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# WATER QUALITY OF BURHI GANDAK RIVER NEAR SAMASTIPUR TOWN, BIHAR

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***Research Paper***

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## ABSTRACT

The physico-chemical parameters such as Temperature, pH, DO, FCO2, Alkalinity, Hardness, TDS, BOD, COD, Chloride, Nitrate and Sulphate of Burhi Gandak river water showed seasonal variations. Most of the parameters of the river at Samastipur Town are within the permissible limit and suitable for the growth and development of fishes but some pollution indicating parameters especially TDS, BOD and COD were found higher than the tolerance limit recommended by WHO.

**Keywords:** Physico-chemical parameters, Burhi Gandak river.

## INTRODUCTION

Water is a major focus of environmental quality because of its relevance in supporting human health and ecosystem health. Water is essential for life on our world, yet it is becoming increasingly scarce and endangered. Water availability and quality have always been essential factors in determining life quality. Rivers, beels, lakes, streams, seas, oceans, and ground water make up 70% of the earth's surface, and all of these forms are critical in the life cycle (Arimieari et al., 2014). Only 3% of the fluids that cover 70% of the earth's surface are considered fresh water, and only around 5% of this fresh water, or 0.15 percent of all global water, is used for beneficial purposes (Usharani et al., 2010). In July 2016, the United Nations General Assembly defined access to clean and safe water for human consumption to be a human right (UN, 2016).

Rivers are crucial and sensitive freshwater systems that are necessary for all life to exist. The diminishing quality of the water in these systems, on the other hand, poses a threat to their long-term viability and is thus a matter for concern. Rivers are important streams all across the world, supplying essential water resources for home, industrial, and agricultural use (Prakash et al., 2020). For ecological balance and agriculture (Verma, 2018a, 2018b), which rely on good physico-chemical qualities of water, a healthy aquatic ecosystem is essential. North Bihar has an abundance of water resources. BurhiGandak is a prominent river in North Bihar's Samastipur district. People in and around Samastipur use this river's water for a variety of activities, including irrigation, bathing, washing, and drinking. Domestic sewage, in addition to these human activities, is discharged into the river. As a result, the quality of the water has deteriorated. River water chemistry has changed dramatically as a result of the industrial revolution, and only a few remain in their natural state.

Although many researchers have looked into the physicochemical and biological parameters of fresh

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water bodies, such as Prakash et al. (2002; 2015), Singh and Verma (2016), Verma (2016, 2019, 2020), and Verma and Prakash (2020), there is still a lack of baseline data on the physicochemical parameters of the BurhiGandak river in Samastipur town. As a result, the current project was launched to investigate the water quality of the BurhiGandak River in Samastipur. The study's goal was to not only improve the river's water quality, but also to look into the prospects for improved management and development.

## MATERIALS AND METHODS

### Study Site

The BurhiGandak River is a major perennial river in north Bihar. It springs in the small settlement Vishambar in the West Champaran district, at an elevation of 300 metres, from the spring of the Someshwar hills. At 27°29" north latitude and 84°8" east longitude, The BudhiGandak flows through the districts of West Champaran, East Champaran, Muzaffarpur, Samastipur, Darbhanga, Begusarai, Munger, and Khagaria, covering a distance of roughly 410 kilometres before merging with the Ganges near Mansi in Khagaria's east. Its overall catchment area is 12,180 square kilometres, with roughly 10.370 square kilometres in Bihar. It provides drinking and residential water, as well as irrigation and fish protein. However, this river has grown contaminated as a result of increased urbanisation, the discharge of domestic sewage as well as municipal garbage, and extensive anthropogenic activity. In this study, an attempt was made to examine the water quality.

Three sites were used to gather water samples from the river BurhiGandak. Surface water was collected in the middle of the river at each sampling point and stored in clean polyethylene bottles. Because of their unstable nature, water temperature, pH, and dissolved oxygen were measured on the spot.

### The selected sites were

Site 1. Entering point of Burhi Gandak river in Samastipur town (Upstream).

Site2. Located in the middle of Samastipur town.
Site 3. 500 meter away from site 2 (Down Stream).

The obtained samples were immediately sent to the laboratory for analysis of the sample water's physico-chemical properties. Following conventional APHA techniques, the obtained samples were evaluated for Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Free CO2 and TDS, DO, BOD, COD, Nitrate, Sulphate, chloride, and heavy metals such as chromium, lead, nickel, copper, zinc, and cadmium (2005).

## RESULTS AND DISCUSSION

The monthly samples collected from four sites of river BurhiGandak were subjected to physicochemical characterization for parameters such as Temperature, pH, DO, $FCO_2$, TSS, TDS, BOD, COD, nitrate, sulphate, chloride and heavy metals as per standard methods. The results of the various physico-chemical parameters of river BurhiGandak of three seasons (Summer, monsoon and winter) from March, 2021- to Feb,2022 are summarized in Table-1. The result of the present study shows wide variations were observed in measured parameters at all stations.

The water temperature fluctuated with the seasons, with the lowest temperatures in the winter and the greatest temperatures in the summer. These findings are validated by the findings of (Singh and Gupta, 2004) in the BurhiGandak river. Many abiotic and biotic components of the aquatic ecosystem are influenced by water temperature, either directly or indirectly. It also reflects the live organism's dynamics, such as metabolic and physiological behaviour in aquatic ecosystems (Singh, 2014). The average temperature in this study ranged from 17.35 to 31.130 degrees Celsius, with the highest average temperature in the summer and the lowest average temperature in the winter. While working on various bodies of water, many employees saw similar patterns (Sen et.al.,2011; Singh, 2014). The temperatures were determined to be suitable for the survival and growth of fish fauna, as fish require a moderate temperature for growth and reproduction (Ansari and Prakash, 2000). The temperature of the water was directly affected by changes in the air temperature. The water temperature was often greater in the summer than it was in the winter (Prakash et al., 2015). The temperature range of the water was within the optimal range for fish development and growth (Jhingran, 1988).

The pH of water is a critical chemical characteristic that impacts its appropriateness for many applications. Because most aquatic organisms are accustomed to an average pH, water pH is vital for biotic communities. During the summer, monsoon, and winter seasons, the average pH values were 7.30, 7.45, and 7.24, respectively. Due to extensive rainfall throughout the winter months, the lowest pH value was discovered. The pH observed in this study

**Table 1:** Seasonal Variation in Physico-chemical Parameters of river BurhiGandak at Samastipur town (During Summer March, 2021-May, 2021; Monsoon June2021- Sept., 2021; Winter Oct., 2021-Feb,-2022).

| Parameters | Season | Site-1 | Site-2 | Site-3 | Average |
|---|---|---|---|---|---|
| **Temp$^0$C** | Summer | 29.70 | 31.40 | 32.30 | 31.13 |
| | Monsoon | 25.4 | 26.5 | 27.8 | 26.56 |
| | Winter | 17.2 | 18.5 | 17.5 | 17.33 |
| **pH** | Summer | 7.52 | 7.17 | 7.21 | 7.30 |
| | Monsoon | 7.54 | 7.35 | 7.48 | 7.45 |
| | Winter | 7.27 | 7.19 | 7.26 | 7.24 |
| **DO** | Summer | 6.25 | 6.35 | 6.10 | 6.23 |
| | Monsoon | 7.10 | 6.70 | 5.80 | 6.53 |
| | Winter | 7.52 | 7.45 | 7.85 | 7.60 |
| **$FCO_2$** | Summer | 55.8 | 60.4 | 57.5 | 43.42 |
| | Monsoon | 41.4 | 42.7 | 41.3 | 41.8 |
| | Winter | 37.4 | 37.7 | 38.4 | 37.8 |
| **Alkalinity** | Summer | 205.5 | 195.3 | 181.4 | 194.06 |
| | Monsoon | 202.4 | 191.3 | 175.4 | 189.70 |
| | Winter | 158.6 | 149.2 | 119.2 | 142.36 |
| **Hardness** | Summer | 111.0 | 112.0 | 125.0 | 116.0 |
| | Monsoon | 95.5 | 98.5 | 105.5 | 99.83 |
| | Winter | 115.5 | 117.8 | 132.4 | 121.90 |
| **TDS** | Summer | 416.0 | 455.5 | 505.5 | 459.0 |
| | Monsoon | 605.0 | 618.5 | 655.0 | 626.16 |
| | Winter | 455.0 | 472.5 | 540.5 | 489.30 |
| **BOD** | Summer | 7.5 | 8.1 | 9.50 | 8.36 |
| | Monsoon | 5.5 | 5.9 | 8.50 | 6.63 |
| | Winter | 5.0 | 6.2 | 6.4 | 5.86 |
| **COD** | Summer | 20.0 | 22.0 | 25.0 | 22.33 |
| | Monsoon | 11.50 | 12.50 | 15.50 | 13.16 |
| | Winter | 18.5 | 19.5 | 22.0 | 20.0 |
| **Chloride** | Summer | 27.5 | 32.5 | 37.5 | 32.5 |
| | Monsoon | 13.5 | 16.5 | 28.5 | 19.5 |
| | Winter | 14.50 | 17.50 | 19.50 | 17.16 |
| **Nitrate** | Summer | 0.62 | 0.85 | 2.03 | 1.17 |
| | Monsoon | 0.49 | 0.67 | 2.5 | 1.22 |
| | Winter | 0.55 | 0.65 | 2.05 | 1.08 |
| **Sulphate** | Summer | 24.40 | 24.60 | 27.80 | 25.60 |
| | Monsoon | 12.50 | 17.00 | 22.75 | 17.41 |
| | Winter | 16.50 | 20.50 | 23.00 | 20.00 |

**Notes**: All values are in mg/l except water temp. and pH.

ranged from 7.24 to 7.45, indicating mildly alkaline circumstances. The pH of the BurhiGandak river was alkaline, which is a favourable sign for fish survival (Prakash. 2001; Khanna et al., 2013).

One of the most essential parameters in determining the quality of water is dissolved oxygen, which has a direct impact on the survival and distribution of flora and fauna in an aquatic ecosystem. During the observation period, the average DO concentration was around 7.00 mg/l. This figure is favourable for healthy fish growth. According to Rajagopal et al. (2010), dissolved oxygen was highest in the winter at 7.60 mg/L and lowest in the summer at 6.23 mg/L, which could be owing to limited solubility at high temperatures and high breakdown of organic compounds. This result is corroborated by Ansari and Prakash's findings (1999). Because fish require at least 5 mg/l dissolved oxygen, river water is adequate for their development and growth (Verma, 2020). The amount of D.O. in water is affected by water temperature, air partial pressure, and other factors.

Carbon dioxide is the most important component of the photosynthetic process in plants. CO2 reacts with water in water bodies to generate carbonic acid, which quickly dissociates into carbonates and bicarbonates, changing the pH of the water (Prakash, 2001). CO2 behaved differently in different seasons in all four sampling sites, which was surprising. In the current investigation, average free CO2 levels ranged from 37.80 to 43.42 mg/L in different seasons and locations. The lowest levels of free CO2 (37.80 mg/l) were found in the winter, while the greatest levels (43.42 mg/L) were found in the summer. Singh discovered similar results (2014). The increase in CO2 levels during the summer months could be attributable to organic matter degradation and decomposition, as well as the addition of industrial waste (Joshi et.al., 1995),

Water's alkalinity is its ability to neutralise strong acids, which is primarily determined by carbonate, bicarbonate, and hydroxide content and is created when CO2 is dissolved in water. In this study, average alkalinity values ranged from 142.36 to 194.06 mg/L in all three seasons, with the highest value (194.06 mg/L) in the summer and the lowest value (142.36 mg/L) in the winter. Some researchers (Sahni and Yadav, 2012; Sen et al., 2011; Khanna et al., 2011) discovered a similar tendency of alkalinity changes in river water. Decomposition of bottom sediments, resulting in the conversion of insoluble carbonates to soluble bicarbonates (Tabrez et.al. 2010). The alkalinity range of river water indicates that photosynthetic activity has taken precedence over biota respiration activity (Ansari and Prakash, 2000). According to Alikunhi (1957), the alkalinity in highly productive water should be greater than 100 mg/l. Because the alkalinity of the water in the Burhi Gandak remained greater throughout the year, it was appropriate for fish farming.

In different seasons, total hardness values ranged from 99.83 to 121.90 mg/L, with the highest value (121.90 mg/L) in summer and the lowest value (99.83 mg/L) in monsoon season. This could be owing to the high levels of calcium and magnesium, as well as sulphate and nitrates (Singh, 2014). The rise in hardness can be ascribed to a decrease in water volume and an increase in the rate of evaporation at high temperatures, high loading organic compounds, detergent, chloride, and other pollutants, as well as high loading organic substances, detergent, chloride, and other pollutants (Prakash et al., 2017). Water with a hardness of up to 75 mg/l is categorised as soft, 76-150 mg/l as moderately soft, 151-300 mg/l as hard, and more than 300 mg/l as very hard, according to various classifications (Saravana Kumar and Kumar, 2011). The selected water samples from the Burhi Gandak River can be classified as soft based on classification.

A high concentration of dissolved solid elements alters the density of water, changes freshwater species' osmoregulation, reduces the solubility of gases (such as oxygen), and reduces the utility of water for drinking, irrigation, and industry. Waters can be classed as desired for drinking (up to 500 mg/L), permissible for drinking (up to 1,000 mg/L), beneficial for irrigation (up to 2,000 mg/L), or not suitable for drinking and irrigation (beyond 3,000 mg/L) based on their TDS content (Lokhande, et al 2011). The average total dissolved salts (TDS) in the current study ranged from 459.0 mg/l (in Summer) to 626.16 mg/l (in Monsoon), which was greater than the recommended limit for drinking water.

The biological oxygen demand (BOD) of Burhi Gandak river water ranged from 6.53 mg/L to 9.66 mg/L on average. The allowable limit was surpassed in all of the samples (EPA, 2001). BOD levels in drinking water are limited to 0.2 mg/L, recreation to 3 mg/L, fish to 6 mg/L, and irrigation to 10 mg/L, according to the Department of Energy (1997). As a result, the BOD levels of the Burhi Gandak river (save

for site 1) were unsuitable for fish production. The chemical oxygen demand (COD) of Burhi Gandak river water ranged from 5.86 mg/l to 8.36 mg/l. It was also below the maximum size and number of fish that could be grown and reproduced. The presence of chemicals, both organic and inorganic, generated by the influx of industrial and domestic waste containing high amounts of organic pollutants results in excessive BOD and COD (Abaidooan, 2015)

The average chlorides level in this study ranged from 17.16 to 32.05 mg/L, with the highest value (32.05 mg/L) occurring during the summer season and the lowest value (17.16 mg/L) occurring during the winter season. Other researchers noticed reduced chloride concentrations in freshwater bodies throughout the winter season (Shiddamallaya and Pratima, 2008). According to Venkatesharaju et al. (2010), higher chloride concentrations in the summer may be attributable to increased warmth, low water levels, and sewage mixing. The higher chloride concentration at site 3 is thought to be a sign of increased pollution from sewage outflow.

The average nitrate content in this study ranged from 1.08 mg/l (in winter) to 1.22 mg/l (in summer) (in Summer). Except when the content of nitrate in water exceeds 90 mg/L, according to Aboyeji (2013), nitrate is rather harmless for fish health. Sulphate concentrations in the BurhiGandak ranged from 17.41 mg/l in the winter to 25.60 mg/l in the summer (in summer). When compared to the EPA limit of 2.0 mg/L, the sulphate level in the Burhi Gandak river was found to be unsuitable for fish growth.

## CONCLUSION

The purpose of this study was to evaluate the physicochemical parameters of surface water collected from four different sampling sites along the BurhiGandak in Samastipur Town. This experiment revealed that various physicochemical parameters, like as temperature, pH, DO, FCO2, alkalinity, and hardness, were within permissible limits in India, whereas TDS, BOD, and COD concentrations were significantly higher than national and international requirements. As a result of the data collected on physicochemical characteristics, it was discovered that the water quality of the River BurhiGandak in Samastipur town was good enough to sustain life and that the water could be used for a variety of purposes.

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