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Physico Chemical Analysis of the Freshwater at River Kapila, Nanjangudu Industrial Area, Mysore, India

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Abstract

Nanjangud is a home town of industries in Mysore district of Karnataka, India. It is on the banks of the river Kapila (Kabini). Water analysis was done for the parameters like odor, turbidity, temperature, pH, dissolved oxygen (DO), total dissolved solids (TDS), chloride, total hardness, calcium hardness, magnesium hardness, nitrate and sulphate for testing the quality of water during the month of March, April and May. The results suggested that the level of organic load increased in the month of May, indicating pollution of the river.

Keywords: River Kapila, dissolved oxygen, chloride.

Introduction

Water is vital resource required by living organisms. It is a most essential basic component to all living being as most of the bio-chemical reactions that takes place through the metabolism and growth of living organisms involve water. Without water no life is possible to sustain on this planet earth hence it is termed as 'Natural liquid Gold'. It is also called 'universal solvent' as most of the inorganic chemicals are dissolved in water. Water occupies 71% of the planet earth surface, out of all the available water on the earth surface only 3% constitute fresh water which is present in the form of ice caps, glaciers, rivers, lakes, ponds, streams and ground water resources. The most important and vulnerable freshwater system is the river and plays a critical role in the sustenance of all life. The decline in the quality of water in freshwater systems threatens its sustainability and has become a cause for concern[1].

The Indian environmental mangers and researchers have recently explained the condition of freshwater resources in India and their management as a serious environmental problem which includes nutrition enrichment, acidification and domestic waste, agricultural waste, sewage and industrial effluents toxic substances identified as major impacts[2-6]. A study has revealed that almost in India 70% of surface water resource and ground water reserves have been contaminated by biological, organic and inorganic wastes[7].

Pollution of water is due to increased human population, industrialization, use of fertilizers in agriculture and manmade activity[8]. The water quality refers to the presence components of water in their optimum level such that it supports the growth of plants and animals. Temperature, turbidity, nutrients, hardness, alkalinity, dissolved oxygen etc are some of the important factors that play a vital role for the growth of living organisms in the water body. Water quality indicates the relation of all hydrological properties including physical, chemical and biological properties of the water body. Hence water quality assessment involves analysis of physic- chemical, biological and microbiological parameters that reflects the biotic and abiotic status of ecosystem.

In the present study an attempt is made to study the water quality in the Kapila river of Nanjangud industrial area. The Kapila, also called Kabini. It is a river flowing in Southern India. It originates in Wayanad district of Kerala state and it flows eastward to join River Kaveri, which empties into the Bay of Bengal.

Material and Methods

Study area: The study area included 2 sites of River Kapila at Nanjangud industrial area. Nanjangud is a town located in Mysore district of Karnataka state, India. It is situated on the banks of River Kapila and lies at distance of 23 km from Mysore city. It is situated at 12°07′N 76°41′ E/ 12.12°N 76.68°E. Branches of many Indian and multinational companies are located in Nanjangud Industrial Area and is spread across 532 acres.

Analysis of water quality parameters: A total of 12 water quality parameters were selected to monitor during the study period (march-may 2012). Water samples were collected from two sampling sites and transported to laboratory for analysis. Temperature and pH were recorded immediately at study site itself. Water samples were analyzed for various physicochemical parameters using standard method[9]as described below:

Turbidity: Nephelometer is used to check the presence of turbidity in a given sample.

Turbidity, NTU= Nephelometer reading X 0.4X dilution factor.

Temperature: Water temperature was measured using a centigrade thermometer at the sampling station itself. Readings were noted by dipping a thermometer into the water and results were recorded in degree centigrade.

pH: pH using pH meter.

Dissolved Oxygen (DO): Dissolved oxygen of the water sample was estimated by winklers iodometric method[9]. Manganese sulphate reacts with the alkali (KOH) and white precipitate is formed. Manganese hydroxide gets oxidised to a brown colored compound in the presence of Oxygen. Manganic ions released oxidises the iodides in acidic medium to liberate iodine equal to the original dissolved oxygen content of the sample. Liberated iodine in turns reacts with more iodine to liberate more iodine complex. This is titrated with sodium thiosulphate using starch as the indicator. The end point is marked by the change in color from blue to colorless.

$$\text{Dissolved Oxygen mg/L} = \frac{(\text{ml X N})\text{of titrant X 8 X 1000}}{\text{V2}\left(\frac{\text{V1}-\text{v}}{\text{V1}}\right)}$$

Total hardness: These parameters were estimated by titrimetric method[9].

$$\text{Total hardness} = \frac{\text{ml EDTA used} \times 100 \text{ mg/L}}{\text{ml sample}}$$

Calcium: 10ml of water sample is taken in a clean conical flask; to this 3 ml of 4N KOH solution and a pinch of paton redon indicator is added. This is titrated against standard EDTA solution until color changes from pink to blue.

$$\text{Calcium, mg/L} = \frac{\text{Volume of EDTA used} \times 100 \text{ mg/L}}{\text{ml of sample}}$$

Magnesium: To get the value of Mg^{++} the value of calcium should be subtracted from the total hardness.

Chlorides: Chlorides in the water sample was estimated by Argentometric method[9].

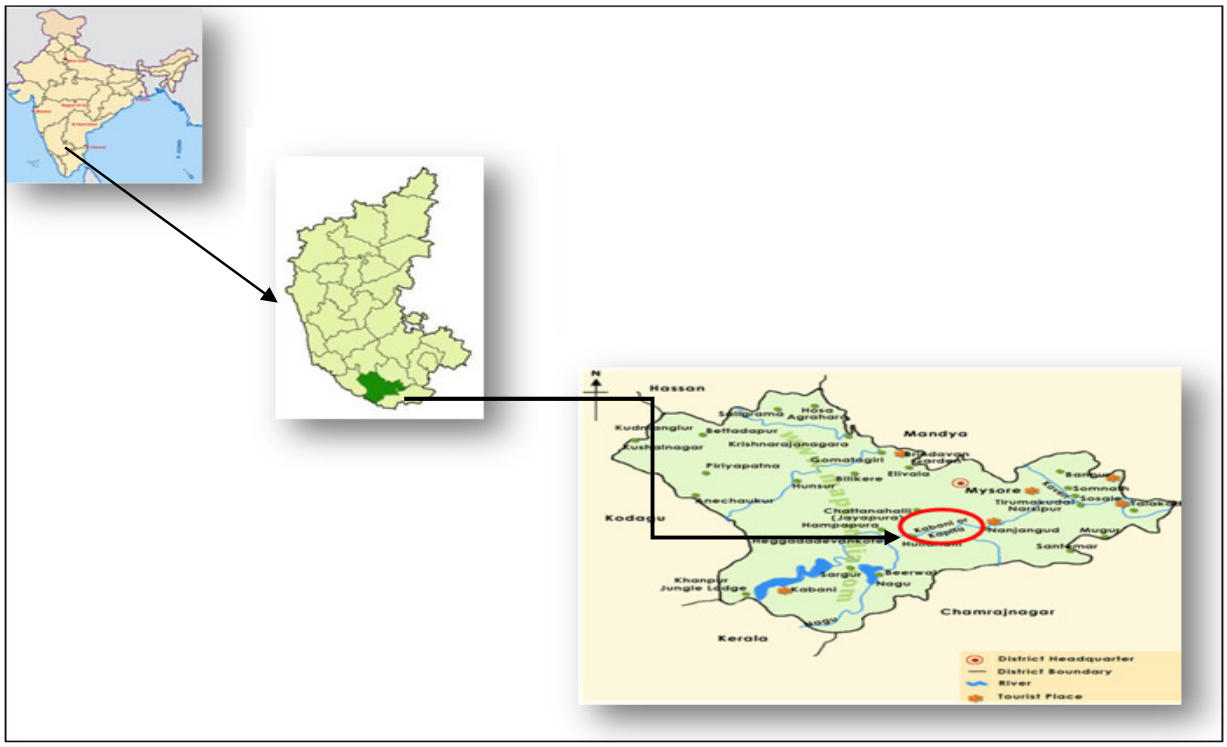
$$\text{Chloride, mg/L} = \frac{(\text{A-B}) \times \text{N of } AgNO_3 \times 1000 \times 35.5 \text{ mg/L}}{\text{ml of sample}}$$

Where, A= volume of $AgNO_3$ consumed for sample, B= volume of $AgNO_3$ consumed for blank

Total dissolved solids: Take 25ml of water sample into a cleaned, dried and weighed glass beaker. Slowly evaporate the water present in the beaker to dryness over a water bath. Then, cool the beaker in air and note down the weight of the glass beaker. Then, the difference between empty beakers along with solid residue can give the weight of total dissolved accumulated solids and express the result in mg/l.

$$\text{TDS} = \frac{(\text{a-b}) \times 1000 \text{ mg/L}}{\text{ml of sample}}$$

Where, a = final weight of the beaker in grams, b=initial weight of the beaker in grams.



Nitrates: Sample is taken in a porcelain dish and was evaporated till it dries. Phenol disulphonic acid was added to the residue along with distilled water and KOH solution contents were stirred and the supernatant of yellow colour was taken and its absorbance was read in the spectrophotometer at 410 nm.

Sulphate: The sample was taken in a volumetric flask and conditioning reagent was added and to this barium crystals were added. Nephelometer was used to study the turbidity. The concentration of suphate was determined from absorbance of light by barium sulphate and was compared it with standard curve.

Results and Discussion

The data on water quality of the study area in different sampling sites on monthly basis is represented in Table1and figures 1-9.

Turbidity: Turbidity was very high exceeding the permissible limit in the month of May 2012. This might be due discharge of effluents and also due to stagnation of the effluents. It was recorded that turbidity in River Ganga 394.5 NTU, which is higher than the present result; this may be due to Ganges highly current and sedimentation of nature[10].

Temperature: The temperature plays an important role in the metabolic activities of the organisms and is considered as a biologically significant factor[11]. Variation in water temperature depends on the changing climatic conditions[12]. The temperature variation in hydrosphere results in characteristic patterns of water circulation, which greatly influence the aquatic life. Water temperature during the study period ranged from 23^0C to 27^0C in the sampling site1 and 24^0C to 25^0C in site 2 from March 2012 to May 2012.

pH: pH is one of the most important measurements commonly carried out in natural waters. pH of water is greatly dependent on the biological activity and temperature changes of the ambient atmosphere. pH value fluctuated between 6.7 to 7.35 in the site 1 and 6.8 to 7.20 in site 2 from March 2012 to May 2012 during the study period. In the present study the pH was not beyond the permissible limit. If ph exceeds the permissible limit it will affect the mucus membrane of the cells[13].

Total dissolved solids: Total dissolved solid depends on various factors such as geological character of watershed, rainfall and amount of surface runoffs and gives an indication of the degree of dissolved substances[14]. The values fluctuate from a range of 116.8 to 180 mg/L in site 1 and 114 to 184 mg/L in site2 during the study period. . Turbidity due to total solids affects aquatic organisms. It could be abrasive and damage or clog the respiratory surfaces.

Dissolved oxygen: Dissolved Oxygen is an important parameter in the study of water quality. It indicates the ability of water body to support aquatic life. Dissolved oxygen indicates the volume of oxygen present in the water. In anaerobic water bodies the end products of chemical and biochemical reactions leads to displeasing color, odour and taste of the water[15]. DO is consumed by oxidation of organic matter of organic agents present in the water. Low oxygen in water can kill fish and other aquatic organisms. In the present study, DO values varied from 4.4 to 5.6 mg/L in site 1 and 4.8 to 5.8 mg/L in site 2 during the month of March 2012 to May 2012.

Chlorides: The values of chloride content ranged between 13 to 52 mg/L in site and 15 to 48 mg/L in during the study period, March 2012 to May 2012. Chloride is highly soluble with most of the naturally occurring cat ions and do not precipitate sediment and cannot be removed biologically. Chloride is present in all types of water. Chloride concentration shows the presence of pollution due to sewage. Higher amount of chloride reacts with sodium making the water salty and also increases TDS values of water[16]. In natural waters, its concentration remains usually low.

Hardness: Hardness defines the total polyvalent cat ions present in the water, the most divalent cat ions are calcium and magnesium. Hardness ranged from 77 to 131mg/L in site 1 and 90 to 128 mg/L in site 2 during the study period. As per Dufor and Backer's classification, 180 ppm of hardness can be categorized as very hard[17].

Table-1
Physico-chemical characteristics of water samples in Nanjangud industrial area (River Kapila) in the month March 2011 to May 2011

Parameters	March		April		May	
	Site 1	Site 2	Site1	Site2	Site1	Site2
Turbidity	2	1	1	1	80	76
Temperature (^{0}C)	25^0C	24^0C	23^0C	24^0C	27^0C	25^0C
pH	6.7	6.8	6.95	6.92	7.35	7.20
TDS (mg/L)	172	184	116.8	114.2	180	179
DO(mg/L)	4.4	4.8	5.6	5.9	5.2	5.8
Chloride (mg/L)	52	48	17.75	17.86	13	15
Hardness(mg/L)	94	108	77	90	131	128
Calcium Hardness(mg/L)	24.48	25.0	16.8	21.6	24.48	21.29
Magnesium Hardness(mg/L)	7.87	7.80	8.4	10.3	16.65	12.80
Nitrate (mg/L)	2.6	1.9	1.4	1.6	1.95	1.90
Sulphate (mg/L)	6	6.2	5	4.9	7	6.6

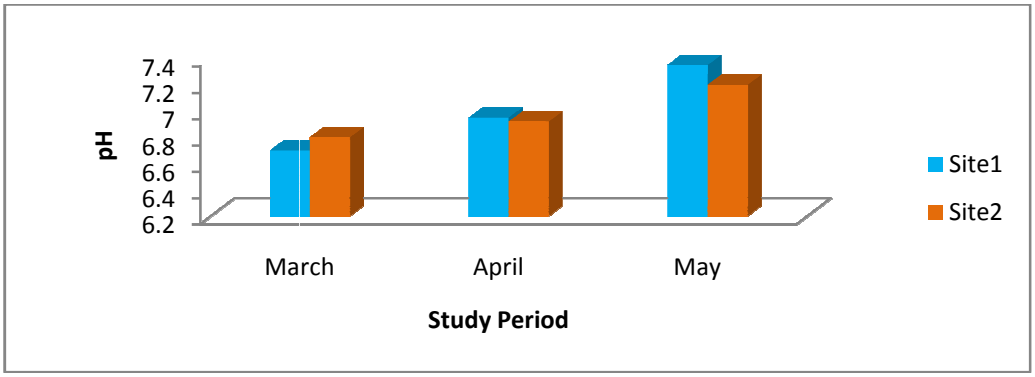


Figure-1
Bar graph showing variation in pH during study period

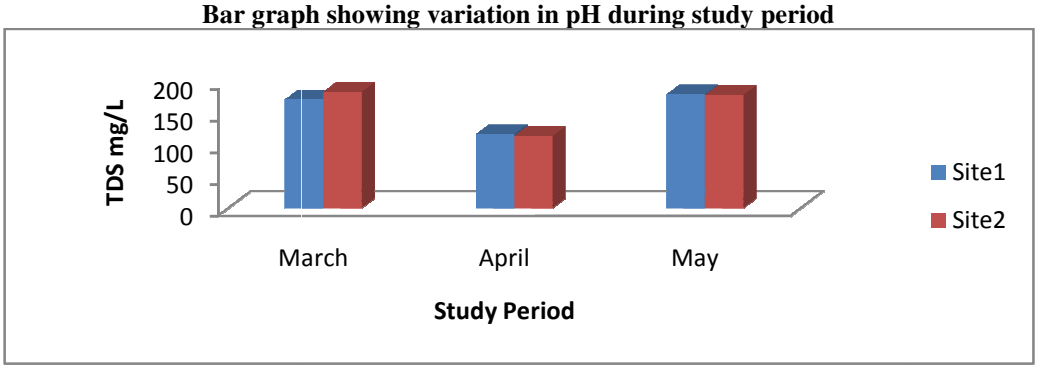


Figure-2
Bar graph showing variation in TDS (mg/L) during study period

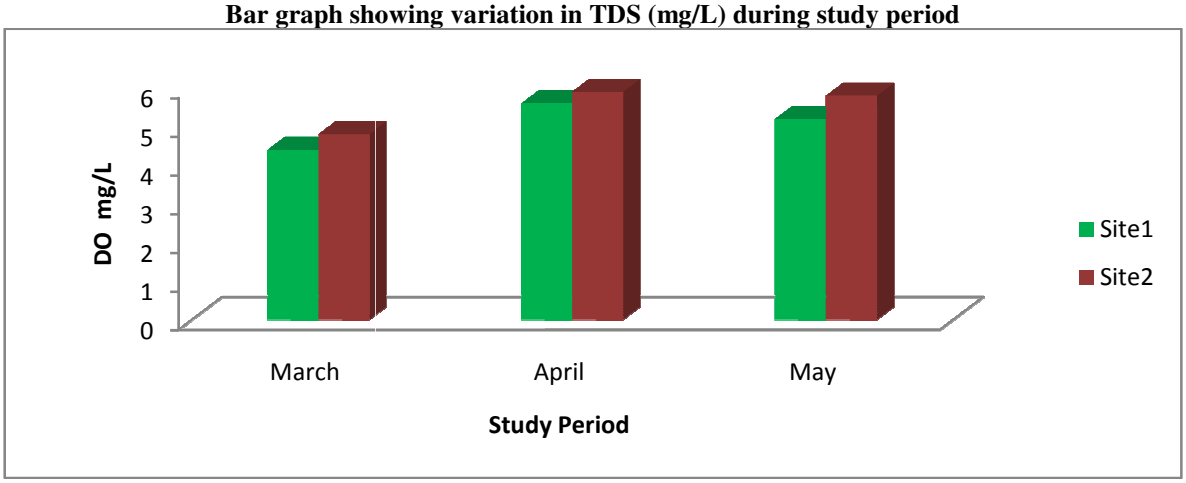


Figure-3
Bar graph showing variation in DO (mg/L) during study period

Nitrates: The main sources for deposition of nitrate in river water are human and animal waste, industrial effluents, agricultural wastes and silage through drainage system. Drinking water that gets contaminated with nitrates can prove fatal to infants that drink formula milk causing the 'blue baby' syndrome and causes digestive tract cancers. It helps in the growth of algae resulting in eutrophication. Nitrate in surface water is an important factor for water quality assessment[18]. The present study shows that in the study area the amount of nitrate was from 1.4 to 2.6 mg/L in site 1 and 1.6 to 1.9 mg/L.

Sulphates: Sulphate ions occur in natural waters contributing to the permanent hardness. The possible causes of the higher value of suphate may be due to the use of detergent and soap by the neighbors and city dwellers[19]. The values of chloride content ranged between 5.0 to 7.0 mg/L in site 1 and 4.9 to 6.6 mg/L from March 2012 to May 2012.

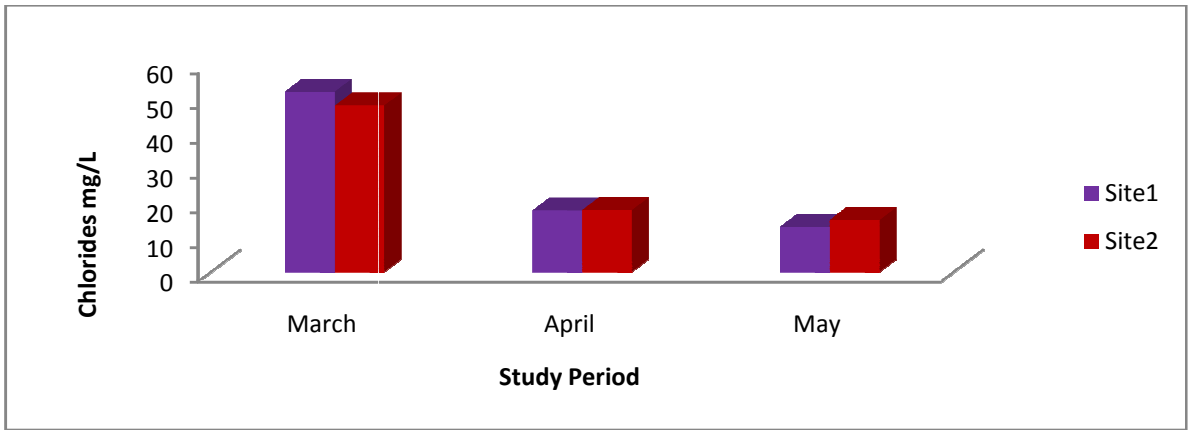


Figure-4
Bar graph showing variation in chlorides (mg/L) during study period

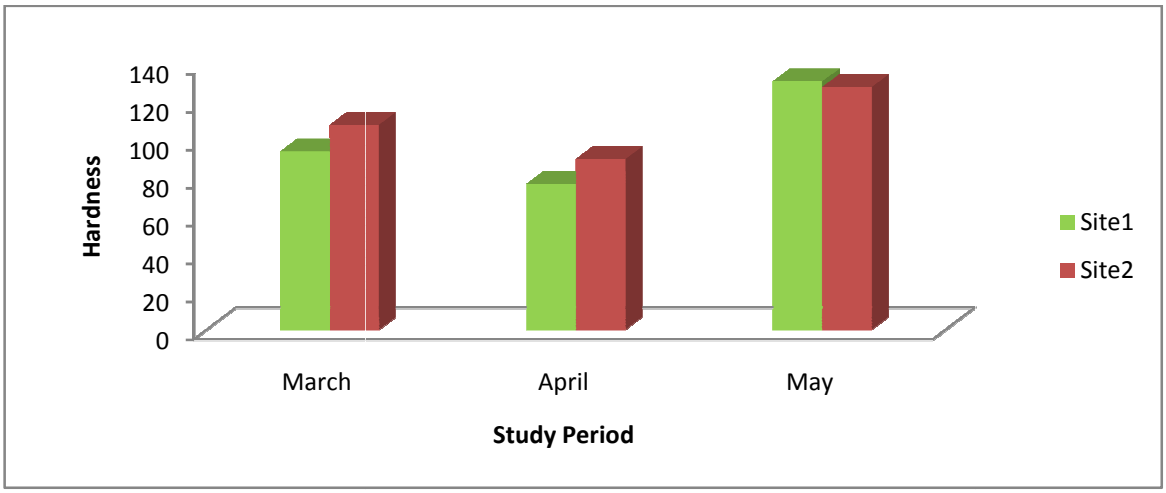


Figure-5
Bar graph showing variation in hardness (mg/L) during study period

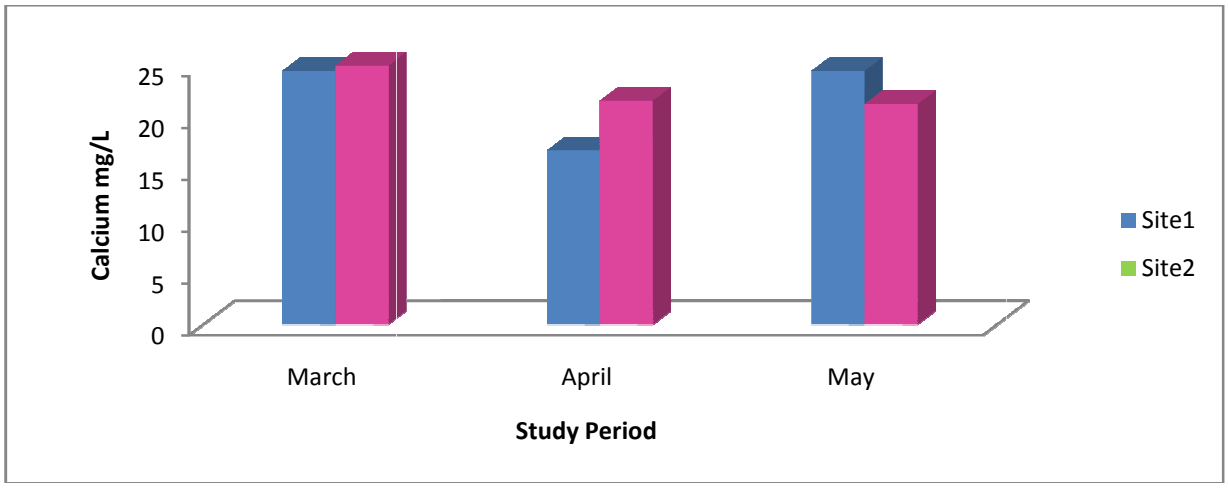


Figure-6
Bar graph showing variation in calcium hardness (mg/L) during study period

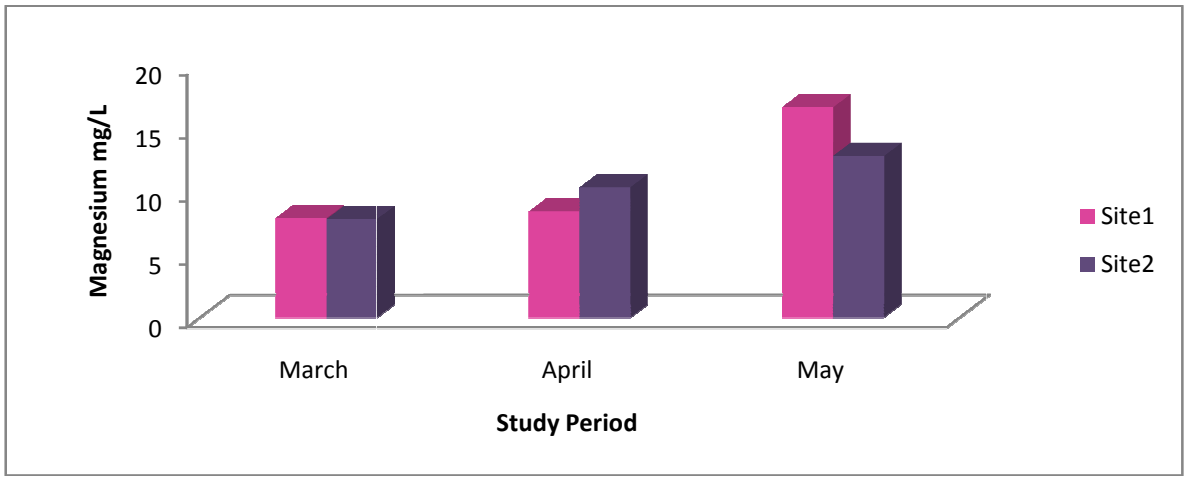


Figure-7
Bar graph showing variation in magnesium hardness (mg/L) during study period

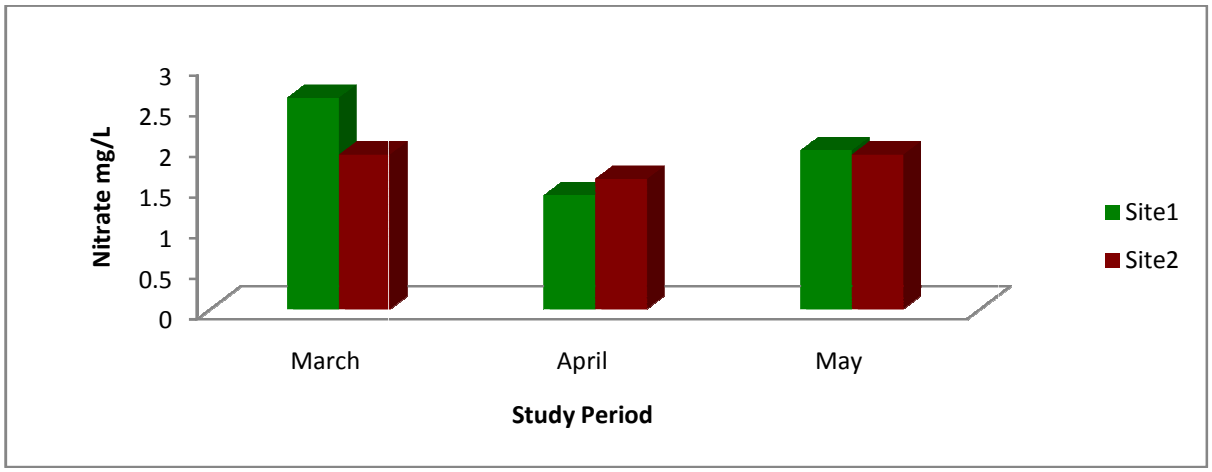


Figure-8
Bar graph showing variation in nitrate (mg/L) during study period

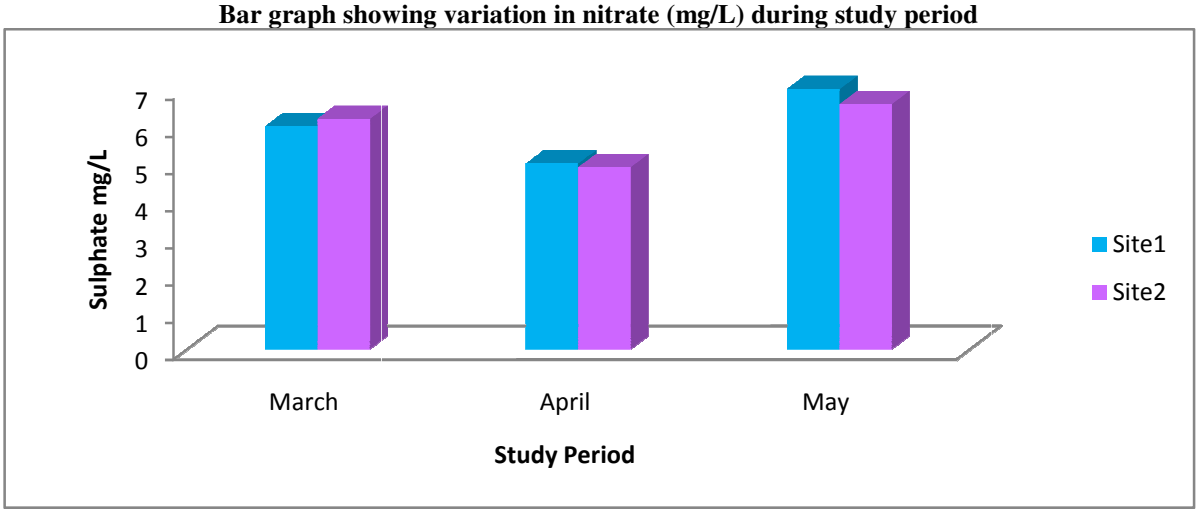


Figure-9
Bar graph showing variation in sulphate (mg/L) during study period

Conclusion

The present study showed that water from River Kapila was contaminated with municipal waste and other organic pollutants resulting in moderately high concentration of TDS, hardness, nitrate and sulphate. The accumulation of these pollutants can be dangerous for both aquatic and human life. It is advisable to discharge treated waste water from industries and homes into the river.

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