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# Studies of surfacewater quality of the Kashipur, Uttarakhand, India

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## Abstract

**Pollution of water bodies is one of the areas of major concern to environmentalists. Water quality is an index of health and well being of a society. Industrialisation, urbanisation and modern agriculture practices have direct impact on water resources. These factors influence the water resources quantitatively and qualitatively. The study area selected were the Bahella river, Mahadev stream and Kosi river basin of Kashipur, Uttarakhand, India. The Bahellariver, Mahadev and Kosi river water is an important source of potable water supply for Kashipur as well as adjointed areas of the U. S. Nagar district for all purposes.Thephysico-chemical parameters like temperature, pH, turbidity, total hardness, alkalinity, BOD, COD, chloride, nitrate and phosphate and fluoride content in water of Bahella river, Mahadev stream and Kosi river were studied to ascertain the drinking and domestic as well as irrigation water supply in Kashipur area. In this present study water quality of Bahellariver, Mahadev stream and Kosi river is taken into account and Khokartalwater is found to be severely polluted with reference to these analyzed parameters.**

***Keywords****:Kosi river, Bahellariver, Mahadevstream, dissolved oxygen, water quality, Kashipur*

## Introduction

India has experienced substantial increase in industrial growth and expansion in recent years. The industry has resulted in increased pollutant emissions and the deterioration of environmental quality and human health in major cities in India. After formation of Uttarakhand as a new State rapid industrialization and urbanization took place due to this there is great pressure on the environmental components.Water is one of the most common yet the most precious resources on earth without which there would be no life on earth. Pollution is a serious problem as 70% of India's water resources and as growing number of its water reserves have been contaminated by biological, organic and inorganic pollutants (Yadav and Kumar, 2011).In south asian countries such as Nepal, India and Bangladesh, pollution of rivers is more severe and critical near urban stretches due to hugeamount of pollution load discharged by urban activities. The Bagmati River in the Kathmandu valley, Yamuna River at Delhi, Buriganga River of Dhaka, Tamiraparani River and Ganga Riverand Ruva River, suffer from severe pollution ( Karn, *et. al*., 2001). Water of river Hindon was found to be more polluted than river Narmada Sidhartha, (2002). The pollution of Pamba River is due to Sabrimala pilgrimage, free flow of sewage, domestic waste andfaecalmatter into the river. The main cause of water pollution is human activities. Humans produce bodily wastes that enter the river and polluted water Rao, (1979). Industries discharge variety of pollutants in the waste water including heavy metals, organic toxins, oil nutrients and solids. Many of the substances are toxic or even carcinogenic.Pathogens can obviously produce water born diseases in either human or animal hosts. These wastes also increase the concentration of suspended solids (turbidity), bacteria and virus growth leading to potential health impacts. Increase in nutrient load may lead to eutophication; organic wastes increases the oxygen demand in water

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leading to oxygen reduction in water with potentially severe impacts on whole ecosystems Rao (1979).

**Description of Study area**.

Kashipur is an old industrial town of Uttarakhand State, earlier belonging to Uttar Pradesh. This town experienced an industrialization way back in 1988 – 1989. Few major type of industries working in this area belongs to Distillery, Chemical, Paper and other small industries. After formation of Uttarakhand in the year 2000 and due to fiscal benefits various kinds of industries are coming up in this area, which includes paper, distillery, chemical, and gas based thermal power.Kashipur has been identified as one of the potential Industrial developing area in Uttarakhand. The study area located in the industrial area of Kashipur in Udham Sing Nagar district of Uttarakhand between 29°10'32.1798'North Latitude and 79°0'24.3457"East Longitude. Major industries in the study area can be categorized broadly into three: viz., Pulp & Paper, Chemical and Steel as given below in Table 2.The sources of water contamination are mainly effluent from industries located at Kashipur, from seweragedisposal from homes. The sources of water contamination are also the water purification process, dumping of chemicals in the water resources, accidents of oil leakage etc.Surface water is mainly contaminated due to direct sources of water contamination. Like the industries effluent, sewage plants, mines, oil plants and tankers, leakage of fuel, direct disposal of waste in water sources, and agriculture.Sewage includes organic matter, animal and human excreta-one of the major pollutants of water in the urban and rural areas is the sewage. The sewage contains the organic matter that encourages the growth of microorganisms. These organisms besides spreading diseases also consume the oxygen present in water. This creates an imbalance in the aquatic ecosystems.Water bodies are being constantly polluted by dumping of sewage which includes organic matter and by the runoff from the agricultural fields that contains fertilizers. Pollutants like sewage, organic wastes and fertilizers contain good amount of inorganic nutrients like nitrates and phosphates.Eutrophication also results in overgrowth of plants like Eicchornia that covers the entire surface of water. This reduces the light reaching the lower layers in water.Thus, enrichment of water with inorganic nutrients like nitrates and phosphates is called eutrophication.These nutrients enrich the water promoting the growth of algae. The water turns green. This is called algal bloom. Rich algal growth leads to great increase in the number of the decomposers. All these life forms-decomposers, algae, other plants, fishes and other aquatic animals, use the oxygen in the water for respiration. This causes great demand for oxygen and results in depletion of oxygen.

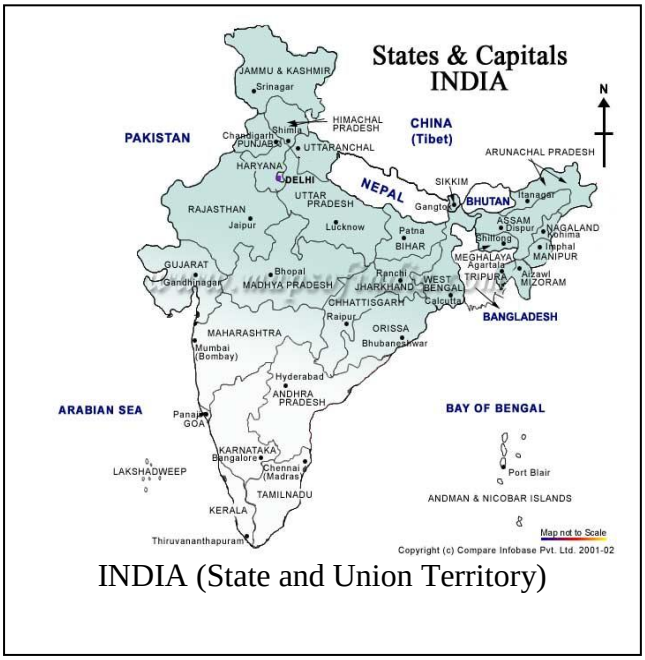
**Table 1. Industrial Activity in Kashipur Area**

| Industry | Location | Product |
|---|---|---|
| India Glycols Limited | Bazpur Road | Chemicals |
| Goraya Straw Board Mills Pvt Ltd | Bazpur Road | Paper |
| Multiwal Pulp & Board Mills (P) Ltd. | Bazpur Road | Paper |
| Prolific Papers (P) Limited | Village Girdhai, Aliganj Road, | Paper |
| Cheema Papers Ltd | Nainital Road | Paper |
| Shravanti Energy | Aliganj Road | Electricity (yet to start) |
| Gama Energy | - | Electricity (yet to start) |
| Beta Energy | - | Electricity (yet to start) |
| Naini Paper | Ramnagar Road | Paper |
| SRF | Ramnagar Road | Chemical |
| KashiVishwanth Steels Ltd | Bazpur Road | Steel, Special Alloys |
| Jindal Baverages | Bazpur Road | Frozen Foods, Edible Oils |

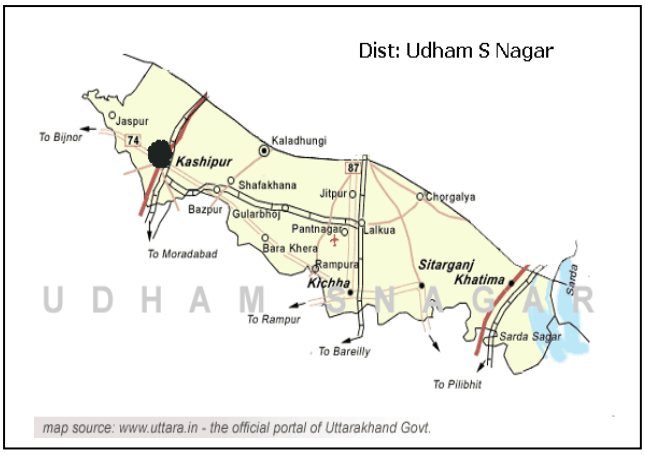
**Selection criteria of siting the monitoring stations**

A total of 6 sampling locations areset up to monitor the surface water quality in the study area. Each such sampling point represents a unique category of microenvironment.The area under study is the basin of river Kosi which pass through Kashipur,

Uttarakhand. It covers 2,367 Km² areas. The people of this area work mainly in agriculture and industries in nearest places. The Kosi River water is used for agricultural, domestic use and as well as drinking purpose.The area under study is the basin of river Bahellawhich pass through Kashipur, Uttarakhand. The people of this area work mainly in agriculture and industries in nearest places. The Bahella River water is used for agricultural, domestic use and as well as drinking purpose in some places.The area under study is Khokratalwhich is near KharagpurDevipura village of Kashipur, Uttarakhand. The people of this area work mainly in agriculture and industries in nearest places. The Khokratal water is used for agricultural,domestic use.The area under study is the Mahadev stream which passes through villages near Kashipur, Uttarakhand. The people of this area work mainly in agriculture and industries in nearest places.TheMahadev stream water is used for agricultural and domestic use in some places.These stations were selected on the basis of even distribution over the study area taking in to consideration various factors like topography of the region, proximity of sensitive establishment and human settlements, industrial activities in the area and its proximity, down wind direction etc. Location plan of the sited ambient air quality monitoring station is presented in Figure 1 and each station site is briefly described below:



INDIA (State and Union Territory)


## Methodology (Sampling and Analysis)

### Water Sampling:

Water samples were collected from 6 locations which aresituated in Kosi river basin and from each location four water samples were taken for study toanalyse the water quality. The samples are collected in clean polyethylene bottles and prior tocollection, the bottles are rinsed throughly with sample water. The water samples are takenthrough pumping so the samples will be a representative in order to avoid any contaminationfrom the surface of river basin.

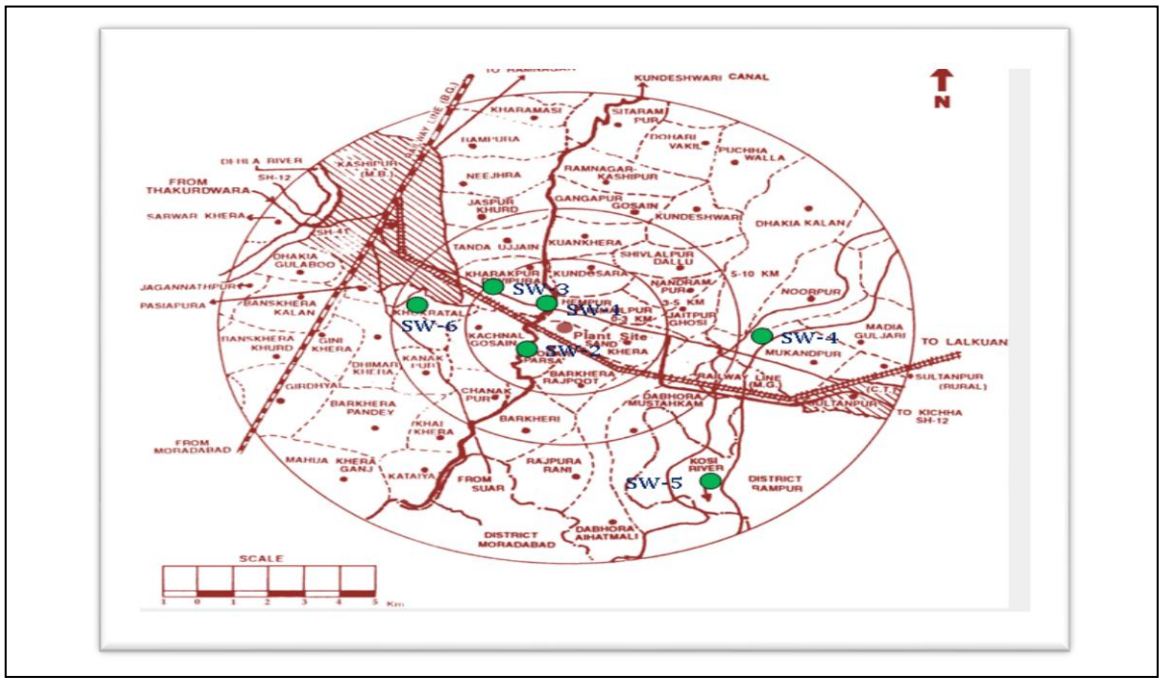



**Fig. 1 Map of industrial area of Kashipur, showing study area and air monitoring station**

**Table 2: Techniques used for ambient air quality monitoring**

| Parameter | Technique |
|---|---|
| 1. Water temperature | Water temperature was recorded in the field using mercury thermometer. |
| 2. pH | The pH of the samples was determined by using digital pH meter |
| 3. Turbidity | Turbidity was determined by Naphelo-turbidity meter |
| 4. Total hardness | Total hardness was determined tetrimetrically using EDTA method |
| 5. Total alkalinity | Total alkalinity was determined by tetrimetrically method. |
| 6. BOD | BOD was determined as per standard method. |
| 7. COD | COD was determined by potassium dichromate open reflex method |
| 8. Chlorides | Chlorides were determined by Mohr's argentometry method. |
| 9. Nitrate and phosphate | Nitrate and phosphate content is determined per standard method |
| 10. Fluoride | Fluoride content is determined using ELICO-52 UV spectrophotometer |

## Results and Discussion

The maximum water temperature (20.0$^{o}$C) was obtained at Bahellariver and minimum watertemperature (17.0$^{o}$C) was obtained at Kosi river. The variation in water temperature may be due to

different timing of collection. Temperature controls behavioral characteristics of organisms, solubilty of gases and salts in water. No other factor has so much influence on temperature Khanna & BhutianiThe maximum value of pH of the water samples

was recorded as 8.0 at Bahella river and minimum value of pH was recorded as 7.48 at Mahadev stream &Kosi river . In general pH was within the limits of standard value. For drinking water source, a pH range of 6.5-8.5 is recommended.The present study shows the turbidity in the range of 2.2 -4.8 NTU. World Health Organization prescribed the

highest desirable limit 5.0 NTU and maximumpermissible limit 25.0 NTU. The value of turbidity present is within permissible limits.The alkalinity of water is its capacity to neutralize acids. The maximum alkalinity was recorded as 302mg/l at Bahella River and minimum value is recorded as 143mg/lat Mahadev stream. BIS has set a desirable levelof alkalinity in drinking water to be 200 mg/l where as its value has been prescribed to be 600 mg/l in the absence of alternative source. So in maximumstations value of total alkalinity present in water are within limit.

**Table 3: Average value of pollutants in 2011**

| S. No | Parameter | Unit | BahellaRiver (U/S) | Bahella River (D/S) | Mahadev Stream | Kosi River (U/S) | Kosi River (D/S) | Khokratal |
|---|---|---|---|---|---|---|---|---|
| 1. | pH | - | 7.85 | 8 | 7.48 | 7.52 | 7.48 | 7.65 |
| 2. | Temperature | Deg C | 20 | 18 | 19 | 17 | 19 | 18 |
| 3. | Color | Hazen | C.L. | C.L. | C.L. | C.L. | C.L. | Light yellow |
| 4. | Conductivity | µδ/cm | 624 | - | 464 | 522 | - | 532 |
| 5. | Dissolved Oxygen | mg/l | 3 | 4 | 5 | 4 | 4 | 2.8 |
| 6. | Total Coliform | MPN/100 ml | 32 | 36 | 38 | 28 | 34 | 54 |
| 7. | B.O.D. (3days at 27 degC) | mg/l | 4 | 8 | 3 | 2 | 8 | 6 |
| 8. | COD | mg/l | 16.2 | 18 | 14 | 8 | 18 | 24.4 |
| 9. | Total dissolved Solids | mg/l | 488 | 385 | 352 | 337 | 385 | 393 |
| 10. | Total Suspended Solids | mg/l | 252 | 56 | 114 | 119 | 56 | 147 |
| 11. | Turbidity | NTU | 4 | 2.2 | 3 | 4.2 | 3 | 4.8 |
| 12. | Total Hardness as CaCO3 | mg/l | 373 | 288 | 383 | 353 | 288 | 478 |
| 13. | Total Alkalinity as CaCO3 | mg/l | 158 | 302 | 155 | 157 | 302 | 190 |
| 14. | Chlorides as Cl | mg/l | 16 | 32 | 14 | 14 | 32 | 56 |
| 15. | Sodium | mg/l | 41.4 | - | 39.1 | 35.5 | - | 33.6 |
| 16. | Potassium | mg/l | 18.1 | - | 16.6 | 20.7 | - | 19.3 |
| 17. | Iron as Fe | mg/l | 0.46 | 0.12 | 0.33 | 0.35 | 0.12 | 0.54 |
| 18. | Zinc as Zn | mg/l | 0.025 | - | 0.021 | 0.019 | - | 0.038 |

parameter but indicates water quality.Biochemical oxygen demand is usually defined as the amount of oxygen required by bacteria in stabilizing the decomposable organic matter.BOD gives an idea

In the present study water hardness of different locations was observed in the range of 288-478mg/l. The hardness of water is not a pollution

about the extent of pollution. In present study water samples, sampling stations BOD was found in the range of 2-8mg/l, it indicates that thepollution affects the water quality. As water can be use as drinking water without conventional treatment but after disinfection if BOD 5 days $20^0$C is 2 mg/l or less.The chemical oxygen demand is a measure of oxygen equivalent to the requirement of oxidizing organic matter contents by a strong chemical agent.The COD test is helpful in indicating toxic conditions and the presence of biologically resistant organic substances. The maximum COD value was recorded 24.4mg/l at station Khokhratal and the minimum values was recorded as 8 mg/l at station Kosi River. The high value of COD due to high level of pollutants present in water samples.Dissolved oxygen is usually defined as the amount of oxygen available in in stabilized water. DO gives an idea about the extent of pollution. In present study water samples, sampling stations DO was found in the range of 2.8-5 mg/l, it indicates that the pollution affects the water quality. As water can be use as drinking water without conventional treatment but after disinfection if DO is 6 mg/l or more. Chlorides occur in all natural waters in widely varying concentrations. The chloride contents normally increases as the mineral content increases. In present study the chloride concentration were found in the range of 12-56mg/l. The maximum chloride contents were due to addition of natural contaminants and pollutants in the Khokratal.The nitrate content of water bodies was found in the range of 16-32.5mg/l. The highest value of 32.5 mg/l was recorded at station SWQ6 (Khokratal) while minimum at station SWQ1 (BahellaRivel U/S) and it is observed that all the station except SWQ1 (BahellaRivel U/S)are higher the accepted limits of drinking water standards of ICMR. (Limit of Drinking water as per ICMR 20 ppm and ISI 45 ppm).The fluoride content in water is below detectable limit.

## Conclusion

Most of the water samples collected in Kosi river basin is evident in all physico-chemicalparameters examined. In general all the parameters are within the range of standard valuesprescribed by various agencies.The water of Khokratalis highly contaminated during the course of study and it is unfit for consumption, domestic and irrigation purposes.Some steps are needed urgently to improve the quality of Kosi River.

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