A Study on Physico-chemical Charactersitics of Yamuna River around Hamirpur (UP), Bundelkhand Region Central India

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Abstract: River Yamuna, the largest tributary of River Ganga has been one of the most prominent and important rivers of India. Unfortunately, certain stretches of River Yamuna are very polluted. Various urban centers are located on the banks of Yamuna River, draw fresh river water for various activities. In almost the entire wastewater generated by these centers is disposed off into the river. The objective of the monitoring studies undertaken for water body is to assess variation in water quality with time. Ten sampling stations were selected along the river for sampling purpose from January to June, 2010.Water samples were analyzed in terms of physico-chemical water quality parameters. Range of values were found as temperature (14°C-28°C), pH (6.43-9.13), conductivity (340.00 µmhos -734.00 µmhos), DO (4.90 mg/l-8.50 mg/l), BOD (3 mg/l-8 mg/l), COD (11 mg/l-24 mg/l), alkalinity (123.00 mg/l- 240.00 mg/l), total hardness (230.00 mg/l- 475.00 mg/l), chloride (18 mg/l-32 mg/l) and fluoride (0.40 mg/l-1.20mg/l). The values of these parameters indicate that Yamuna River is moderately polluted under the study area.

Keywords: Water Quality, Yamuna River and Hamirpur

INTRODUCTION

Rivers are water ways of strategic importance across the world, providing main water resources for domestic, industrial and agricultural purposes (Faith, 2006). Rivers play a major role in integrating and organizing the landscape and moulding the ecological setting of a basin. They are prime factors controlling the global water cycle and in the hydrologic cycle, they are the most dynamic agents of transport (Garrels et al., 1975). The quality and quantity of surface water in a river basin is influenced by natural factors such as rainfall, temperature and weathering of rocks and anthropogenic changes that curtail natural flow of the river, or alter its hydrochemistry (Raj and Azeez, 2009). Quality of water generally refers to the component of water, which is to be present at optimum level for suitable growth of plants and animals. Various factors like temperature, turbidity, nutrients, hardness, alkalinity and dissolved oxygen play an important role for the growth of plants and animals in water body, on the other hand biological oxygen demand indicate the pollution level of the water body (Kamal et al., 2007).

River pollution in India has now reached to a point of crisis due to unplanned urbanization and rapid growth of industrialization. The entire array of life in water is affected due to pollution in water. The problem of water quality deterioration is mainly due to human activities such as disposal of dead bodies, discharge of industrial and sewage wastes and agricultural runoff which are major cause of ecological damage and pose serious health hazards (Meitei et al., 2004).

It is estimated that community waste from human activities accounts for four times as much wastewater as industrial effluents, most of which is discharged untreated/partially treated into the water courses in India (Sahu, 1993).

An attempt has, therefore, been made to study water quality of Yamuna river in Hamir Pur district, Uttar Pradesh.

MATERIALS AND METHODS

District Hamir Pur lies between 25^07'N-26^07'N latitude to 79^017' E- 80^021' longitude in Uttar Pradesh, India. Ten sampling locations were selected along the Yamuna river. The samples were collected for six months (January to June, 2010) to check possible temporal changes. The parameters like temperature, pH, Conductivity and Dissolved Oxygen were recorded in field. Laboratory evaluations were carried out to referring 'Standard methods' (APHA 1992) to analyze six chemical water quality parameters, i.e. Biochemical Oxygen Demand, Chemical Oxygen Demand, Alkalinity, Total Hardness, Chloride and Fluoride.

RESULTS AND DISCUSSION

River water quality study is usually required for stabilizing base line conditions, setting quality certain and

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standards, monitoring of temporal (Kamal et al., 2007).

Temperature was found to be ranged between 14^0C (minimum) to 28^0C (maximum) with average value of $21^0 \pm 9.9^0C$ from all the sites. Impinging solar radiation and the atmospheric temperature brings interesting spatial and temporal changes in natural waters. The rise in temperature of water accelerates chemical reactions, reduces solubility of gases, amplifies taste and odour and elevates metabolic activity of organisms (Usharani et al., 2010).

pH of the aquatic system is an important indicator of the water quality and the extent pollution in the watershed areas. pH was recorded to be varying from 6.43 (minimum) to 9.13 (maximum) with an average value of 7.78 ± 1.91 from all the sites (Jonnalagadda et al.,2001). It has been mentioned that the increasing pH appear to be associated with increasing use of alkaline detergents in residential areas and alkaline material from wastewater in industrial areas (Chang, H., 2008).

Conductivity is a good and rapid method to measure the total dissolved ions and is directly related to total solids. Higher the value of dissolved solids, greater the amount of ions in water (Bhatt et al.,1999). The range of Electrical conductivity from all the sites was recorded as 340.00 µmhos (minimum) to 734.00 µmhos (maximum) with an average value of 537.00 ± 278.60 µmhos.

The value of Dissolved Oxygen is remarkable in determining the water quality criteria of an aquatic system. In the system where the rates of respiration and organic decomposition are high, the DO values usually remain lower than those of the system, where the rate of photosynthesis is high (Mishra et al., 2009). During the study period DO was found to be ranging between 4.90 mg/l (minimum) to 8.50 mg/l (maximum) from all the sites with an average value of 6.70 ± 2.55 mg/l.

Biochemical Oxygen Demand is a measure of the oxygen in the water that is required by the aerobic organisms. The biodegradation of organic materials exerts oxygen tension in the water and increases the biochemical oxygen demand (Abida, 2008).BOD has been a fair measure of cleanliness of any water on the basis that values less than 1-2 mg/l are considered clean, 3 mg/l fairly clean, 5 mg/l doubtful and 10 mg/l definitely. During the study period BOD varied from 3.00 mg/l (minimum) to 8.00 mg/l (maximum) with an average value of 5.50 ± 3.54 mg/l at all the sites.

Chemical Oxygen Demand 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. The measure of COD determines the quantities of organic matter found in water. This makes COD useful as an indicator of organic pollution in surface water (King et al., 2003).COD pointing to a deterioration of the water quality likely caused by the discharge of municipal waste water (Mamais et al., 1993). In the present study COD was found to be ranging from 11 mg/l (minimum) to 24 mg/l (maximum) with average value of 17.50 ± 9.19 at all the sites.

Alkalinity of water is a measure of weak acid present in it and of the cations balanced against them (Sverdrap et al., 1942). Total alkalinity of water is due to presence of mineral salt present in it. It is primarily caused by the carbonate and bicarbonate ions (Singh et al., 2010). Alkalinity was ranged between 123.00 mg/l (minimum) to 240.00 (maximum) mg/l with average value of 181.50 ± 82.73 mg/l from all the sites.

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 purpose attributed to presence of bicarbonates, sulphates, chloride and nitrates of calcium and magnesium (Taylor, 1949). The variation in Total hardness during study period at all the sites was recorded as 230.00 mg/l to 475.00 mg/l with average value of 352.50 ± 173.24 mg/l.

Chlorides occur naturally in all types of water. High concentration of chloride is considered to be the indicators of pollution due to organic wastes of animal or industrial origin. Chlorides are troublesome in irrigation water and also harmful to aquatic life (Rajkumar et al., 2004). The levels of chloride in the present study were ranging from 18.00 mg/l (minimum) to 32.00 mg/l (maximum) with an average value of 25.00 ± 9.90 mg/l at all the sites.

Fluoride concentration is an important aspect of hydrogeochmistry, because of its impact on human health. The recommended concentration of Fluoride in drinking water is 1.50 mg/l. The values recorded in this study was ranged between 0.40 mg/l (minimum) to 1.20 (maximum) mg/l with an average value of 0.80 ± 0.57 mg/l from all the sites.

Table 1: Physico-chemical qualities of river water

Parameter	Minimum	Maximum	Average
Temperature (^{0}C)	14.00	28.00	21.00 ± 9.90
pH	6.43	9.13	7.78 ± 1.91
Conductivity (mg/l)	340.00	734.00	537.00 ± 278.60
D.O. (mg/l)	4.90	8.50	6.70 ± 2.55
BOD (mg/l)	3.00	8.00	5.50 ± 3.54
COD (mg/l)	11.00	24.00	17.50 ± 9.19
Alkalinity (mg/l)	123.00	240.00	181.50 ± 82.73
TH (mg/l)	230.00	475.00	352.50 ± 173.24
Chloride (mg/l)	18.00	32.00	25.00 ± 9.90
Fluoride (mg/l)	0.40	1.20	0.80 ± 0.57

Whereas D.O.= Dissolved Oxygen, BOD= Biochemical Oxygen Demand, COD= Chemical Oxygen Demand, TH= Total Hardness.

CONCLUSION

The present study concluded that river water of study area was moderately polluted in respect to analyzed parameters. pH, total hardness, chloride and fluoride were found within permissible limit but the higher values of BOD and COD in present study attributed river water was not fit for drinking purpose. It needs to aware local villagers to safeguard the precious river and its surrounding.

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