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Water Quality Analysis of River Tungabhadra using Statistical Tool Analysis

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Abstract— **The assessment of water quality is vital for understanding the health of river systems, particularly in areas facing rapid industrialization and urbanization. The Tungabhadra River, important for cultural and economic reasons in southern India, has experienced pollution from industrial effluents, untreated sewage, and agricultural runoff. This study evaluates its water quality by analyzing various physico-chemical and biological parameters such as temperature, pH, dissolved oxygen (DO), and nutrient levels from multiple sampling sites.**

Using statistical tools like correlation analysis and Principal Component Analysis (PCA), the study identifies pollution indicators and sources, revealing significant pollution near industrial and urban areas, with declining DO levels and high biochemical oxygen demand (BOD). The findings stress the need for better river basin management, enforcement of effluent treatment regulations, and ongoing water quality monitoring to address these issues.

Keywords— **Tungabhadra, water quality, water, hardness, turbidity , biological oxygen demand, alkalinity.**

I INTRODUCTION

Water is a vital resource essential for life, but increasing industrialization, urbanization, and human activities are contributing to its pollution. Contaminants enter waterways through industrial effluents, sewage, and everyday practices like bathing, washing, and swimming near rivers. As the demand for clean water grows, effective management and monitoring are critical. Water quality is influenced by physical, chemical, and biological factors and must meet different standards depending on its use—whether for drinking, recreation, or industry. Monitoring water quality is a complex but essential process that involves setting goals, collecting data, and using multidisciplinary approaches. In response to these challenges, this study focuses on assessing the water quality of the Bhadra River at specific sites and proposes practical solutions for its improvement and sustainable management.

A. Objective Of The Study

1. To identify the sources and types of pollution affecting the Tungabhadra River.
2. To conduct physico - chemical analyses the liquid content present in the Tungabhadra River, focusing on both concentration levels and their impacts.
3. To examine the changes in water quality caused by pollutants entering the Tungabhadra River by analysing graphs for each parameter.
4. To assess the different parameters using statistical analysis methods.
5. To identify remedial measures aimed at controlling pollution and enhancing the condition of the river.
6. To accurately assess the levels of sodium and potassium ions found in water samples.
7. To track water quality and detect pollution sources like sewage, industrial discharges, or agricultural runoff.
8. To supply data for comparing various sampling sites and time frames in water quality research

II LITERATURE REVIEW

A. General

This chapter provides a structured overview of river water monitoring, highlighting its importance due to increasing pollution from domestic, industrial, and agricultural sources. It emphasizes the need for regular assessment to ensure water quality for diverse uses such as drinking, irrigation, recreation, and industrial processes.

B. Literature Studies

Chandrahas D. and Varnekar C.D. (2001) studied the water quality of the Tungabhadra River at Koodli, focusing on DO, BOD, and nutrient levels before and after the confluence of the Tunga and Bhadra rivers. Their 7results showed that the Bhadra had lower water quality, mainly due to industrial pollution upstream.

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Suresh B., Manjappa S., and Puttaiah E.T. (2008) assessed the Water Quality Index (WQI) of the Tungabhadra River near Harihara using data from 2000 to 2005. They found that water quality was notably disturbed downstream of industrial discharge, especially during the monsoon season.

Harish Kumara B.K. et al. (2010) conducted a seasonal water quality assessment around the Tungabhadra Dam in 2009–10. They observed elevated EC, hardness, BOD, and TDS downstream, and recommended water treatment before domestic use, despite most ions being within WHO limits.

Venkatesharaju et al. (2010) assessed the physical, chemical, and bacteriological quality of the Cauvery River in Kollegal over two years. While physico-chemical parameters were within limits, high coliform levels from human activities rendered the water unsafe for drinking without treatment, highlighting the need for continuous monitoring.

Harish Kumar et al. (2010) conducted a seasonal study of the Tungabhadra River near the TB Dam (2009–2010) and found elevated levels of nitrates, hardness, BOD, conductivity, and TDS during the post-monsoon season. The pollution was mainly attributed to agricultural runoff, untreated domestic waste, and increased human activities.

Rehana S. and Mujumdar P.P. (2011) studied the impacts of climate change on water quality in the Tunga-Bhadra River using hydrological modelling. Their findings indicated a likely decline in dissolved oxygen (DO) and related parameters due to rising temperatures and altered flow patterns

Mahesh et al. (2012) assessed the physical and chemical properties of the Tunga River in Shivamogga over 2011, analyzing 11 parameters across two sites. Their results showed elevated BOD, nitrate, and phosphate at site B due to sewage discharge, with several parameters

The IJERT case study (2015) examined seasonal variations in physical, chemical, and bacteriological parameters of the Tunga River at Shivamogga, highlighting the impact of urban activities. The findings serve as a comparative reference for assessing water quality in the upper tributaries of the Tungabhadra River.

Ranjith S. (2019) conducted a study using a Weighted Arithmetic Water Quality Index (WQI) to assess the Tungabhadra River, as published in IJITEE. Their findings identified critical areas adversely affected by urbanization and demonstrated the usefulness of the index for water quality management and communication.

Ranjith S. and Shivapur A.V. (2020) performed a comprehensive evaluation of the Tungabhadra River's water quality along a 40–41 km section near Harihara, reported in NEPT. Their study revealed that the majority of parameters met drinking water regulations; however, there were significant rises in pollution levels further downstream, corroborated by robust spatial statistics from eight monitoring locations.

III METHODOLOGY

A. Study Area

Water samples were collected from five locations along the Tungabhadra River in and around Harihara, chosen to represent religious, urban, and regulated water environments**.**

Sampling Stations & Selection Criteria

1. Station 1 – Upstream of Harihareshwara Temple
   - Assesses baseline water quality before human/ritual activity.
2. Station 2 – Downstream of Temple
   - Captures impacts from domestic sewage and ritual discharges.
3. Station 3 – Upstream of Reservoir Viewpoint
   - Baseline for reservoir inflow; minimal human influence.
4. Station 4 – Midsection of Reservoir
   - Evaluates water mixing, stagnation, and sedimentation effects.
5. Station 5 – Downstream of Reservoir Viewpoint
   - Monitors effects of storage, tourism, and local discharges.

Additional Sampling

- Biweekly samples from Harihara river station **(**8 total**)** between April–July**.**
- 5 agricultural water samples collected from fields along the Davanagere–Harihara road, representing typical irrigation sources.

Sampling Station	Location	Latitude	Longitude
1	Harihareswara Temple - Upstream	[14° 30' 25.19" N]	[75° 48' 4.19" E]
2	Harihareswara Temple - Downstream	[14° 30' 25.19" N]	[75° 48' 4.19" E]
3	Harihara River View point: Inflow (Upstream of Reservoir)	[14° 30' 25.19" N]	[75° 48' 4.19" E]
4	Harihara River View point-Mid-Reservoir (Central)	[14° 30' 25.19" N]	[75° 48' 4.19" E]
5	Harihara River View point-Outflow (Downstream)	[14° 30' 25.19" N]	[75° 48' 4.19" E]

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Sl. No	Parameters	Method/Instrument	Unit
1	Temperature	Digital thermometer	°C
2	pH	pH meter	-
3	Electrical Conductivity	Conductivity meter	µS/cm
4	Turbidity	Nephelometer	NTU
5	Alkalinity	Titrimetric method	mg/L
6	Total Hardness	EDTA titrimetric	mg/L
7	Calcium Hardness	EDTA titrimetric	mg/L
8	Magnesium Hardness	Titrimetric	mg/L
9	Chloride	Mohr's titrimetric	mg/L
10	Dissolved Oxygen	Winkler's method	mg/L
11	Total Dissolved Solids	Gravimetric method	mg/L
12	Biochemical Oxygen Demand	Dilution	mg/L
13	Chemical Oxygen Demand	Closed Reflux	mg/L
14	Sodium	Flame photometer	mg/L
15	Potassium	Flame photometer	mg/L

V RESULTS

Table 4.1 Assessment of the Quality of Collected Water Samples.

Month: April, Sampling date: 1/04/25

Sl. No	Parameters	Units	Sampling Stations				
			1	2	3	4	5
1	Time	-	11.15 AM	11.20 AM	11.30 AM	11.35 AM	12.00 PM
2	Temperature	°C	26	26	27	26	26
3	pH		7.53	7.63	7.28	7.39	7.81
4	Electrical Conductivity	µS/cm	392.4	418.6	442.0	488.5	529.0
5	Turbidity	NTU	3.2	3.8	4.1	4.6	5.0
6	Alkalinity	mg/l	62	85	70	95	88
7	Total Hardness	mg/l	108.6	160.9	131.1	178.8	151.9
8	Calcium Hardness	mg/l	59.2	92.0	81.5	102.4	93.2
9	Magnesium Hardness	mg/l	49.4	68.9	49.6	76.4	58.7
10	Chloride	mg/l	19.2	23.5	21.8	25.4	28.6
11	Total Dissolved Solids	mg/l	271.4	575.8	307.8	551.2	507.0
12	Dissolved Oxygen	mg/l	8	7.67	7.6	7.52	7.35
13	Biological Oxygen Demand	mg/l	3.2	4.8	3.9	5.1	4.6
14	Chemical oxygen demand(COD)	mg/l	7.2	11.0	8.0	9.5	10.2
15	Sodium	mg/l	10.68	13.73	24.58	37.59	65.72
16	Potassium	mg/l	10.2	20.8	31.5	51.2	101.4

4.1 Temperature

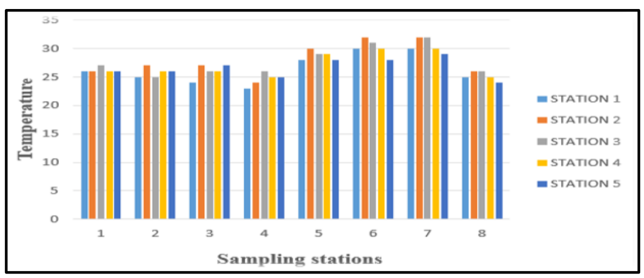

Fig 4.1 Temperature Fluctuations at Various Sampling Locations (15-Day Intervals)

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4.2 pH

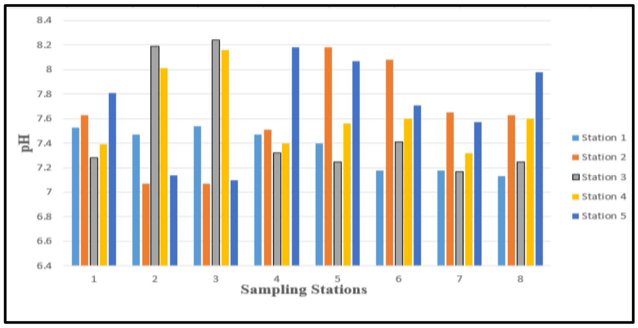

Fig 4.2: pH Fluctuations at Various Sampling Locations (15-Day Intervals)

4.3 Electrical Conductivity

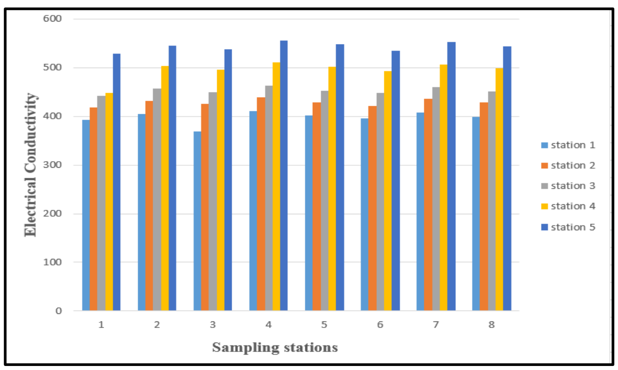

Fig 4.3: Electrical Conductivity Fluctuations at Various Sampling Locations (15-Day Intervals)

4.4 Turbidity

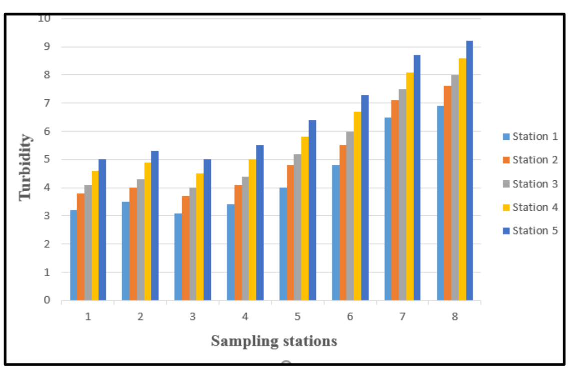

Fig 4.4: Turbidity Fluctuations at Various Sampling Locations (15-Day Intervals)

4.5 Alkalinity

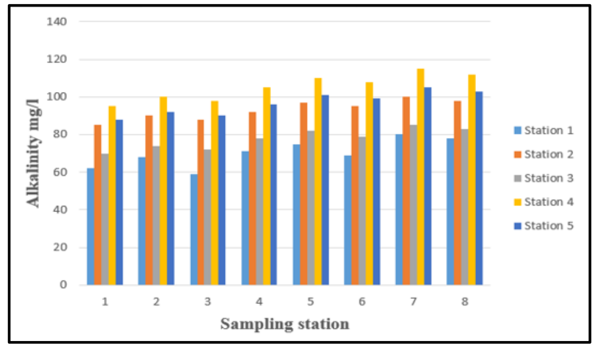

Fig 4.5: Alkalinity Fluctuations at Various Sampling Locations (15-Day Intervals)

4.6 Total Hardness

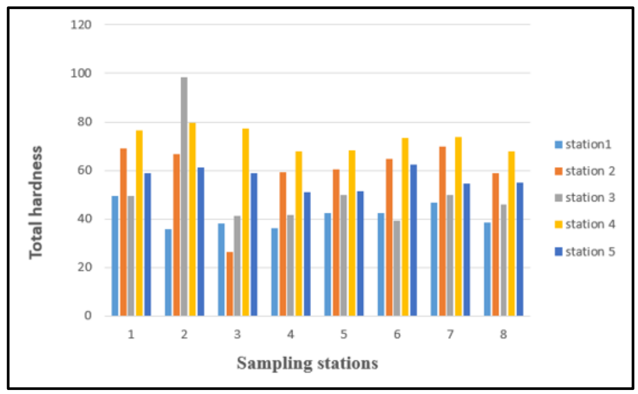

Fig 4.6: Total Hardness Fluctuations at Various Sampling Locations (15-Day Intervals)

4.7 Chloride

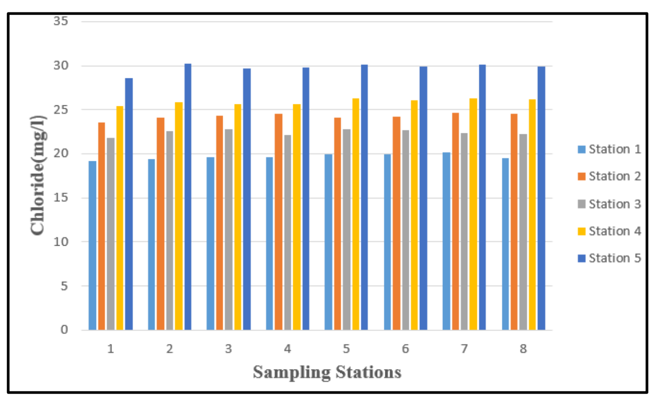

Fig 4.7: Chloride Fluctuations at Various Sampling Locations (15-Day Intervals)

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4.8 Total Dissolved Solids

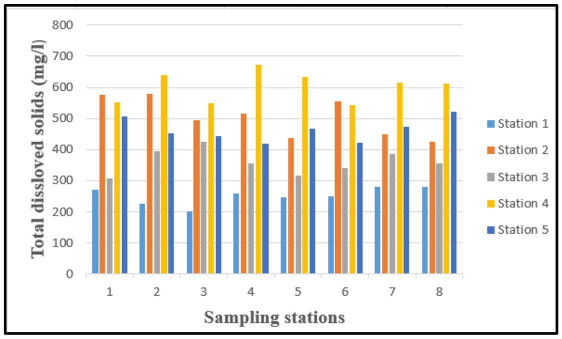

Fig 4.8: Total Dissolved Solids Fluctuations at Various Sampling Locations (15-Day Intervals)

4.9 Dissolved Oxygen

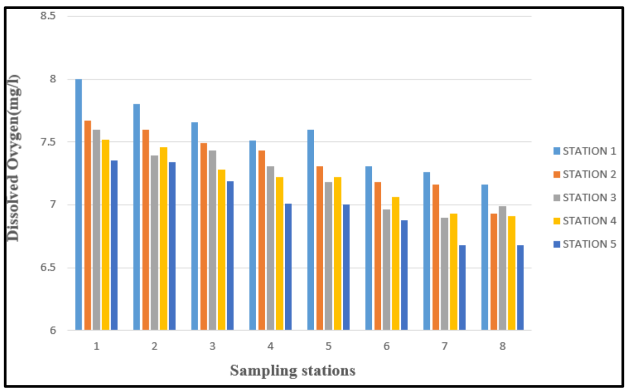

Fig 4.9: Dissolved Oxygen Fluctuations at Various Sampling Locations (15-Day Intervals)

4.10 Biological Oxgen Demand

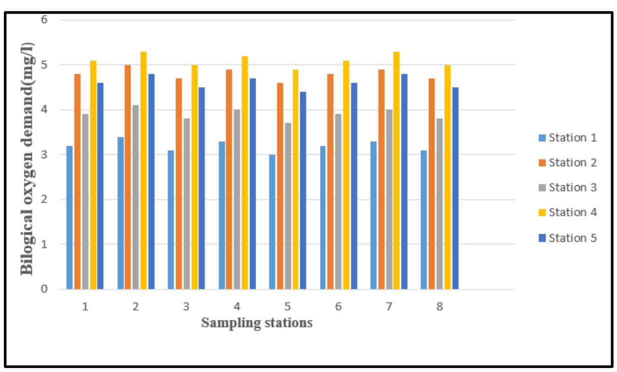

Fig 4.10: Biological Oxygen Demand at Various Sampling Locations (15-Day Intervals)

4.11 Chemical Oxygen Demand

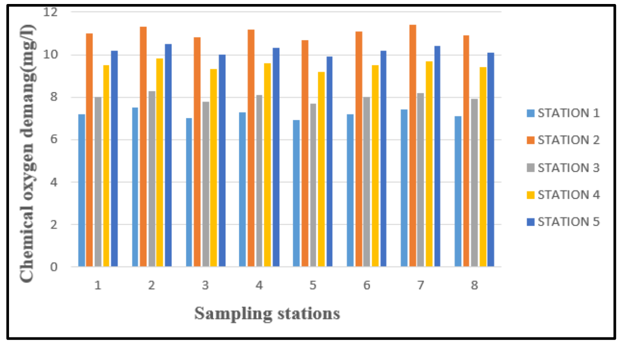

Fig 4.11: Chemical Oxygen Demand at Various Sampling Locations (15-Day Intervals)

4.12 Sodium

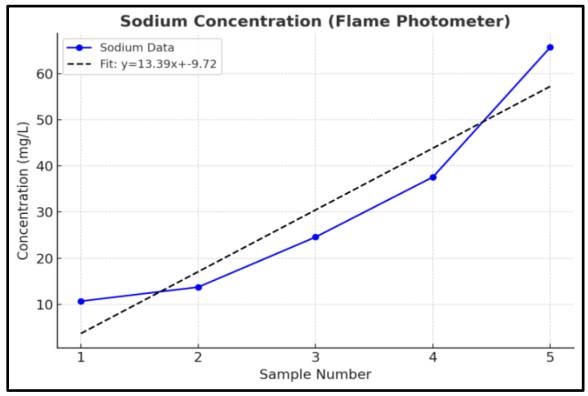

Fig 4.12: Calibration Graph for Sodium Concentration (Flame Photometry)

4.13 Potassium

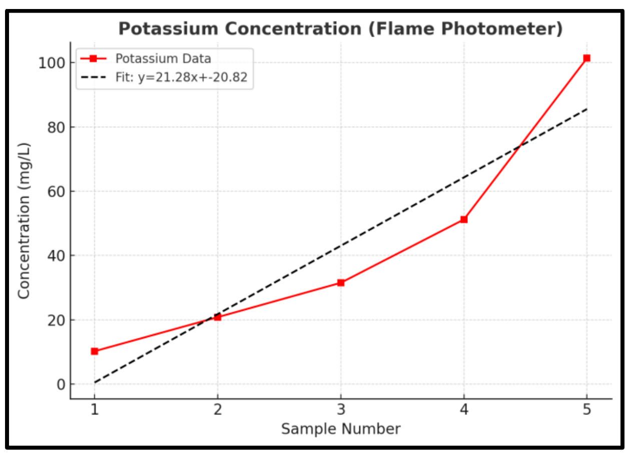

Fig 4.13: Calibration Graph for Potassium Concentration (Flame Photometry)

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4.14: Analysis Of Sodium And Potassium Levels In Water Samples

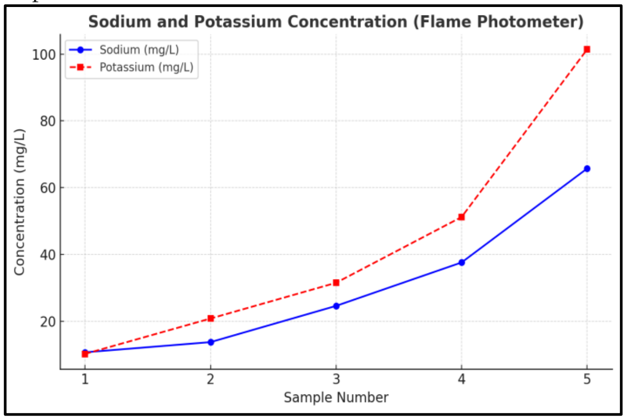

Fig 4.14: Analysis of Sodium and Potassium Levels in Water Samples

VI CONCLUSION

The current research assessed the standard of water in the Tungabhadra River by analysing various physicochemical parameters and utilizing statistical tools as well as Mean, Median, Standard Deviation, Minimum, Maximum, and Coefficient of Variation to assess variations across different sampling stations. The statistical findings indicated that several parameters, including pH, TDS, BOD, COD, and DO, exhibited significant spatial and seasonal variations along the river's length. While the mean values for most of these parameters fell within the permissible limits established by BIS and WHO standards, some locations recorded extreme values, suggesting localized pollution from sources like industrial discharges and domestic sewage. The analysis of standard deviations and coefficients of variation revealed moderate to high fluctuations in water quality at selected stations, indicating how human activities have influenced it. In general, the standard of the water Tungabhadra River is marginally suitable for domestic and agricultural use, although it necessitates proper treatment before any direct human consumption. The study emphasizes the effectiveness of statistical tools in identifying variability and trends in river water quality, providing a scientific a basis for effective oversight of water resource management and strategies for controlling pollution in a sustainable manner.

Scope for Future Work

- Extend sampling to more sites along the Tungabhadra River for broader coverage.
- Conduct long-term and seasonal monitoring to track water quality trends.
- Apply advanced statistical and GIS tools for source identification and spatial analysis.
- Develop a Water Quality Index (WQI) specific to the river for simplified assessment.
- Investigate major pollution sources and their impacts on ecosystems and health.
- Propose sustainable mitigation and management strategies for river conservation.

REFERENCES

1. APHA (2017). Standard Procedures for Analysing Water and Wastewater, 23rd Edition, American Public Health Association, Washington, D.C.
2. BIS (2012). Standard Methods for the Examination of Water and Wastewater, 23rd Edition, published by the American Public Health Association, Washington, D.C..
3. Chandrahas, D., & Varnekar, C. D. (2001). An analysis of the physical and chemical properties of the Tungabhadra River at Koodli. [Details of journal/book if available].
4. Harish Kumara, B. K., et al. (2010). Assessment of seasonal water quality at ten sites around the Tungabhadra Dam (Kudli–Honnavalli) during 2009–10. [Journal/Proceedings details].
5. Harish Kumar, et al. (2010). Seasonal analysis of water quality in the Tungabhadra River close to the TB Dam from 2009 to 2010 at ten diverse locations.
6. Mahesh, et al. (2012). Analysis of physical and chemical attributes of the Tunga River in Shivamogga, Karnataka, India. [Journal details].
7. Rehana, S., & Mujumdar, P. P. (2011). The impact of climate change on the quality of water in the Tungabhadra River. [Journal details].
8. Ranjith, S. (2019). Assessment of the Tungabhadra River utilizing the Weighted Arithmetic Water Quality Index (WQI). Published in IJTEE.
9. Ranjith, S., & Shivapur, A. V. (2020). In-depth analysis regarding the quality of water in a 40–41 km stretch of the Tungabhadra River near Harihara. Published in NEPT.
10. Suresh, B., Manjappa, S., & Puttaiah, E. T. (2008). Evaluation of the Water Quality Assessment (WQA) for the Tungabhadra River near Harihara based on monthly data from 2000 to 2005. [Journal details].
11. The IJERT Case Study. (2015). Seasonal changes in physical, chemical, and bacteriological parameters of the Tungabhadra River at Shivamogga. IJERT.
12. Venkatesharaju, et al. (2010). Analysis of physical, chemical, and bacteriological features of the Cauvery River in the Kollegal area (2006–2008). [Journal/Conference details].