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# Study of water analysis of ken river speciall Wqi

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**Abstract**
Water quality analysis is one of the most important aspects in surface water studies. Assessment of water quality is a critical factor for assessing the pollution level. Water sample were collected from 6 different sampling stations for evaluate the water quality status of river Ken during October 2019. A total 16 water quality parameters were analysed. During the present investigation the mean ±SD values of air temperature, water temperature, turbidity, pH, electrical conductivity, total dissolved solids, free carbon dioxide, total alkalinity, chloride, total hardness Calcium Hardness dissolved oxygen, nitrate, orthophosphate, biochemical oxygen demand, chemical oxygen demand were noted as 27.30±2.23, 24.67±2.04, 12.78±5.44, 8.29±0.35, 270.83±36.10, 180.17±32.65, 4.30±6.72, 140.00±22.24, 22.11±6.02, 139.33±14.92, 75.±84±8.95, 7.34±1.71, 1.18±0.76, 0.21±0.08, 7.60±2.45 and 19.17±6.34 respectively. The objectives of present study was to understand the water quality of river Ken at Banda (U.P.).

**Keywords:** water analysis, river, ken, wqi

## 1. Introduction
Water Quality can be described as the chemical, physical and biological characteristics of water, generally in admire to its suitability for a specific use. Water can be used for recreation, drinking, fisheries, agriculture or industry. Each of these detailed uses has unique defined chemical, bodily and organic standards indispensable to fulfil the respective purpose. For example, there are stringent standards for water to be used for ingesting or swimming in contrast to that used in agriculture or industry. After many years of research, water nice standards are put in region to ensure the suitability of efficient use of water for a special purpose. Water fantastic analysis is to measure the required parameters of water, following general methods, to test whether they are in accordance with the standard. Water is used for drinking, irrigation, and transportation, washing and waste disposal for industries and used as a coolant for thermal strength plants. Water shapes the earth's surface and regulates our climate. With growing human population and rapid development, the world water withdrawal demands have increased many folds and a giant share of the water withdrawal is polluted due to atmospheric activities. Rivers are the most necessary water resources. It has long been used for discharging the wastes. Unfortunately the rivers are being polluted by means of indiscriminate disposal of sewage, industrial wastes and with the aid of human activities. Pollution of the river first influences its physico-chemical fantastic and then systematically destroys the neighborhood disrupting the refined food web. The objective of the present study is to Investigate the water quality of river Ken.

## 2. Methodology
### Study area
The Ken River originates near the village Ahirgawan on the north-west slopes of Barner Range in Katni district and travels a distance of 427 km, before merging with the Yamuna at Chilla village, district Banda in Uttar Pradesh at 25°46′N 80°31′E. Ken rising is district Damoh, touches Banda near village Bilaharka in Naraini tahsil for about two km and then turns towards Chhatarpur district appearing again in the same tahsil. Then entering Banda tahsil near Utarandi village it flows north-east bordering district Hamirpur and then turns eastward to meet Yamuna at Chillghat.
Baghein is the second important river of this district. Emanating from a hill near Kohari of Panna district, it enters Banda district at Masauni Bharatpur village (the. Naraini). It flows north-east-ward and at a point separates Banda from the newly created Chitrakut district forming boundaries between Atarra, Baberu and Karrwi tahsils.
The climate of the district is characterized by a hot summer and a pleasant winter. The cold season from about middle of November to February is followed by hot season from March to middle of June. The period from mid-June to the end of September is south-west Monsoon season.
The sampling sites were Barua, Girwar, Manipur, Tendwara, Banda and Mawai.

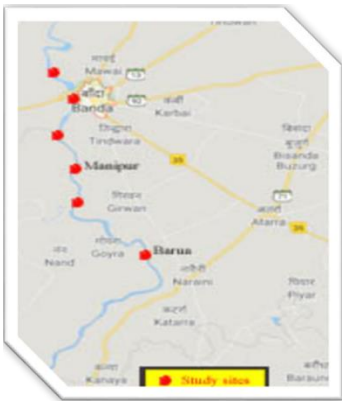


**Fig 1**

**Laboratory methods**

Samples were collected in acid wash 1 litre plastic canes and brought to the laboratory for further analysis. The sampling was done 9 a.m.-3 pm. Physico-chemical parameters like water temperature, pH, conductivity, DO, free Carbon-dioxide and total alkalinity were measured in the field. Other parameters were mostly tested within 24 hrs of collection. Preservation of water samples was done at 4°C temperature. The water quality parameters were analyzed by standard methods given in APHA (1998) [1]. and Trivedi and Goel (1987) [2].

**Table 1:** Drinking Water Quality Parameters as per Indian Standards/CPCB/WHO and their estimated unit weight.

| S.No. | Water Quality Parameters | Limits According to Indian Standards /CPCB/WHO | Unit Weight Wi = K/Si |
|---|---|---|---|
| 1. | pH value | 6.5-8.5 | 0.35 |
| 2. | Alkalinity, mg/l (as $CaCO_3$), Max | 200 | 0.015 |
| 3. | Total Dissolved Solids, mg/l, Max | 500 | 0.006 |
| 4. | Total Hardness, mg/l (as $CaCO_3$), Max | 300 | 0.01 |
| 5. | Chlorides, mg/l, Max | 250 | 0.012 |
| 6. | Dissolved Oxygen, mg/l | Not less than 4 mg/l | 0.7 |
| 7. | Temperature °C | Shall not exceed 30°C | 0.1 |

**Table 2:** Classification of Water Quality Index and Status of Water Quality

| Water Quality Index (WQI) Levels | Status of Water Quality | Grading | Designated Best Use (Fresh Waters) |
|---|---|---|---|
| 0-25 | Excellent Water Quality | **A** | Drinking water source without conventional treatment but after disinfection. |
| 26-50 | Good Water Quality | B | Outdoor bathing |
| 51-75 | Poor Water Quality | C | Drinking water source with conventional treatment followed by disinfection. |
| 76-100 | Very Poor Water Quality | D | Propagation of wildlife, fisheries |
| Above 100 | Unsuitable for Drinking. | E | Irrigation, industrial cooling, and controlled waste disposal. |

## 3. Results and Discussion

The results of water quality parameters are depicted in table 3 and correlation matrix table 4.

**Table 3:** Variation in physico-chemical parameters of Ken river at different sampling site in Banda district.

| S. No. | Parameters | Sampling sites | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Barua | Girwan | Manipur | Tendwara | Banda | Mawai | Mean | SD |
| 1. | Air Temperature (°C) | 25 | 27.6 | 26.5 | 25.5 | 31.2 | 28 | 27.30 | 2.23 |
| 2. | Water Temperature (°C) | 23.2 | 25.5 | 25 | 22.1 | 28 | 24.2 | 24.67 | 2.04 |
| 3. | Turbidity (NTU) | 10.5 | 21.6 | 8.3 | 9.5 | 17.5 | 9.3 | 12.78 | 5.44 |
| 4. | pH | 8.40 | 7.70 | 8.65 | 8.45 | 8.05 | 8.50 | 8.29 | 0.35 |
| 5. | Conductivity (µs/cm) | 265 | 332 | 241 | 231 | 287 | 269 | 270.83 | 36.10 |
| 6. | TDS (ppm) | 157 | 227 | 171 | 149 | 215 | 162 | 180.17 | 32.65 |
| 7. | Free $CO_2$ (mg/l) | 0 | 14.3 | 0 | 0 | 11.5 | 0 | 4.30 | 6.72 |
| 8. | Total Alkalinity (mg/l) | 132 | 171 | 125 | 113 | 162 | 137 | 140.00 | 22.24 |
| 9. | Chloride (mg/l) | 20.30 | 30.70 | 17.50 | 15.16 | 27.90 | 21.12 | 22.11 | 6.02 |
| 10. | Total Hardness (mg/l) | 139 | 159 | 127 | 122 | 155 | 134 | 139.33 | 14.92 |
| 11. | Calcium Hardness (mg/l) | 75.2 | 90.65 | 71.2 | 63.82 | 79.5 | 74.67 | 75.84 | 8.95 |
| 12. | Dissolved Oxygen (mg/l) | 8.25 | 4.90 | 8.45 | 8.60 | 5.40 | 8.45 | 7.34 | 1.71 |
| 13. | Nitrate (mg/l) | 0.679 | 2.380 | 0.560 | 0.645 | 1.875 | 0.918 | 1.18 | 0.76 |
| 14. | Orthophosphate (mg/l) | 0.186 | 0.314 | 0.155 | 0.115 | 0.305 | 0.193 | 0.21 | 0.08 |
| 15. | BOD (mg/l) | 7.20 | 11.0 | 6.10 | 4.90 | 10.2 | 6.20 | 7.60 | 2.45 |
| 16. | COD (mg/l) | 17.5 | 28.4 | 15.2 | 12.2 | 25.5 | 16.2 | 19.17 | 6.34 |

**Table 4:** Simple correlation coefficient test between physico-chemical factors of Ken River at different sampling site in Banda district.

| | Air. Temp. | Waterr Temp. | Turbidity | pH | Conductivity | TDS | Free $CO_2$ | Total Alkalinity | Chloride | Total Hardness | Calcium Hardness | Dissolved Oxygen | Nitrate | Orthophosphate | BOD | COD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Air. Temp. | 1.00 | | | | | | | | | | | | | | | |
| Water Temp. | 0.90 | 1.00 | | | | | | | | | | | | | | |
| Turbidity | 0.55 | 0.63 | 1.00 | | | | | | | | | | | | | |
| pH | -0.46 | -0.51 | -0.99 | 1.00 | | | | | | | | | | | | |
| Conductivity | 0.47 | 0.56 | 0.92 | -0.92 | 1.00 | | | | | | | | | | | |
| TDS | 0.82 | 0.82 | 0.94 | -0.88 | 0.87 | 1.00 | | | | | | | | | | |
| Free $CO_2$ | 0.65 | 0.73 | 0.99 | -0.95 | 0.87 | 0.98 | 1.00 | | | | | | | | | |
| Total Alkalinity | 0.69 | 0.78 | 0.93 | -0.89 | 0.95 | 0.95 | 0.93 | 1.00 | | | | | | | | |
| Chloride | 0.67 | 0.75 | 0.94 | -0.91 | 0.96 | 0.94 | 0.94 | 1.00 | 1.00 | | | | | | | |
| Total Hardness | 0.63 | 0.73 | 0.93 | -0.91 | 0.94 | 0.91 | 0.92 | 0.98 | 0.99 | 1.00 | | | | | | |
| Calcium Hardness | 0.45 | 0.61 | 0.88 | -0.86 | 0.98 | 0.87 | 0.84 | 0.95 | 0.95 | 0.93 | 1.00 | | | | | |
| Dissolved Oxygen | -0.67 | -0.76 | -0.98 | 0.95 | -0.88 | -0.98 | -1.00 | -0.95 | -0.95 | -0.94 | -0.86 | 1.00 | | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate | 0.64 | 0.68 | 0.98 | -0.96 | 0.93 | 0.96 | 0.98 | 0.95 | 0.96 | 0.93 | 0.89 | -0.98 | 1.00 | | | |
| Orthophosphate | 0.73 | 0.81 | 0.92 | -0.88 | 0.92 | 0.95 | 0.94 | 0.99 | 0.99 | 0.99 | 0.92 | -0.95 | 0.95 | 1.00 | | |
| BOD | 0.63 | 0.77 | 0.95 | -0.92 | 0.92 | 0.96 | 0.95 | 0.97 | 0.98 | 0.99 | 0.92 | -0.97 | 0.94 | 0.98 | 1.00 | |
| COD | 0.63 | 0.76 | 0.96 | -0.93 | 0.94 | 0.96 | 0.96 | 0.99 | 0.99 | 0.99 | 0.94 | -0.97 | 0.96 | 0.99 | 1.00 | 1.00 |

**Table 5:** Water Quality Index (WQI) of Ken River at Six Different Sampling Sites.

| | Barua | Girwan | Manipur | Tendwara | Banda | Mawai |
|---|---|---|---|---|---|---|
| WQI value | 56.61 | 51.77 | 56.67 | 57.82 | 60.11 | 58.06 |
| | Poor | Poor | Poor | Poor | Poor | Poor |

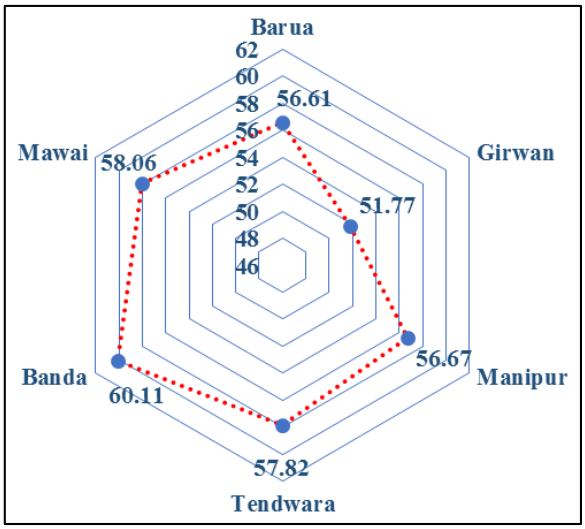


**Fig 2:** Water Quality Index (WQI) of Ken River at Six Different Sampling Sites

**Air Temperature:** In the present higher air temperature was observed 31.2°C at Banda site while lowest 25°C was at Barua site. The mean ±SD values of water temperature were recorded as 27.30±2.23$^0$C. In was negatively correlated with pH and dissolved oxygen. The fluctuations of air temperature are more evident in fresh water habitats. Flowing waters, however, lack wide fluctuations in temperature (Leonard, 1971) [3].

**Water Temperature:** Temperature is one of the most important parameter of water as it affects the biotic as well as abiotic component of the ecosystem. It is a critical water quality parameter, since it directly influences the amount of dissolved oxygen that is available to aquatic organisms. During the present study water temperature varied from 22.1 to 28°C. The mean ±SD values of water temperature were recorded as 24.67±2.04$^0$C. Temperature is an important physical parameter of the water body which regulates natural process within the environment and governs physiological function in organism (Negi *et al*., 2006) [4].

**Turbidity:** Turbidity of water is actually the expression of optical property in which the light is scattered by the particles present in the water. Clay, slit, organic matter, phytoplankton and other microscopic organisms cause turbidity in water (Das *et al*., 2003)[5]. In the present study turbidity values varied from 8.3 NTU to 21.6 NTU. In was negatively correlated with pH and dissolved oxygen. Higher values of turbidity at Girwan site may be attributed to the comparatively higher suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter (Sadar, 1996) [6].

**pH:** pH, or the "potential of hydrogen" is a measure of the concentration of hydrogen ions in the water. This measurement indicates the acidity or alkalinity of the water. On the pH scale of 0-14, a reading of 7 is considered to be "neutral". Readings below 7 indicate acidic conditions, while readings above 7 indicate the water is alkaline or basic. Naturally occurring fresh waters have a pH range between 6 and 8. The pH of the water is important because it affects the solubility and availability of nutrients, and how they can be utilized by aquatic organisms. It is one of the important factors that serve as an indicator of pollution of water body. Highest pH value of the sample was recorded as 8.65 at Manipur site and that of minimum 7.70 at Girwan site. In was positively correlated with dissolved oxygen. Various factors bring about changes the pH of water. The difference in the pH value of the sample might be due to fact that the accumulation of domestic sewage. Similar findings were also made by Patil (1982) [7].

**Electrical Conductivity:** Conductivity value ranged from 230-398 µs/cm at different sampling sites of the river Ken. The minimum and maximum value obtained was 231µs/cm and 332 µs/cm respectively at Tendwara site and Girwan site. In was negatively correlated with pH and dissolved oxygen. This indicated that the river water had different quality at different stations. Usually higher EC value indicate the presence of higher content of dissolved salts in river water (Abdullah and Musta, 1999)[8] and the EC values are a good measure of the relative difference in water quality between different aquifers. (Roscoe, 1990) [9].

**Total Dissolved Solids:** The term TDS describes all solids (usually mineral salts) that are dissolved in water. Desirable limit of TDS is 500 mg/l (ICMR, 1975) [10]. TDS of the water sample varied from 149 ppm to 227 ppm. The mean ±SD values of TDS were recorded as 180.17±32.65ppm. Variations of dissolved solids in water could affect conductivity measurements, but provides no indication of the relative quantities of the various components. There is a relationship between conductivity and total dissolved solids in water. As more dissolved solids are added, water's conductivity increases (McNeely *et al*., 1979) [11].

**Free Carbon dioxide:** The amount of free $CO_2$ in water is generally maintained by diffusion from atmosphere, respiration by animals along with plants and bacterial decomposition of organic matter (Mishra *et al*., 1993) [12]. During the present study free $CO_2$ fluctuated between 11.5-14.3 mg/l, highest being recorded at Girwan site and lowest at Banda. These observations are referable to the results obtained by Cooum river from Madras by Jabanesean *et al.*, (1994) [13]. Bahini river and Brahmputra river of Guwahati by Das *et al.*, (2003) [5].

**Total Alkalinity:** Total alkalinity is caused by bicarbonates, carbonates, OH ions, borates, silicates and phosphates (Kataria *et al.*, 1995) [14]. Alkalinity is a measure of buffering capacity of water and is important for aquatic life in a freshwater system because it equilibrates the pH changes that occur naturally as a

result of photosynthetic activity of phytoplankton (Kaushik and Saksena, 1989) [15]. Total alkalinity values in the present observations fluctuated from 113 to 171 mg/l. Minimum total alkalinity 113 mg/l was observed at Tendwara site while maximum 171 mg/l at Girwan site. Upadhyay and Rana, (1991) [16]. were reported the higher value of alkalinity indicates the pollution of river water by sewage.

**Chloride:** Chloride concentration is one of the most indicators of water pollution (Munawar, 1970) [17]. It is one of the major anions found in water and are generally combined with calcium, magnesium or sodium. During the study period Chloride value ranged from 15.16-30.70 mg/l. Chloride content of different Indian rivers were studied by various workers. Rai (2020) [18]. reported chloride 8.2 to 81.5 mg/l in river Ganga. Raised value of chloride at Banda site is due to mixing of municipal sewage and domestic waste in river water. Similar observation was made by Dwivedi and Odi (2003) [19]. from Dickrong river.

**Total Hardness:** Total hardness is the parameter of water quality used to describe the effect of dissolved minerals (mostly Ca and Mg), determining suitability of water for domestic, industrial and drinking purposes and attributed to presence of bicarbonates, sulphates, chloride and nitrates of calcium and magnesium (Taylor, 1949) [20]. Total hardness varies from 122 to 159 mg/l all selected sampling sites. The maximum total hardness was recorded at Tendwara site may be attributed to the mixing of domestic sewage and industrial effluents into the river water (Radhakrishnan *et al.* 2007) [21].

**Calcium Hardness:** Calcium ions are important components of plant tissues and participate in various cellular functions. It is also required as a nutrient for various metabolic processes and assists in proper translocation of carbohydrates that facilitates the availability of other ions (Wetzel, 1975) [22]. During the present study period Calcium hardness varied from 63.82-90.65 mg/l. The lowest Calcium hardness 63.82 mg/l was observed at Tendwara site while maximum 90.65 mg/l at Girwan site. Khadse (2008) [23]. reported maximum value of calcium content in Kanhan river which might be due to higher calcium content in city sewage.

**Dissolved Oxygen:** The dissolved oxygen concentration of river water varied from maximum 8.60 at Tendwara site and a minimum of 4.90 at Girwan site. The change in dissolved oxygen content was mainly due to the solubility of dissolved oxygen increased with decreased in water temperature. The change in the content was mainly due to the utilization of these molecules by the aerobic bacteria present in the sample and release free $CO_2$ as a result of decomposition. This was accordance to the findings of Moss (1972) [24].

**Nitrate:** Nitrate represents the end product of oxidation of nitrogenous matters and its concentration may depend on the nitrification and denitrification activities of micro-organisms. Domestic sewage contains very high amount of nitrogenous compounds. Atmospheric nitrogen fixed into nitrates by the nitrogen fixing organism is also a significant contributor to nitrates in the water (Rai, 2020) [18]. In the present investigation, nitrate content varied between 0.560 mg/l to 2.380 mg/l throughout the study period. The maximum values of nitrate were recorded at Girwan site due to influx of nitrogen rich flood water that brings large amount of contaminated sewage water.

**Orthophosphate:** During the present study minimum orthophosphate 0.115 mg/l was recorded at Tendwara site while maximum 0.314 mg/l was noted at Girwan site. Rajeshwari and Saraswathi (2009) [25]. reported phosphate concentration in Tungbhadra river varied from 0.001 to 2.1 mg/l and contamination is mainly due to washing clothes with detergents.

**Biochemical Oxygen Demand:** BOD is the amount of oxygen required by the bacteria in stabilizing the decomposable organic matter. The aim of BOD test is to determine the amount of bio chemically oxidizable carbonaceous matter (Gupta *et al*., 2003) [26]. During the study BOD measured in the range of 4.90 to 11 mg/l. Maximum BOD was recorded at Girwan site which could be due to the influence of sewage. Higher values of BOD and lower values of DO indicate more amount of organic matter present in sewage (Vaishali, 2005) [27].

**Chemical Oxygen Demand:** Chemical oxygen demand (COD) is a measure of the oxidation of reduced chemicals in water. It is commonly used to indirectly measure the amount of organic compounds in water. In the present study COD varies from 12.2 to 28.4 mg/l. The maximum value of COD 28.4 mg/l was observed at Girwan site which indicates to increase the pollution level of the river Ken. In was negatively correlated with pH and dissolved oxygen. Koshy and Nayar (1999) [28]. Found that the river Pamba receives large quantities of hospital and domestic wastes which may contribute to the high COD level.

## 4. Conclusion

The present study reveals that the water quality of river Ken is deteriorated. It was due to directly mixing of the domestic sewage and industrial effluents in river Ken. To improve the quality of water, sewage treatment plants are essential. Therefore the discharged of effluents before treatment and other waste into the River Ken should be controlled and enforced.

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