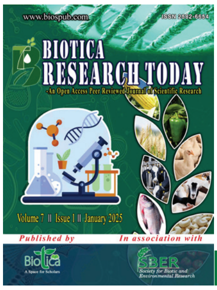

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Short Communication

Water Quality of Manli River, Thrissur, Kerala: A Ticking Bomb?

Murali K.V.[1*], Abhin M. Sunil[2] and Gopakumar S.[1]

[1]*Dept. of Forest Resource Management, College of Forestry, Kerala Agricultural University, Thrissur, Kerala (680 656), India*

[2]*Dept. of Wildlife Sciences, College of Forestry, Kerala Agricultural University, Thrissur, Kerala (680 656), India*

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Corresponding Author

Murali K.V.

✉: murali-2022-27-007@student.kau.in

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Abstract

Water quality is the basis of public health and environmental sustainability and rivers are vital sources of water. Using physical, chemical and bacteriological criteria, the current study evaluated the degree of water contamination in the Manli River in Kerala, India. Five locations along the river, including the upper and lower stream sections, were used to gather water samples. Turbidity, electrical conductivity, pH, total dissolved solids, alkalinity, hardness and chemical ions were all measured in the samples. Except for iron, which at one place surpassed the permissible level, most of the physical and chemical properties stayed within acceptable bounds. The prevalence of sewage contamination was implied by the bacteriological analysis, which revealed the growth of coliform bacteria in every sample site. Reduced water quality was indicated by a downstream drop in aquatic life, especially the pollution-enduring odonate species *Brachythemis contaminata*. Some of the possible sources of contamination include the direct discharge of wastewater that seeps from nearby industrial zones and towns. According to the study, to reduce health hazards and save the river's ecosystem, immediate action is required, including the construction of a water treatment plant in Eravakkad.

Keywords: Coliform bacteria, Manli river, Turbidity, Water quality

Introduction

Human survival on Earth depends on three essential resources: soil, water and air. And water is one of the most essential elements for the existence of life. During the period between 1900 and 1995, our global need for water had increased six times faster than normal; where population growth has been surpassed by it (Ashley and Cashman, 2006). With almost all river systems in India severely contaminated, water contamination has reached a disastrous level. The NEERI experts at Nagpur claim that water pollution in India has risen to almost 70%. Furthermore, according to the NITI Aayog research, more than 60 crore people experience acute water stress and if proper measures are not taken, they may eventually experience water destruction (Maheshwari *et al.*, 2014).

Urbanization, with a decadal growth rate of 17%, contributes significantly to water consumption and pollution through the discharge of untreated domestic and industrial wastewater (Chai *et al.*, 2021). Migration from rural to urban areas and the overexploitation of groundwater worsen the issue. Industrialization further intensifies water demand by 4% annually, increasing the discharge of industrial effluents. According to projections, the combined water consumption of the residential, agricultural and industrial sectors would reach 1447 BCM by 2050 and 103 BCM by 2025 (Muogbo *et al.*, 2023). Thirteenth among water-stressed nations, India is experiencing water scarcity in the majority of its cities, with 21 metropolitan zones at risk of depletion (Vimalkumar *et al.*, 2021). India, a country of 1.3 billion people, consumes 15 to 135 liters of water per person per day, making cost-effective, compliant wastewater treatment difficult (Panagopoulos *et al.*, 2022).

Kerala, a state renowned as "God's Own Country," is well-known for its important river systems and stunning scenery. Despite having such a rich natural history, Kerala is now increasingly aware of the contamination of its rivers from industrial and domestic trash in addition to fertilizers and pesticides used in agriculture (George and John, 2015). Rivers Chalakudy, Periyar, Muvattupuzha, Meenachil, Pampa and Achenkovil are all severely contaminated with germs

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(Benneyworth *et al.*, 2016). Water quality has also been impacted by urbanization; urban areas have lower and tougher DO levels than woodland regions (Chattopadhyay *et al.*, 2005). Only 27% of Kerala's water sources are suitable for human consumption, according to the KSLMA. A 2017 survey found that 26.9% of the remaining sources are entirely polluted and 46.1% are partly polluted. The majority of those who live close to water bodies are not actively involved in conservation efforts, even though 70% of them are aware of the sources of contamination.

The Manli River, one of the two tributaries of the Karuvannur River in Thrissur district, Kerala, originates from the Peechi-Vazhani Wildlife Sanctuary. It flows through Kannara, Maraikkal, Mulayam, Valakkav, Kainoor and Paliyekkara before merging with the Kurumali River to form the Karuvannur River at Palakadavu bridge near Arattupuzha. The upper stream of the river traverses through plantations, forests and rural households, while the downstream passes through urbanized areas. At Paliyekkara, the river is heavily polluted with garbage and downstream at Eravakkad, water is pumped directly for household use. This stark contrast highlights the urgent need for intervention.

Water quality has a direct impact on human health, the environment and economic activities. The World Health Organization (WHO), the Indian Council of Medical Research (ICMR) and the United States Public Health Service Drinking Water Standards (USPHS) all emphasize the significance of regular monitoring and effective water management (Umar *et al.*, 2001). Despite widespread understanding of water pollution, action at the community and institutional levels is insufficient. The Manli River's water quality deteriorates downstream as a result of expanding urbanization, industrial effluents and inadequate waste management practices. The river and its tributaries' water quality are predicted to significantly improve as a result of community-based interventions and sustainable management practices. This study aims to examine the current water quality using physical, chemical and bacteriological factors.

Materials and Methods

After completing the southwest monsoon, on a clear day, in August 2023, water samples (1 liter each) were collected from five random locations in the Manli River (Figure 1; Table 1) (two locations in the upper stream and three locations in the lower stream) in clean polyethylene terephthalate (PET) bottles. Care was taken to collect water samples with as little disturbance as possible from the middle portion of the river (Alam *et al.*, 2007). All the collected samples were tested for the water quality in the Centre for Analytical Instrumentation-Kerala (CAI-K) at Kerala Forest Research Institute, Peechi, Thrissur. Physical characteristics studied such as turbidity, electrical conductivity, pH, total dissolved solids; and chemical analyses such as acidity and alkalinity values, total hardness and ion concentrations (Ca, Mg, Cl, F, Fe, NO_2 and SO_4) were studied properly. Meanwhile, bacteriological examination for the presence or absence of the various coliforms; such as Escherichia coli, were performed.

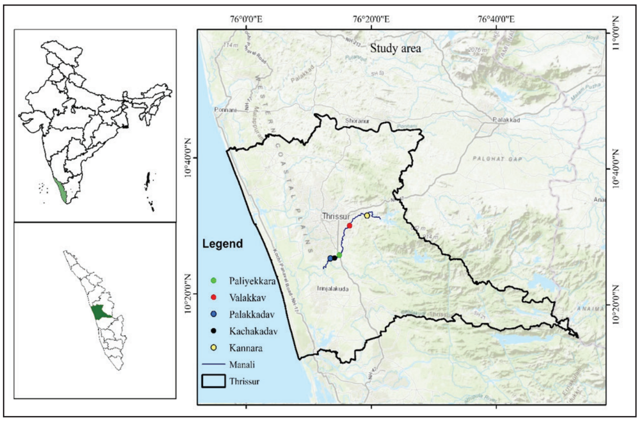

Figure 1: Water sampling points in the Manli River, Kerala

Table 1: GPS points of water sampling points

Sample point	Latitude	Longitude
Kannara	10.541604 N	76.332577 E
Valakkav	10.517478 N	76.288406 E
Paliyekkara	10.439482 N	76.263308 E
Kachakkadav	10.436045 N	76.257561 E
Palakkadav	10.426626 N	76.240157 E

Results and Discussion

Physical Parameters

The turbidity threshold of fewer than 5 (NTU) Nephelometric Turbidity Units was met by all sampling sites, which indicates that the water is relatively pure. Electrical conductivity values were acceptable and no serious concentrations of dissolved salts and minerals were present. The pH values were in permissible range from 6.5 to 8.5 meaning that water is neutral to slightly alkaline. The maximum permitted TDS value was 2000 mg L^{-1} at all sites, thereby placing limits to the over mineralization of the water. Alkalinity levels were much below the regulatory limit of 600 mg L^{-1}, which may aid in pH fluctuation buffers. Total hardness levels were likewise within the permitted range of 600 mg L^{-1}, showing the number of calcium and magnesium ions that can be tolerated (Table 2).

Chemical Parameters

Most parameters found by chemical analysis were found to be within the acceptable and permissible limits. All calcium, chloride, fluoride, nitrite and sulfate contents were below the acceptable limits of the Indian Standards (IS: 10500-2012), which indicate safe values (Table 3). Magnesium concentrations remained satisfactory and the modest rise observed at Kachakkadav, 3.40 mg L^{-1}, was within acceptable limits. The Kannara sample had an iron concentration of 0.64 mg L^{-1}, which was above the allowed level of 0.3 mg L^{-1} but was less than the tolerable value of 1.00 mg L^{-1}. It signifies that the chemical quality of the water at the analyzed places is generally excellent, with just minor variations in iron and magnesium that should not cause concern.

Table 2: Physical parameters

Sample point	Turbidity (NTU)	Electrical Conductivity (s cm^{-1})	pH	Total dissolved solids (mg L^{-1})	Alkalinity (mg L^{-1})	Total Hardness (mg L^{-1})
Acceptable Limit (IS: 10500-2012)	1	NA	6.5 to 8.5	500	200	200
Permissible Limit	5	NA	No Relaxation	2000	600	600
Kannara	1.40	256	6.49	197.12	40	34
Valakkav	1.84	69	6.41	53.13	30	26
Paliyekkara	2.14	74	6.50	56.98	34	36
Kachakkadav	2.10	82	6.48	63.14	38	38
Palakkadav	1.60	89	6.74	68.53	36	34

Table 3: Chemical parameters

Sample point	Chemical parameters (mg L^{-1})						
	Ca	Mg	Cl	F	Fe	NO_2	SO_4
Acceptable Limit (IS: 10500-2012)	75	30	250	1	0.3	45	200
Permissible Limit	200	100	1000	1.50	1.00	100	400
Kannara	11.8	2.43	24	0.56	0.64	2.14	2.10
Valakkav	08.01	1.45	24	0.41	0.50	2.70	2.51
Paliyekkara	16.82	BDL	30	0.38	0.34	1.80	1.41
Kachakkadav	11.8	3.40	26	0.49	0.69	2.53	1.84
Palakkadav	11.8	2.43	26	0.48	0.52	2.54	2.14

Bacteriological Analysis

According to the Indian Standard IS: 10500-2012, both coliforms and *Escherichia coli* are not permissible in drinking water. All sample points exceeded the permissible limit for coliforms, indicating contamination, while *Escherichia coli* was absent at all locations (Table 4), which may suggest that the contamination is primarily from non-faecal sources.

During the study, it was visually evident that water-dependent microfauna (like fishes, amphibians, odonates, *etc.*) were less active as we proceeded downstream. A more fascinating observation was the presence of an odonate species, "Ditch Jewel" (*Brachythemis contaminata*). This species is known to have tolerance to polluted waters and thrive in them and therefore act as an indicator of polluted water (Bora, 2019). As we moved downstream beyond the Paliyekkara NH bridge, Ditch Jewel was the only water-dependent species we encountered, which indicated the growing pollution levels. Further, we could not also spot any fish downstream. This may also be due to the difference in turbidity downstream, which might be blocking visibility.

In the case of physical parameters, turbidity values were more than the acceptable limit all along the stream, but it was below the permissible limit as per the Indian standard code for drinking water (IS: 10500-2012). There was an observed increase in BOD and turbidity levels, which are indicators of water quality deterioration due to contamination (Laskar, 2024). The quantity of light that suspended particles in a water sample scatter or block is measured and reported as the turbidity value. Water, that is clear, has low turbidity, whereas muddy or foggy water has higher turbidity. Soil particles, organic debris, metals and other similar materials suspended in the water column are the causes of turbidity. Visually water was clearer upstream than downstream. Although the turbidity levels are under acceptable limits now, unchecked, further pollution may push it up over permissible limits, very shortly.

Though the Manli river passes through wetland areas and small farmlands along the drainage line, there were not many chemical constituents polluting the water. Nitrates and sulfates present in fertilizers can leach out and cause increased levels in rivers (Chattopadhyay *et al.*, 2005). The result of our study was somewhat relieving in that context since all the chemical parameters were below acceptable levels, except Iron, which was slightly above the acceptable limit. This may be due to the lateritic nature of the soil through which the river is flowing. In all the locations, the presence of coliform bacteria was observed. The most common causes of coliform bacteria in ambient water are nonpoint sources of human and animal waste and overflowing residential sewage. The presence of coliform bacteria is a clear sign that a river has been contaminated by sewage and may also be home to other harmful pathogens (Benneyworth *et al.*, 2016). We observed that the polluted wastewater, including human excreta contamination, flowed down to the Manli River from the comfort station situated at NH 544 Paliyekkara toll gate *via* Kachakadav bund. This could be a possible contributing point to the coli form count in the river water (Roy and Paramanik, 2022), which needs to be confirmed. The local people in Kachakadav described the water coming from Paliyekkara as "Blackish-grey water, with a very foul smell". They even recommended to wash our hands with good water, after collecting water samples from the spot. It is to be noted that the Ervakkad pump house is just 2 kilometers away from Kachakadav. This poses a potential high health risk to the people. Based on our analysis and observation, an urgent need for respective authority involvement is solicited to reduce the pollution happening in the Manli river. The possibility of waste from the NH toll plaza reaching the river waters should be examined and corrective measures taken to arrest the water pollution. A water treatment plant could be set up at Ervakkad, to ensure the safety of water supplied.

Table 4: Bacteriological analysis

Sample point	Coli forms (No./ 100 ml)	*Escherichia coli* (No./ 100 ml)
Acceptable Limit (IS: 10500-2012)	Not Acceptable	Not Acceptable
Permissible Limit	Not Permissible	Not Permissible
1. Kannara	243	Absent
2. Valakkav	243	Absent
3. Paliyekkara	1100	Absent
4. Kachakkadav	1100	Absent
5. Palakkadav	1100	Absent

Conclusion

The water quality analysis of the Manli River highlighted significant pollution concerns, particularly in the downstream areas. While physical and chemical parameters such as turbidity, electrical conductivity, pH and total dissolved solids fell within acceptable limits, certain parameters like iron slightly exceeded the acceptable limit in Kannara. Additionally, the presence of coliform bacteria, particularly along the river's course, indicated contamination from human and animal waste, likely exacerbated by untreated sewage discharge. The absence of *E. coli* is reassuring, but the presence of coli forms remains a concern, signaling potential health risks. The study also noted a decline in biodiversity, with only pollution-tolerant species, such as the Ditch Jewel, found downstream. The findings underline the need for urgent intervention to control pollution, including examining potential sources of contamination from nearby toll plazas and setting up a water treatment plant at Ervakkad to ensure the safety of water for the surrounding communities.

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