COMPARATIVE EVALUATION OF PHYSICOCHEMICAL AND BIOLOGICAL PARAMETERS IN PAYASWINI RIVER, BOREWELL WATER, AND WASTEWATER SOURCES ACROSS SEASONS IN SULLIA CITY.

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Abstract

This study investigates the seasonal variation in water quality parameters of different water sources in the Sullia Taluk region, including the Payaswini River, borewell water, rubber wastewater, and untreated sewage water. Key parameters such as pH, turbidity, total dissolved solids (TDS), electrical conductivity (EC), dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), nitrate (NO_3^-), hardness, coliform count, iron (Fe), and zinc (Zn) were analysed across pre-monsoon, monsoon, post-monsoon, and winter seasons. The results reveal significant seasonal and source-based differences in pollution levels. Sewage and rubber wastewater exhibited critically high BOD, COD, turbidity, and microbial loads, particularly during the monsoon. Borewell water remained within acceptable limits for most parameters but showed elevated hardness and TDS. The Payaswini River showed moderate fluctuations with relatively better water quality, especially in winter. This study emphasizes the need for continuous monitoring and localized treatment strategies to ensure water safety and sustainability.

Key Words:

Seasonal Water Quality, Payaswini River, Borewell Water, Rubber Wastewater, Sewage Contamination, Water Pollution, Physicochemical Parameters.

Introduction

Water quality plays a pivotal role in maintaining the ecological balance and safeguarding public health. In many semi-urban and rural regions, diverse water sources—including rivers, borewells, and surface runoff—serve as the backbone for drinking, domestic, and agricultural needs. However, increasing urbanization, industrial effluents, and untreated sewage discharge have led to significant changes in water chemistry, especially during seasonal variations.

This study focuses on assessing the seasonal fluctuations in water quality across four key sources in the Sullia Taluk region: the Payaswini River, borewell water, rubber processing wastewater, and untreated sewage water. By monitoring physical, chemical, and biological parameters across pre-monsoon, monsoon, post-monsoon, and winter, this project aims to identify pollution trends, potential health risks, and the overall potability and usability of these water sources. The findings are crucial for implementing targeted water management practices and informing local stakeholders on pollution control measures.

Objectives

Evaluate the seasonal variations (pre-monsoon, monsoon, post-monsoon, and winter) in the physico-chemical and microbiological parameters of various water sources in Sullia Taluk, including borewell, river, sewage, and rubber industry effluents.

Literature review

(MS Arya et al) A study conducted in Munroe Island evaluated the spatial and seasonal status of water quality using multivariate statistical methods over a year. Nineteen environmental variables, including temperature, pH, electrical conductivity, turbidity, total dissolved solids, and various ions, were analysed. The study found that parameters like temperature, pH, and total hardness were higher in the pre-monsoon season, while dissolved oxygen and nutrients like nitrates and phosphates peaked during the monsoon. Multivariate statistical tools helped in identifying contamination sources and analysing results.

(Arafat Rahman et al) In Bangladesh, researchers assessed the seasonal variation of physicochemical parameters in the Turag River. Parameters such as temperature, pH, dissolved oxygen, biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), and total dissolved solids were measured across four distinct seasons. The study revealed that 40% of water quality indices were within permissible limits, with exceptions noted in parameters like electrical conductivity and turbidity. Statistical analyses indicated significant seasonal differences, with pollutants like BOD_5 and COD being higher in certain seasons due to industrial discharges.

(A. Najar & A. Basheer) A study on Dal Lake utilized multivariate statistical techniques to assess seasonal variations in water quality. Thirteen parameters were analysed across four seasons, revealing significant variations in temperature, pH, dissolved oxygen, and nutrient concentrations. Cluster analysis grouped sampling sites into categories based on pollution levels, while principal component analysis identified domestic wastewater, agricultural runoff, and catchment geology as significant contributors to water quality variation.

(Runit Isaac et al) An assessment of the Yamuna River's water quality across different seasons employed the Water Quality Index (WQI) and multivariate statistical approaches. Fourteen parameters were analyzed quarterly, revealing that WQI values varied seasonally, with the poorest quality observed in spring due to religious activities. Principal Component Analysis identified key factors influencing water quality, and high concentrations of metals were detected using inductively coupled plasma mass spectrometry

(S Day et al) A study focused on the seasonal variation of water quality parameters in a college pond. Nineteen physicochemical parameters were measured during summer and winter seasons. The findings indicated that parameters like temperature, pH, and total alkalinity peaked in summer, while dissolved oxygen levels were highest in winter. The study emphasized the importance of monitoring water quality for sustainable use in agriculture and aquaculture.

(Krishnapal Singh and abhishek Saxena) Over a 12-year period, researchers analysed seasonal variations and correlations among water quality parameters in the Chambal River. Parameters such as pH, electrical conductivity, total dissolved solids, and turbidity were monitored. The Water Quality Index ranged from poor to unsuitable for drinking purposes across different seasons. Statistical analyses, including Principal Component Analysis and dendrogram analysis, highlighted the need for stricter pollution control measures.

(Driss Hammoumi et al) study on the Nador Canal assessed seasonal variations in surface water quality using the Water Quality Index and Principal Component Analysis. Water samples from 22 sites were analysed for physical, chemical, and heavy metal parameters. The results showed significant seasonal variations, with water quality deteriorating in summer due to higher temperatures and improving in winter. The study emphasized the influence of rainfall patterns and agricultural runoff on water quality.

(**Guoce Xu** et al) Researchers investigated seasonal changes in water quality and influencing factors in the Dan River basin. Statistical analyses revealed that nitrate nitrogen and total phosphorus were major contributors to pollution, with their concentrations varying seasonally. The study found that vegetation coverage and land use significantly impacted water quality, emphasizing the need for season-specific water management strategies

Result and discussion

Water samples were collected from the Payaswini River, borewell sources, untreated sewage outlets, and local rubber processing units in the Sullia region, where these discharges interact with the river basin. The collected samples were then analysed, and the test results are summarized in the following tables.

Payaswini River Water

Season	pH	Turb	TDS	EC	DO	BOD	COD	NO3	Hard	Coliform	Fe	Zn
Pre-monsoon	7.2	3.3	186	361	6.3	2.5	9.4	5.2	111	130	0.20	0.4
Monsoon	6.6	10.2	165	310	5.3	4.1	13.4	9.3	120	800	0.28	0.7
Post-monsoon	6.9	4.7	175	330	6.5	3.0	10.2	6.2	115	300	0.24	0.5
Winter	7.3	2.1	170	325	7.0	2.4	8.5	4.9	100	90	0.18	0.3

Borewell Water – Sullia Town Area

Season	pH	Turb	TDS	EC	DO	BOD	COD	NO3	Hard	Coliform	Fe	Zn
Pre-monsoon	7.4	1.1	420	910	4.5	1.2	5.0	12.5	280	15	0.34	0.6
Monsoon	6.8	2.7	390	880	4.2	2.0	6.3	18.7	295	55	0.37	0.7
Post-monsoon	7.2	1.3	410	895	4.8	1.6	5.7	13.9	275	25	0.32	0.5
Winter	7.5	0.8	405	870	5.0	1.1	4.5	10.2	260	10	0.29	0.4

Sewage Water (Untreated)

Season	pH	Turb	TDS	EC	DO	BOD	COD	NO3	Hard	Coliform	Fe	Zn
Pre-monsoon	6.7	18.4	870	1350	1.8	18.2	58	21.2	230	>1600	0.89	1.3
Monsoon	6.3	26.5	950	1420	1.2	22.6	73	25.7	240	>2400	0.94	1.5
Post-monsoon	6.6	20.1	910	1390	1.5	19.7	64	23.0	235	>2000	0.91	1.4
Winter	6.9	15.2	860	1310	2.1	16.3	54	19.4	220	>1500	0.87	1.2

Rubber Wastewater (Effluent Before Treatment)

Season	pH	Turb	TDS	EC	DO	BOD	COD	NO3	Hard	Coliform	Fe	Zn
Pre-monsoon	6.5	34.2	1020	1640	1.4	26.8	82	15.3	310	1200	1.25	2.1
Monsoon	6.2	42.7	1125	1750	0.9	30.2	97	17.8	320	1500	1.34	2.5
Post-monsoon	6.3	37.1	1065	1680	1.1	28.3	89	16.2	315	1300	1.28	2.2
Winter	6.7	30.5	980	1600	1.6	24.5	75	14.0	300	1000	1.19	1.9

Best & Worst Water Quality (by season & source)

Source	Best Season	Worst Season	Suitability
River Water	Winter	Monsoon	Good after treatment
Borewell Water	Winter	Monsoon	Suitable with minor issues
Sewage Water	None	Monsoon	Not suitable without full treatment

Rubber Effluent	None	Monsoon	Needs industrial-level treatment

The pH levels across all sources remained within the acceptable range (6.5–8.5), though slight acidic shifts were observed during the monsoon. Borewell water maintained a stable and slightly alkaline pH (~7.4 to 7.5).

Rubber and sewage water were slightly acidic during monsoon, possibly due to increased organic matter decomposition and runoff. A significant increase in turbidity was observed in sewage and rubber wastewater during monsoon -Rubber wastewater: +44% increased
Sewage water turbidity: +25% increased. Payaswini River turbidity rose from 3.2 NTU to 10.2 NTU (~218% increase) in monsoon, indicating surface runoff and soil erosion. Borewell water showed consistently low turbidity, remaining under 3 NTU, indicating good clarity.

During the study, the highest Total Dissolved Solids (TDS) concentration was recorded in sewage water, reaching up to 1125 mg/L during the monsoon season, followed by rubber wastewater, which exhibited TDS levels around 950 mg/L. Borewell water also showed consistently high TDS values, ranging between 405–420 mg/L, likely due to the leaching of minerals from surrounding soil and rock layers. In contrast, the Payaswini River exhibited relatively low TDS levels, between 165–185 mg/L, making it more suitable for consumption after undergoing basic treatment. Across all water sources, TDS and electrical conductivity (EC) demonstrated similar trends, indicating a strong correlation between the presence of dissolved ions and conductivity values

Lowest DO was found in sewage (0.9 mg/L) and rubber wastewater (1.2 mg/L) during monsoon – a critical indicator of high organic pollution. Payaswini River DO remain above 5 mg/L, except during monsoon (5.3 mg/L), supporting aquatic life. Borewell DO was lower (4.2–5.0 mg/L), likely due to lack of aeration.

Sewage water showed highest BOD (30.2 mg/L) and COD (97 mg/L) in monsoon – very high pollution load.

Rubber wastewater followed closely with BOD ~22.6 mg/L and COD ~73 mg/L.

Payaswini River had moderate levels (BOD ~2.4 to 4.1 mg/L, COD ~8.5 to 13.4 mg/L).

Borewell water had very low BOD/COD, indicating minimal organic contamination.

Elevated nitrate levels were found in borewell (up to 18.7 mg/L) and rubber wastewater (25.7 mg/L), likely from fertilizers and leaching. Payaswini levels were under 10 mg/L, indicating minimal agricultural runoff. Sewage showed moderate nitrate (~15.3–17.8 mg/L), from fecal contamination.

Hardest water: Borewell water (>280 mg/L), classified as very hard, especially in monsoon. Sewage and rubber showed moderate hardness (~220–320 mg/L). Payaswini River had the lowest hardness (~100–120 mg/L), favourable for domestic use.

Extremely high coliform counts were found in sewage (>1500–2400 MPN/100mL) and rubber wastewater, especially in monsoon. Payaswini showed seasonal spikes: from 130 (pre-monsoon) to 800 MPN/100mL (monsoon), indicating surface runoff contamination. Borewell water maintained low coliform presence (<55), indicating microbial safety.

Sewage showed highest iron (1.34 mg/L) and zinc (2.5 mg/L), far above acceptable limits. Rubber wastewater also had elevated metals. Payaswini and borewell water showed metal concentrations within safe limits.

Reference

1.M.S Arya., A Biju., Dani Benchamin., (2023) Assessment of spatial and temporal variations in water quality using multivariate statistical analysis in the Munroe Island, Kerala, India. *International Journal of Environmental Science,* 43(5) ,751-763.

2.Arafat Rahman., Ishrat Jahanara., Yeasmi Nahar Jolly.,(2021) Assessment of physicochemical properties of water and their seasonal variation in an urban river in Bangladesh. *International Journal of Environmental Analytical Chemistry*, 14(2), 139–148

3.A. Najar & A. Basheer (2012). Assessment of seasonal variation in water quality of Dal Lake (Kashmir, India) using multivariate statistical techniques. *Environmental Monitoring and Assessment*, 164, 123–134.

4. Fernanda Pires Pinto., Mylena Feitosa Tormam., Carina Krüger Bork., Hugo Alexandre Soares Guedes., Luisa Barbosa Pinto Da Silva. (2020). Seasonal assessment of water quality parameters in Mirim Lagoon, Rio Grande do Sul State, Brazil. *Brazilian Journal of Water Resources*, 92(3), 1–15.

5.Runit Isaac., Shaziya Siddiqui., Prerna Higgins., Abhay SahilPaul., Noel Abhick Lawrence., Anurag SamsonLall., Afsana Khatoon., Astha Singh., Praveen Andrew Majeed., Sheersh Massey., Aman Prasad (2024). Assessment of seasonal impacts on Water Quality in Yamuna river using Water Quality Index and Multivariate Statistical approaches. *Journal of Water Science and Technology*, 2(3), 145–153.

6. S. Dey, S. Botta, R. Kallam, R. Angadala, J. Andugala (2021). Seasonal variation in water quality parameters of Gudlavalleru Engineering College Pond. *International Journal of Environmental Research*, 4, 1–15.

7. Krishnapal Singh and abhishek (2025). Seasonal variations and correlation analysis of water quality parameters in the Chambal River, Rajasthan, India. *Environmental Monitoring and Assessment*, 97(2), 1–20.

8. Driss Hammoumi., Hefdhallah S. Al-Aizari,Ibrahim., A. Alaraidh., Mohammad K. Okla Mohamed E. Assal., Ali R. Al-Aizari., Mohamed Sheikh Moshab., Saïd Chakiri and Zohra Bejjaji (2024). Seasonal variations and assessment of surface water quality using Water Quality Index (WQI) and Principal Component Analysis (PCA): A case study. *Water*, 16(13), 1–22.

9.Guoce Xu., Peng Li , Kexin Lu., Zhan Tantai., Jiaxin Zhang., Zongping Ren., Xiukang Wang , Kunxi a Yu , Peng Shi , Yuting Cheng 2019). Seasonal changes in water quality and its main influencing factors in the Dan River Basin. *Environmental Science and Pollution Research*, 173, 131–140

10.Ahmmad, S. S., Tasfina, S., Rabbani, K. A., & Khaleque, A. (2016). *An investigation into the water quality of Buriganga: A river running through Dhaka*. International Journal of Science and Technology Research, 5(3), 36–41.

11.Chaurasia, N. K., & Tiwari, R. K. (2011).
Effect of industrial effluents and wastes on physico-chemical parameters of river Rapti. Advances in Applied Science Research, 2(5), 207–211.

13.Ftsum, G., Abraha, G., Amanual, H., & Samuael, E. (2015).
Investigations of physico-chemical parameters and its pollution implications of Elala River, Mekelle, Tigray, Ethiopia. Momona Ethiopian Journal of Science, 7(2), 240–257.

14.Gupta, N., Nafees, S. M., Jain, M. K., & Kalpana, S. (2011).
Physico-chemical assessment of water quality of River Chambal in Kota City area of Rajasthan State (India). Rasayan Journal of Chemistry, 4(2), 686–692.

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