly improved in pH, DO, and TDS physicochemical properties. The study will help set up a baseline for river pollution in Mandla City. It will also help generate awareness among the decision-makers, media, and general public about the water quality in the river Narmada and the contribution of its tributaries to its health.

Introduction

Water is a crucial resource for both human survival and the global economy. However, the quality of worldwide water has quickly degraded for decades as a result of both natural and manmade processes (Vadde et al. 2018). Rivers are always an important source of water supply, but due to the release of various types of influents, industrial and domestic wastewater (Desai, 2014), agricultural activities, etc. (Khatri & Tyagi, 2015; Ongley, 1998).

India has about 1953 km2 of network of rivers (Kumar, Singh, & Sharma, 2005). Due to the release of various contaminants, including organic and inorganic contaminants, bacteria and viruses, etc most of the rivers are polluted. (Bhardwaj, 2005; Kurunthachalam, 2013). Urban areas situated near rivers produce large volumes of sewage which are usually discharged into water sources without proper treatment (Central Pollution Control Board [CPCB], 2018a, 2018b; Shukla & Gedam, 2018), while use of chemical fertilizers in agriculture in river catchments are major sources of river contamination (Khatri & Tyagi, 2015). Studies of WQI have been reported on many rivers, e.g., Ganga River (Bhargava 1983); Dez River (Samaneh et al. 2020); River Mahi (Srivastava et al. 2011); River Cauvery (Pandian et al. 2011); River Sabarmati (Shah & Joshi 2017); Al-Gharraf River (Ewaid & Abed 2017); Yamuna River (Sharma & Kansal 2011); and Narmada River (Rahi 2025).

The Narmada River and its tributaries play a vital role in providing water resources to urban areas. However, rapid urbanization and industrialization have led to concerns about water quality degradation. This study presents an assessment of water quality in urban-dominated areas of Mandla City, Madhya Pradesh along its tributaries during the COVID-19 lockdown in April–May 2020.

Methodology

The criteria for site selection were one tributary or stream in upper catchment of the Narmada River and the lower Catchment of the Narmada River, covering almost all regions, including forest, Agriculture, and human settlement. For analysis of the quality of water, seven sampling sites (two in Narmada river and one in Gour, Matiyari, Halon and Surpan rivers) were selected in Narmada river and its tributaries the study area of Mandla district (Figure 1). For water quality analysis, five samples per site are taken and samples are transferred to the laboratory for analyzing pH and Electric Conductivity (EC), Temperature, Total dissolved solids (TDS), and Dissolved Oxygen (DO). Water analysis is done by a multi-parameter and DO meter for pH, electrical conductivity, TDS, Temperature, and Dissolved Oxygen.

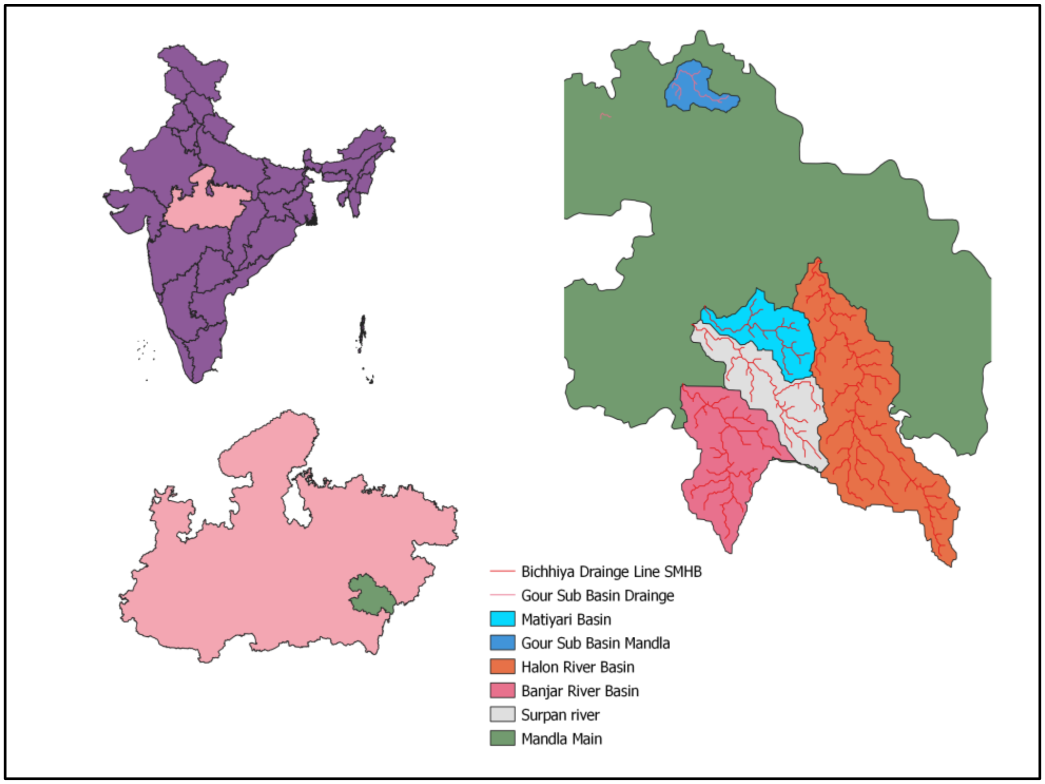

Fig.1 Location Map

Result & Discussion

The comparative analysis of water quality during the COVID-19 lockdown reveals contrasting conditions between the upper and lower catchments of the Narmada River. While the upper catchment maintained relatively stable water quality, the lower catchment experienced significant improvements during the lockdown period.

pH Value

pH is calculated by the number of hydrogen ions in solution. The lower the number, the more acidic the water is. The higher the number, the more basic it is. A pH of 7 is considered neutral. pH values of the two sites are within the acceptable range (6.5 to 8.5). In Rapta Ghat the pH is about 6.7, whereas in Rangrej Ghat pH is about 7.0.

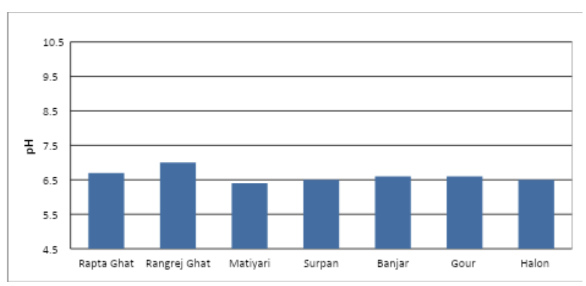

Fig 2: Comparative values of pH of selected sites in Narmada and its tributaries

Temperature

Temperature is an important factor to consider when assessing water quality. In addition to its effects, temperature influences several other parameters and can alter the physical and chemical properties of water. Water temperature can affect the metabolic rate and biological activity of aquatic organisms. Higher temperature leads to increased oxygen consumption. Further above 35 °C can begin to denature the enzyme's activities.

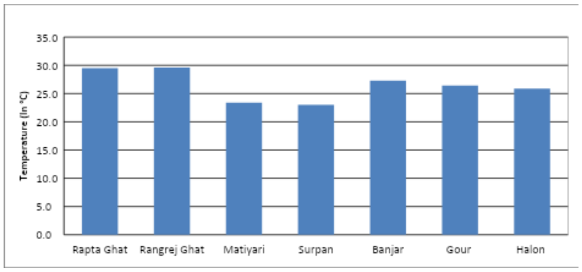

Fig 3: Comparative values of Temperature-selected sites in Narmada and its tributaries

Total Dissolved Solids

Total Dissolved Solids (TDS) of the Narmada River are between 180-200 ppm, which is good for drinking and bathing, whereas Holan and Matiyari rivers' TDS are slightly higher. Unseasonal Rainfall in March 2020 may affect the flow and TDS.

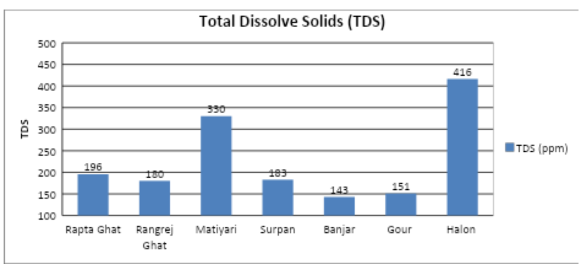

Fig 4: Comparative values of TDS of selected sites in Narmada and its tributaries

Conductivity

High conductivity of water means more chemicals in water. In simple words, more conductivity increases the mobility of ions in water. The rate at which conductivity increases is dependent on the salts present in the solution. The lower the number, the more acidic the water is. Distilled or deionized water has low conductivity on the other hand Sea seawater has a very high conductivity. Freshwater streams ideally should have conductivity between 150 to 500 µS/cm to support diverse aquatic life.

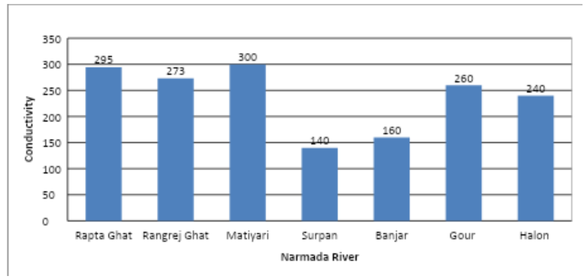

Fig 5: Comparative values of Conductivity selected sites in Narmada and its tributaries

Dissolve Oxygen

It is an important parameter in assessing water quality because it influences the organisms living within a body of water. A dissolved oxygen level that is too high or too low can harm aquatic life and affect water quality. Dissolved oxygen level should be more than 6 mg/L. The maximum DO was found in Surpan River (8.6mg/L), whereas the minimum in Narmada River DO level is 7.6 mg/L.

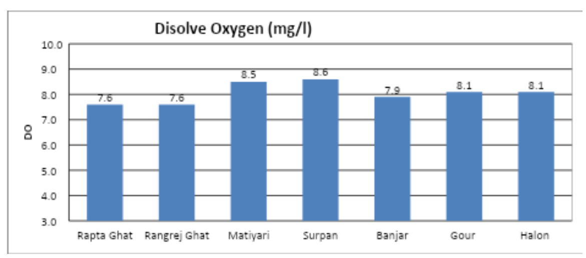

Fig 6: Comparative values of DO of selected sites in Narmada and its tributaries

For getting information on the water quality of rivers or streams and for effective management, regular monitoring programs are required (Singh et al., 2005; Gupta et al.

2017). The values of pH were well within the standard in all the study sites (BIS, 2012; WHO, 2017). The pH values of Rapta Ghat and Rangrej Ghat is slightly higher as compared to other sites during the lockdown period but in before the lockdown, the pH range was higher. The highest WT was recorded at (29.7°C) during the study period and the lowest at Surpan (23.0°C (Fig. 3). Expect two sites in the Narmada River all sites have riparian vegetation cover, which helps to reduce the temperature and plays an important role in the maintenance of streams. Riparian trees maintain low water temperatures by providing shade which reduces light and in turn photosynthesis (Arthington et al., 1992).

TDS (Total Dissolved Solids) and EC (Electric Conductivity) indicate the salinity of the water (Singh et al., 2020). The highest EC (300 μS cm−1) in matiyari and TDS (416 mg/l) recorded at Halon, within the acceptable limit (ICMR, 1975; BIS, 2012). Lowest EC (140 μS cm−1) recorded in Surpan and TDS (143 mg/l) were recorded at Surpan and Banjar respectively. All the sites have EC and TDS within the Acceptable limits (Fig. 4 and Fig. 5). The value of EC and TDS could be attributed to agricultural runoff. Agricultural runoff carrying organic matter and nutrients in the water body might be responsible for high EC and TDS in water (Jindal and Sharma, 2011) and Singh et al., 2020).

.It can be said that riparian vegetation in Surpan and Banjar River land use changes might have played a crucial role. The riparian vegetation of this site is dominated by some common plant species of this region such as Bambusa species, Terminalia arjuna, Butea monosperma, Syzygium communi, and Ficus Sp. Terminalia elliptica, some species of aquatic plants, ferns, and varieties of grass species help in maintaining the water quality parameters. The most significant variable for assessing water quality is Dissolved Oxygen (DO). DO is an indicator of good water quality that ensures not only water quality but also is essential for aquatic life. The Standard limit of DO is 4–6 mg/l and the ideal value is 14.6 mg/l (Gupta et al., 2017). DO value in water less than this range is expected to be the polluted water (Burden et al., 2002). Due to sewage discharge to the river might be degrading its water quality resulted in the minimum DO concentration reported at Rangrej ghat (2.6 mg/l) and Rapta ghat also reported a rather low DO concentration, at 3 mg/l (Gupta et al. 2020). Both ghats are in the middle of Mandla, one of the oldest towns in Madhya Pradesh, suggesting that sewage discharge to the river might be degrading its water quality. The DO values ranged from 7.6 mg/l at Rapta ghat and Rangrej ghat to 8.6 mg/l at Surpan River. The DO levels are improved from 2.6 - 3.0 to 7.6 mg/l in Rangrej ghat and Rapta ghat.

Conclusions

Before the Lockdown in the upper catchments of the Narmada River where forest is dominated, relatively pristine conditions with low levels of pollutants, minimal anthropogenic activities, and limited human settlements.

Due to these reasons, marginal changes in water quality parameters were observed and overall, water quality remained relatively stable and within acceptable limits during the lockdown period. Domestic sewage is still finding its way into rivers but in the absence of Solid waste and general Garbage and increase in water flow has considerably helped river. In the lower catchment area (Mandla City) elevated levels of pollutants due to urban runoff, agriculture activities in bank areas, significant anthropogenic pressures leading to degraded water quality, bathing, performing rituals in densely populated and municipal sewage discharge into the river, significant anthropogenic pressures leading to degraded water quality in before lockdown period (Gupta et al. 2020) but during the lockdown noticeable improvements in water quality parameters observed reductions in pollutant levels.

Improved dissolved oxygen levels and water clarity due to decreased ritual activity and urban pollution. Sustained efforts are needed to address ongoing pollution challenges and ensure the long-term health and sustainability of the Narmada River ecosystem.

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Fig.7 Cultural and rituals were stopped during the lockdown, resulting in water clarity and overall water quality improved

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