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Physico-Chemical Assessment of Water Quality of the Mula River, Pune

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Abstract
The Mula River is an important tributary of the Mutha River flowing through the rapidly urbanizing city of Pune, Maharashtra, and serves as a vital freshwater resource for domestic, agricultural, and ecological needs. The present study assesses the physico-chemical characteristics of the Mula River with emphasis on key water quality parameters including colour, odour, pH, temperature, and dissolved oxygen (DO). The study was conducted from January to June 2025, during which water samples were collected from three selected locations along the river to assess spatial variations and the influence of anthropogenic activities. The river water exhibited greenish-black and muddy coloration along with an unpleasant odour, indicating significant organic pollution. Water temperature ranged from 27 to 29 °C, pH values varied between 7.3 and 7.6, and dissolved oxygen levels were recorded between 2.6 and 3.4 mg/L, reflecting degraded water quality and ecological stress. The findings highlight considerable deterioration of water quality in the Mula River and emphasize the need for regular monitoring and effective pollution control measures to protect and restore the ecological health of this urban river.

Keywords: Water quality assessment; Water pollution; Dissolved oxygen; Anthropogenic activities; Urbanization; Mula River

Introduction

Human health and overall quality of life are strongly influenced by the availability of safe and clean water (Avtar et al., 2019; Pandiarajan, A et al., 2023). Although water covers much of the Earth's surface, only a limited proportion is freshwater, whereas the majority is saline. Unsustainable utilization and pollution have rendered freshwater a scarce and vulnerable resource. (Hassan and Ali, 2016; Hassan, N. E., & Mohammed, S. J. 2023) The increasing degradation of water quality has made water pollution one of the most serious environmental problems at the global level in recent years (Naghipour et al., 2018). The majority of water pollutants are chemical compounds—such as dissolved salts and heavy metals—that remain either dissolved or suspended within the aquatic medium. (Hassan and Al-Barware, 2016).

According to the World Health Organization (WHO), a substantial proportion of infectious diseases worldwide are associated with the consumption of contaminated water, including groundwater sources. Rapid urbanization, intensive livestock rearing, rural industrial activities, and agricultural practices contribute significantly to the introduction of pollutants into water resources. Specific sources of aquifer contamination include agricultural runoff, industrial effluents, domestic sewage, leachate from landfills, and seepage from pit latrines. Ongoing expansion of industrial and agricultural activities, coupled with inadequate freshwater management and regulatory frameworks, is likely to further exacerbate groundwater quality deterioration (Abduljabar et al., 2020; Amangabara and Ejenma, 2012; Hassan, N. E., & Mohammed, S. J. 2023). Dissolved oxygen (DO) serves as a key indicator of the health of aquatic ecosystems. Adequate oxygen levels are necessary for the survival of aquatic organisms and play an important role in the decomposition of organic matter, as well as in controlling water taste, odour, and sediment–water interactions. Changes in climate, particularly rising temperatures and altered water circulation, can reduce oxygen availability in surface waters. Consequently, evaluating the effects of climate change on dissolved oxygen is crucial for understanding future trends in water quality and maintaining ecosystem balance (Chapra, S.C 2021). The present study assessed the water quality of the Mula River in Pune city with reference to its suitability for irrigation. Pollution intensity was evaluated using key physico-chemical parameters, namely colour, odour, temperature, pH, and dissolved oxygen (DO). The Mula River, a major tributary of the Mutha River originating in the Western Ghats, flows through rapidly urbanizing areas of Pune and is increasingly impacted by

domestic sewage, industrial effluents, agricultural runoff, and solid waste disposal. Alterations in pH, reduced dissolved oxygen levels, and the presence of undesirable colour and odour indicate organic pollution and declining water quality. These changes may adversely affect soil quality and crop productivity when river water is used for irrigation, highlighting the need for regular monitoring and effective management to protect the river ecosystem.

Material and Method

Study locations

The Mula River originates in the Mulshi region of the Western Ghats, Maharashtra, and flows eastward through Pune city before joining the Mutha River. Within the Pune Metropolitan area, the river stretches for approximately 22–25 km and traverses highly urbanized and industrialized zones.

For the present investigation, river water samples were collected twice monthly from January 2025 to June 2025 at three selected urban sampling stations: Aundh (Station I), Pimple Nilakh (Station II), and Balewadi (Station III), located upstream of the Mula–Mutha confluence. Sampling was conducted to evaluate spatial variations in river water quality.

The collected samples were analysed for selected physico-chemical parameters, including colour, odour, temperature, pH, and dissolved oxygen (DO), to assess the pollution status of the river. Temperature and pH were measured in situ using a multiparameter probe (Eutech PCS Tester 35), while dissolved oxygen was determined using a digital bench-top DO meter (Aqua sol AB-DO-01). The resulting data were subjected to statistical analysis for interpretation.

Result and Discussion

The physico-chemical characteristics of the Mula River recorded at three urban sampling locations- (S1), (S2), and (S3) are summarized in Table 1. Variations in the measured parameters among the stations indicate the influence of localized anthropogenic activities along the river course.

Colour and Odour

Distinct differences in water appearance and smell were observed at the sampling sites. At S1, the river water exhibited a greenish-black coloration with a strong organic odour, suggesting elevated organic matter and possible sewage contamination or algal proliferation. In contrast, water samples from (S2) and (S3) were muddy to grey in colour and emitted a muddy odour, indicating high suspended solids likely originating from surface runoff, domestic wastewater, and urban disturbances. These sensory characteristics reflect a degraded water quality status in the urban stretch of the river.

Temperature

Water temperature values ranged between 27.8 °C and 29.0 °C at the studied locations. The maximum temperature recorded at S2 may be attributed to reduced shading, intense urban activity, and possible inflow of warmer effluents. Elevated water temperature is known to influence chemical processes in aquatic systems and can negatively impact dissolved oxygen availability (Sardana, M. et. al. 2022)

pH

The pH of the river water remained slightly alkaline at all sampling stations, with values varying from 7.3 to 7.6. Although these values lie within permissible limits for surface water, the alkaline nature may reflect the contribution of urban runoff, domestic discharges, and materials derived from construction and industrial activities.

Table 1: Physicochemical parameters of Sampling sites of Mula river

Mula River sampling sites	Physiochemical Parameters (Mean±SD)				
	Colour	**Odour**	**Temperature (°C)**	**pH**	**OD (mg/L)**
S1	Greenish black	Unpleasant organic odour	27.83±0.41	7.67±0.10	2.43±1.29
S2	Muddy	Muddy	29±0.63	7.6±0.18	2.61±0.99
S3	Grey	Muddy	27.67±0.52	7.38±0.09	3.45±0.53

Dissolved Oxygen (DO)

Dissolved oxygen concentrations were consistently low across all sampling stations, ranging from 2.61 mg/L to 3.45 mg/L. The lowest DO value was observed at S2, followed by S1, (Fig.1) indicating substantial organic loading and enhanced oxygen consumption due to microbial decomposition of organic matter. Comparatively higher DO levels at S3 may result from improved aeration or comparatively lower pollutant input. However, the recorded DO values

at all sites remain below the optimum levels required to sustain healthy aquatic life, indicating stressed ecological conditions.

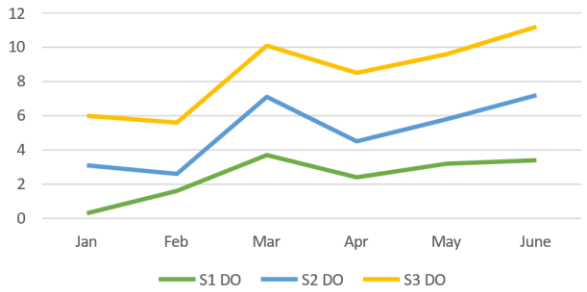

Fig. 1. Dissolved Oxygen Levels at Selected Sampling Sites of the Mula River

Conclusion

The assessment of physico-chemical parameters of the Mula River across selected urban locations in Pune reveals a clear decline in water quality associated with human activities. Variations in colour and odour across the sampling stations indicate the presence of organic matter, suspended solids, and untreated wastewater entering the river system. These observations reflect the impact of rapid urban growth and inadequate management of domestic and surface runoff along the river stretch. Water temperature showed slight spatial variation, with higher values recorded in densely urbanized areas, which may influence the chemical balance of the river and reduce oxygen solubility. Although pH values remained within acceptable limits, their slightly alkaline nature suggests continuous input from urban and construction-related sources. Of particular concern are the low dissolved oxygen levels observed at all sampling sites, which signify elevated organic pollution and unfavourable conditions for aquatic organisms. Overall, the study demonstrates that the urban stretch of the Mula River is experiencing considerable ecological stress. The findings underline the importance of continuous water quality monitoring, improved wastewater treatment, and effective pollution control strategies to protect and restore the river ecosystem. Timely management interventions are essential to ensure the long-term sustainability of the Mula River as a vital freshwater resource.

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Author Contributions

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