Comprehensive Analysis of Water Quality of Rapti River in Gorakhpur Region

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Abstract - *The Rapti river is an important freshwater resource for drinking, irrigation and ecological equilibrium. Yet, this river is facing growing pollution problems due to anthropogenic activities, industrial effluents and agricultural runoffs. This research focuses on the assessment of physio-chemical parameters of the river water to understand the water quality. Parameters like pH, turbidity, hardness, alkalinity, chloride etc. were measured at some sites of the river. We suggest regular monitoring, efficient wastewater treatment, conservation of natural habitats and sustainable agricultural practices to avert pollution and to ensure the river water be potable and suitable for irrigation and other uses. This article underlines the necessity of integrated water resource management towards sustainable development and prevention of water quality degradation of Rapti River.*

Key Words: Rapti River, water quality of Gorakhpur, pollution, environmental assessment, water parameters, water management, river pollution.

1. INTRODUCTION

The Gorakhpur district depends on the Rapti River because it delivers fundamental water supplies which support agricultural activities, industrial operations, and household needs. Human activities have created significant pollution threats which endanger the river. The Rapti River pollution affects both environmental systems and public health because it harms aquatic ecosystems and the human populations that depend on the river. The river starts in the lower Himalayas and goes into the Gangetic plains, which supports diverse biological systems while serving as the main water supply for nearby communities.

1.1 OBJECTIVE OF STUDY

Comprehensive water quality assessment requires investigation of rising human activities which include urban development and agricultural expansion and industrial growth Water quality evaluation determines whether water can be used for drinking, irrigation, and industrial purposes. This study aims to analyze selected water quality parameters at key locations along the Rapti River to assess the spatial variation in water quality and pinpoint sources of pollution.

1.2 KEY WATER QUALITY PARAMETERS

Water quality parameters which include pH, dissolved oxygen (DO), turbidity, temperature, biochemical oxygen demand (BOD), chemical oxygen demand (COD), nitrates phosphates and microbial content help determine aquatic system health and pollutant levels. The parameters enable identification of contamination sources while they monitor changes in time and assist water management policies.

2. LITERATURE REVIEW

- Sahni, P. & Varshney, D.1 (2024)- River water has served as an essential resource since ancient times because people have used it for drinking water and irrigation and hydropower generation and aquaculture and navigation and transportation. The area supports economic development while providing habitats for human communities and sustaining various aquatic organisms. The Yamuna River now faces severe pollution problems because industrialization and urbanization and mining activities and sewage disposal and technological advancements have increased pollution levels. The contamination of the river system creates serious health hazards for both urban and rural populations who use it as their primary water source for household needs and agricultural purposes. The research study demonstrates that continuous pollution monitoring and effective treatment programs need to be established as urgent requirements for restoring and protecting the water quality of the Yamuna River in India.

- Yadav, D. & Pandey, G.3 (2021)- The city of Gorakhpur sits on the banks of the Rapti River which flows into the Ami River at Sohgaura because the Ami River carries higher pollution levels than the Rapti River. The Rapti River continues its course until it reaches the Ghaghra River at Kaparwar Ghat. Researchers conducted a study to evaluate the water quality of Rapti River through measurements of physical and chemical parameters which included pH and turbidity and total dissolved solids and dissolved oxygen and total hardness. The research results show that human activities which include urban development and construction work and agricultural practices and discharge of untreated sewage and disposal of solid waste lead to significant contamination and environmental degradation of the river ecosystem.

- Pandit, P. & Fulekar, M.H.5 (2017)- The study assessed water quality across nine coastal regions of Gujarat, India, during the pre-monsoon season by measuring various physicochemical parameters. Principal Component Analysis (PCA) served as the statistical method that researchers used to evaluate and interpret their collected data. The results provide fundamental data about environmental conditions while showing how human activities affect coastal ecosystem health. This research shows that PCA functions effectively as a data simplification tool which enables researchers to extract essential information about water quality for improved environmental monitoring and management in Gujarat coastal areas.

- Rai, A.4 (2015)- The Ami River shows higher pollution levels than the Rapti River which harms groundwater quality in the surrounding regions. Three study sites were established at Kauriram which is located before the Ami meets the Rapti River and at Malav which is located before the Ami River and at Sohagaura which is located after their confluence to examine water quality from shallow and deep hand pumps. The researchers conducted an analysis of physical properties and chemical composition and biological characteristics of groundwater which they collected from Indian Mark hand pumps situated near both rivers. The results demonstrate that pollution from the Ami River deteriorates groundwater quality in Sohagaura, which shows that better river water management practices are necessary to safeguard local water resources.

- Alam, JB et al.2 (2007)- Researchers tested water quality from multiple locations along the Surma River which flows between Chattak and Sunamganj during both the dry season and the monsoon season. The river section contains two important industrial facilities which include a paper mill and a cement factory that could affect the water quality of the river. The analysis showed that people should not consume the river water in this area because it needs treatment to become safe for drinking. The water maintains sufficient quality for multiple surface water applications which demonstrates the requirement for effective management methods and pollution prevention measures to safeguard this important resource.

3. METHODOLOGY

3.1 Sample collection: We have collected water sample from four places which are present in GIDA, Gorakhpur, for testing their properties.

- Rajghat
- Barhuan
- Mokshdham
- Muhamdpur Maphi

Fig.3.1: Rapti River (Rajghat)

3.2 Selected Parameters: The water samples were analyzed for various physico-chemical parameters, including:

- pH
- Alkalinity
- Hardness
- Turbidity
- Acidity
- Total Dissolved Solids

3.3 Parameters Analyzed:

a) pH:

pH is a measure of the acidity or basicity of a solution. In the context of water quality, pH is an important parameter to measure.

- In water quality monitoring, pH is measured to:
- Determine the acidity or basicity of the water
- Assess the potential for corrosion or scaling
- The acceptable pH range for drinking water is typically between 6.5 and 8.5.

Fig.3.2: pH Test

b) Alkalinity:

Alkalinity is the ability of water to resist changes in pH when acids or bases are added. It's a measure of the concentration of bases, such as bicarbonate (HCO_3^-), carbonate (CO_3^{2-}), and hydroxide (OH^-), that can neutralize hydrogen ions (H^+). Alkalinity levels can vary depending on the water source and location.

Low alkalinity: Less than 10 mg/L as $CaCO_3$ (calcium carbonate)

Moderate alkalinity: 10-50 mg/L as $CaCO_3$

High alkalinity: Greater than 50 mg/L as $CaCO_3$

The acceptable limit of alkalinity in drinking water is 200 mg/L as $CaCO_3$ (calcium carbonate), according to IS 10500-2012 [1]. However, in the absence of an alternative source, the permissible limit can be extended to 600 mg/L as $CaCO_3$ [2].

c) Hardness:

Water hardness refers to the concentration of dissolved minerals, specifically calcium and magnesium, in water. These minerals can cause scaling, which can lead to problems in plumbing, appliances, and industrial equipment. Water hardness is typically measured in:

1. mg/L (milligrams per liter): This unit measures the concentration of calcium and magnesium ions in water.

2. ppm (parts per million): This unit is equivalent to mg/L.

3. DGH (degrees of general hardness): This unit measures the concentration of calcium and magnesium ions in water, with 1 DGH equivalent to 17.9 mg/L.

4. Grains per gallon (GPG): This unit measures the concentration of calcium and magnesium ions in water, with 1 GPG equivalent to 17.1 mg/L.

The acceptable limit for water hardness varies depending on the intended use:

Drinking water: 200-400 mg/L (11.3-23.4 GPG)

Industrial water: 100-500 mg/L (5.7-29.2 GPG)

High water hardness can cause:

Scaling: The formation of mineral deposits in pipes and appliances.

Corrosion: The degradation of pipes and equipment due to the presence of minerals.

Soap scum formation: The formation of soap scum on skin and surfaces.

Fig.3.3: Hardness Test

d) Turbidity: Turbidity refers to the cloudiness or haziness of water due to the presence of suspended particles, such as sediments, clay, silt, and other impurities. Turbidity can affect the appearance, taste, and odor of water, as well as its safety for drinking and other uses.

Turbidity is typically measured in:

Nephelometric Turbidity Units (NTU): This is the most common unit of measurement for turbidity.

Formazin Turbidity Units (FTU): This unit is similar to NTU but uses a different calibration standard.

WHO (World Health Organization): 5 NTU

USEPA (United States Environmental Protection Agency): 0.3-1 NTU

BIS (Bureau of Indian Standards): 5 NTU

Fig.3.4: Turbidity Test

4. STANDARD VALUE:

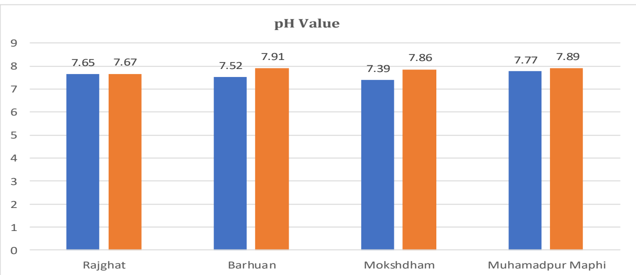
Table 4.1: Water Quality Parameters Specified by BIS and WHO

PARAMETER	UNIT	BIS 1991	WHO 2011	ANALYTICAL METHOD
Turbidity	NTU	1	1	Digital Turbidity Meter
Hardness	mg\l	300	600	Titration
pH value	---	6.5-7.5	6.5-7.5	Universal Indicator
Alkalinity	mg\l	200-600	200-600	Titration
Acidity	mg\l	50	50	Titration
TDS	mg\l	300-600	500	TDS Meter

5. RESULT & ANALYSIS

5.1 pH Test Result: -

	Rajghat	Barhuan	Mokshdham	Muhamadpur Maphi
Aug.	225	200	450	250
Sep.	280.25	260.23	300.27	240.21



Graph 5.1: pH values across different locations

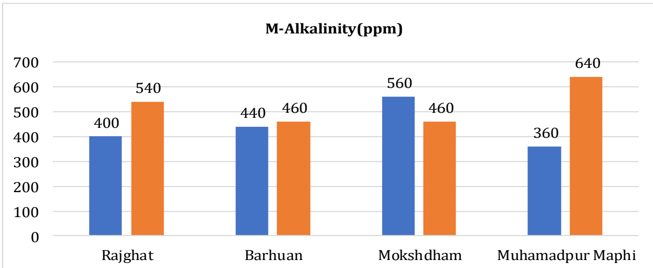
Table 5.1: pH Values

	Rajghat	Barhuan	Mokshdham	Muhamadpur Maphi
Aug.	7.65	7.52	7.39	7.77
Sep.	7.67	7.91	7.86	7.89

5.2 Alkalinity Test Result: -

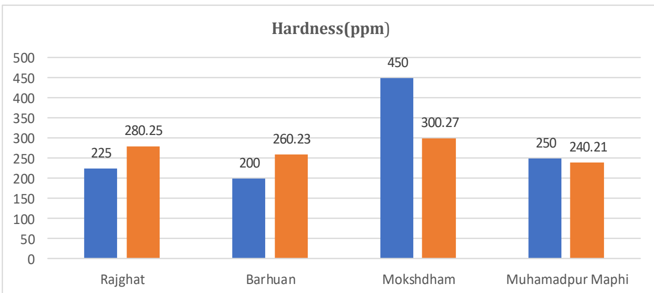
Table 5.2: Alkalinity Values

	Rajghat	Barhuan	Mokshdham	Muhamadpur Maphi
Aug.	400	440	560	360
Sep.	540	460	460	640



Graph 5.2: -Alkalinity across different locations

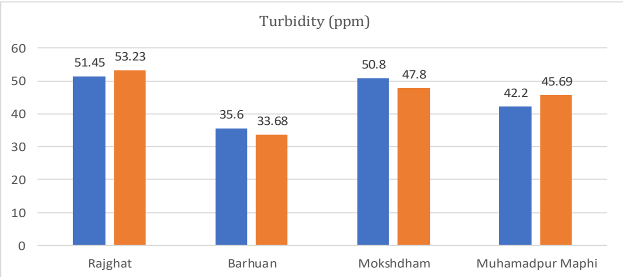
5.3 Hardness Test Result: -



Graph5.3: Hardness across different locations

Table 5.3 Hardness level

	Rajghat	Barhuan	Mokshdham	Muhamadpur Maphi
Aug.	51.45	35.6	50.8	42.2
Sep.	53.23	33.68	47.8	45.69

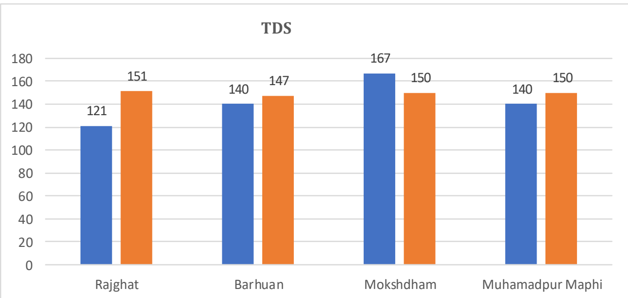


Graph 5.4: Acidity across different locations

Table 5.4: Acidity Values

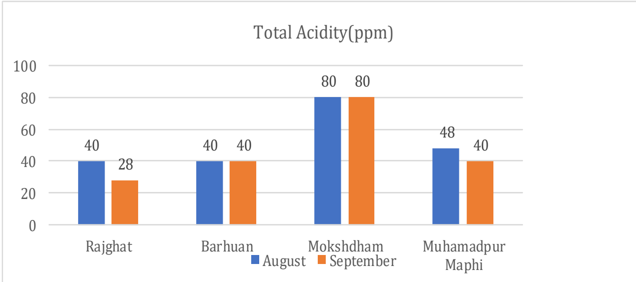
	Rajghat	Barhuan	Mokshdham	Muhamadpur Maphi
Aug.	40	40	80	48
Sep.	28	40	80	40

5.5 Turbidity Test Result: -



Graph 5.5: Turbidity across different locations

5.6 TDS Test Result: -



Graph 5.6: TDS across different location

Table 5.2: TDS Values

	Rajghat	Barhuan	Mokshdham	Muhamadpur Maphi
Aug.	121	140	167	140
Sep.	151	147	150	150

6. CONCLUSION

The evaluation of water quality parameters in the Rapti River indicated substantial fluctuations in physical, chemical, and biological attributes. The findings show that the river water is polluted because it has high levels of turbidity, total suspended solids, biochemical oxygen demand, chemical oxygen demand, and total coliform. The Bureau of Indian Standards says that the pH, hardness, alkalinity, and chloride levels were all within the acceptable range for drinking water. But the turbidity and bacteria levels were too high, which could be bad for people's health The Rapti River needs our help because we have to manage wastewater in a way, take care of natural habitats and use farming methods that do not harm the environment. We have to check the water of the Rapti River all the time to make sure it is safe for people to drink for farmers to use for irrigation and for things. The Rapti River is in trouble because of things that people have done. The water of the Rapti River has a lot of things in it which is very bad for the environment and for people's health. We need to do something now to stop the pollution of the Rapti River and make its water clean again. These measures may include: Implementation of efficient wastewater treatment systems

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18. 2020 JETIR June 2020, Volume 7, Issue 6 www.jetir.org (ISSN-2349-5162)

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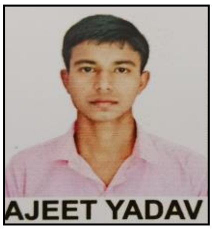

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