COMPARISON OF WATER QUALITY OF THREE RIVERS JALDHAKA, KAROLA, TISTA: DISTRICT JALPAIGURI, WEST BENGAL, INDIA

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Abstract

Safe water is the basic needs of mankind. Jaldhaka, Tista, Karola are three main rivers of District Jalpaiguri. The present study compares the water quality of River Jaldhaka with River Karola and River Tista. Some preliminary water quality parameters were selected to assess the present condition of water. The parameters reveal that the water of River Jaldhaka is better than River Karola and Tista before entering to the cities but it must not be considered as a pollution free river. To the search for the probable differences of contaminations among the rivers, the study shows that the sources of pollution are different for them. River Karola and Tista have covered highly populated cities in their catchment but River Jaldhaka before the study point does not pass through residential areas. The pollution entering to River Jaldhaka is mainly by agricultural sources. The findings prove that the surface water pollution is much higher due to urbanization than agricultural and forest lands. So, immediate action to control the pollution must be taken.

Keywords: surface water pollution, water quality, urbanization, sources of pollution, contamination, control

I. Introduction

Environmental pollution is the reflection of rapid industrialization and rapid population explosion. Water pollution is one of the vital parts of environmental pollution. Agricultural developments, domestic wastes, sewage carried by industry, growing tonnage of paper and plastic refuse are the main sources of water pollution. Moreover drugs and household chemicals, phosphate from detergent do not discharge by any municipal treatment policies. Rain drainage is another major polluting agent because it carries such substances as highway debris including oil and chemicals from automobile exhaust. Debris from building construction also adds some harmful materials to fresh water through runoff. These all sources of water pollution heavily contaminate surface water (Mishra S. P., 2006). So the water pollution is a very important issue,

The district of Jalpaiguri lies between 26^0 $0^{'}$ and 27^0 $0^{'}$ north latitude, and between $88^0 20^{'}$ and $88^0 53^{'}$ east longitude. The main town situated on the west or right bank of the River Tista. River Karola divides the town Jalpaiguri into two halves. The principal rivers in the district from west to east are the Mahananda, Karola, Tista, Jaldhaka, Duduya, Mujnai, Torsa, Kaljani, Raidhak, Sankos etc.. The entire area is rich of numerous tea gardens, agricultural fields. Huge amounts of fertilizer, pesticide, herbicides are used in these fields. The untreated sewage disposal of the residential areas is also a source of pollution of surface water of this area.

The present study firstly attempted to assess the water quality of River Jaldhaka before entering to the cities of District Jalpaiguri because the people of the basin area are not aware about the suitability of the water for their daily use. Secondly the study proves that the water pollution is more prominent in urban areas in respect to forest and agricultural land. The work selected three points - entry point, middle point, leaving point for Karola and Tista to collect the samples at Jalpaiguri town. The sampling site were chosen for River Jaldhaka just before it enters the cities of District Jalpaiguri.

II. Origin and short description of Rivers

Tista*:* Tista originates from glaciers of Sikkim. The river is named Tista from the Himalayan gorges at Chungthang after the union of the hill streams Lachenchu and Lachung Chu at in North Sikkim. After passing through Sikkim it bursts through the mountain barrier and enters plain through a gorge known as the Sivok Gola Pass. It then traverses the Darjeeling Terrain and enters the Jalpaiguri district at its north-east corner. Here it meets with Karola (Grunning F. John 2008).

Karola*:* It originates from Terrain slopes of the Tista catchment area in Baikuntthapur forest. It meets with Tista at Old Ferry Ghat at Jalpaiguri. River Karola has drained to River Tista at downstream. It carries direct sewage from cremation ghat, Maskalaibari, Sadar Hospital and Dinbazar area of Jalpaiguri town.

Jaldhaka**:** River Jaldhaka rises in Bhutan hills and flows through eastern slopes of Rishi-la Mountain in the Darjeeling district. Before entering to district Jalpaiguri the river flows through Kalimpong district.

III. Methodology

Samples were collected and transported by ice box. Temperature and TDS found in the spot. 500ml Borosil bottles was used to consume the water for the measurement of BOD (Biologycal Oxygen Demand) and DO (Dissolved Oxygen). The samples for BOD and DO was collected from a depth of 0.5 meter keeping the mouth of the bottle towards the flow direction and caped under water.

To measurement of temperature centigrade thermometer was used. DO was measured by water analyzer kit (Elico PE 138) by membrane electrode. BOD was measured from 5 days DO values preserving the sample at 20°C. Chemical Oxygen Demand (COD) was measured by potassium dichromate method using ferroin indicator. pH, TDS, Conductivityalso measured by same instrument using electrode provided. Total hardness, calcium hardness measured by titration (Manivasakam N., 1980). Magnesium hardness measured by subtraction between total-hardness and Ca-hardness. Chloride measured by titration. Orthophosphate was determined spectophotometrically by stannous chloride method using double beam UV-VIS Spectrophotometer model SL-210 (Elico, India). Alkalinity was directly determined by titration with 0.02 (N) H_2SO_4 using phenolphthalein and mixed indicator (methyl red and bromo cresol green). Soluble manganese compounds are oxidised to permanganate by persulphate in acid solutions. The resulting colour of the permanganate solution is measured photometrically at 545 nm. Ferrous Iron was measured spectrophotometrically by ∞-∞ Bipyridyl method at 565 nm. Fluoride was measured by Spands Method using kit in PHE lab. Arsenic also determined in PHE lab Using density meter (APHA, 1989).

IV. Result and Discussion

The physico chemical properties discussed to assess the quality of water for these rivers are six months average and in case of River Karola and Tista three points (entry, middle and leaving point) average also.

Extra nuclear fluid of the body works in very specific pH -7.4 (Ganong W.F. 1971). Solubility of many salts is pH dependent and the critical physiological works of body are also pH sensitive. So, maintain the proper pH range of drinking water is very necessary as water act as a solvent of our body. The desirable range is 6.5-8.5 (depends on agency). Water of River Jaldhaka and Karola have pH 7.4 and 7.77 respectively whereas River Tista has 8.26 (Table 1).

The conductivity and TDS (total dissolved solid) measurement is very important for assessment the quality of water because excess dissolved substances and sedimentation can lower the penetration power of sunlight by absorbing it and reduction of photosynthesis take place (A Goel., 2008). Conductivity of River Karola and Tista 97.72 µmho/cm and 110.45 µmho/cm but River Jaldhaka has lower value of conductivity 56.31 µmho/cm. The amounts of Turbidity are 1.57 mg/lit, 1.65 mg/lit and 1.28 mg/lit for River Jaldhaka, Karola, Tista respectively (Table 1).

DO, BOD COD values are indicative of amount of oxygen present in the water. Good quality of water has DO value near 10 mg/lit and lower limit is 4-5 mg/lit. Micro organisms require oxygen to decompose organic compounds as food. So when excess amount of micro organism are present increasing amount of oxygen needs for this purpose and level of DO reduces. COD is reflection of chemical compound present in water that can be oxidized chemically. BOD is always indicative of biologically oxidisable substances (Ching W. C., Lee W. H., Toriman M. E., Abdullha M., Yatim B. B. 2015). The DO values of these water body not healthy. 6.8 mg/lit, 6.5 and 4.8 mg/lit for River Jaldhaka, Karola, Tista respectively. BOD and COD of River Jasldhaka are 1.4 mg/lit and 55.2 mg/lit (Table 1). BOD and COD were not done fot Karola and Tista.

Alkalinity values of Jaldhaka 16 mg/lit, Tista and Karola 42 mg/lit, 57 mg/lit are respectively (Table 1). Alkalinity is mainly the acid neutralizing capacity of water.

Chloride ion is the common anion found in water and sewage. There is higher concentration of chloride ion in the hill streams of North Bengal. The higher concentration of chloride ion in the hill streams of North Bengal may be due to sewages, pesticide, leaching etc. Sewage water contains higher chloride ion concentration because sodium chloride is a common article of diet and passes unchanged through the digestive system. High chloride content may harm metallic pipes and structures as well as the aquatic plants, which naturally grows in the marshy lands of North Bengal. Chloride content of River Jaldhaka is lower than Karola and Tista (Table 1).

Total Hardness is lower for River Jaldhaka 19.2 mg/lit, Karola and Tista have 29.61 mg/lit and 32.53 mg/lit respectively. Calcium Hardness is more or less same for the three rivers but Magnesium Hardness is higher for River Karola and Tista. Magnesium is an essential element for human beings. It is relatively nontoxic to man. It is undesirable for industrial water because of its scale forming capacity. Desirable limit of manganese is 0.1 mg/lit. River Jaldhaka carries 0.25 mg/lit manganese i. e. slightly higher than desirable limit (Table 1).. River Karola and Tista have less than 0.25 mg/lit manganese. The higher value of manganese affect the taste of water and hamper laundry work but it may occur impotence to human (Scottish Environment Protection Agency). Its over dose also can attack central nervous system of body (Agarwala S. K., 2009).

Nitrogen and phosphorus are the nutrients but excessive amount of these materials can effect negatively (Jeong H., Kim H., and Jang T., 2016). Fertilizer used for plant growth is mainly rich with nitrogen and phosphorus (Mathur I, Choudhary S. S.,. 2004). Nitrate and nitrite is two salt form of nitrogen. Nitrite is more harmful to human as well as animal. The excessive amount of nutrients support growth of algae and over growth can cause eutrophication. Nitrate content of River Jaldhaka is 4.8 mg/lit, Phosphate content is higher for River Karola and Tista (Table 1).

Fluorosis is a common disease caused by daily use of excess fluoride but most cases in India the problem arises from groundwater (Alhluwalia V. K., 2015). Desirable range in drinking water is 1 mg/lit. The amount of fluoride in river Tista is not safe, the value is 1.17 gm/lit but River Jaldhaka belongs to safe ranges of fluride content (Table 1).

Arsenic in drinking water should not exceed 0.01 mg/lit but this proportion is applicable if anybody drinks 2 lit of water per day. If anybody drinks water 4 lit per day, the amount 0.05 mg/lit is safe for drinking purpose. Arsenic has very adverse effect on human. Some plants can accumulate arsenic through their root (Nag D., 2015). So, care should be done for it. In present cases arsenic content for the rivers is less than 0.01 mg/lit (Table 1).

Iron as ferrous sulphide shows that River Jaldhaka has greater iron content. It is a noncritical heavy metal (Agarwala S. K., 2009) and an essential element for human body. Higher amount of iron content supports growth of bacteria.

The above discussion reveals that the quality of water of River Jaldhaka is not beyond pollution. The pollution level of River Jaldhaka already threatened to its fish species (Sarkar T., Pal J., 2018).

The study also proves that the water of River Jaldhaka is fresher than River Tista and Karola. To search for the good health of River Jaldhaka, it reveals that the catchment area is responsible for it. The catchment areas of River Jaldhaka cover mainly some hill station, agricultural fields and forest land. River Karola is mainly a rain fed river and covers agricultural fields, tea gardens and Town Jalpaiguri in its catchment area. Tista basin has some busier hill station than Jaldhaka Basin, tea gardens, agricultural fields and small portion of reserve forest in its upper and middle stream catchment areas. So, River Jaldhaka upto the investigation point contaminates the sewage from small hill station, agricultural fields, tea gardens and reserve forests; the source of water pollution in case of River Tista is similar to River Jaldhaka but it carries sewage from the city Darjeeling and Gantok, the River Karola carries some sewage into it in Jalpaiguri in its downstream; River karola mainly flowes through agricultural fields, tea gardens of District Jalpaiguri and carries the sewage from cremation ghat, Maskalaibari, Sadar Hospital and Dinbazar area of Jalpaiguri town. Therefore the pollutants from town Jalpaiguri enhance the pollution of River Tista and Karola. The effect of water pollution due to urbanization is greater in River Karola than Tista (Das A., 2017) and it contaminated adversely the water of River Tista after meeting at old ferry ghat. According to Dissmeyer (Dissmeyer G. E., 2000) the water quality of grassland and forest are better than urban and agricultural field. The present study proves that the effect of urbanization is very prominent than others pollution sources. The water quality of River Jaldhaka just before entering to urban belt is polluted but pollution is lower. The primary cause of water pollution in urban areas are uncontrolled municipal, industrial discharges, excessive water use and waste generation, failure to water quantity and quality issues (Jain A. K., 2014).

Table 1: Physico-chemical Parameters of River Jaldhaka(J), River Karola (K), River Tista (T) Under Investigation

Parameters	J	*K	*T
Temperature ^{0}C	21.5	24.7	23.5
pH	7.64	7.77	8.26
Conductivity in umho/cm	56.31	97.72	110.45
TDS in ppm	30.58	50.88	56.72
Chloride in mg/l	4	18.63	22.94
Alkalinity mg/l	16	42	57
Total Hardness as $CaCO_3$ mg/lit	19.2	29.61	32.53
Ca-Hardness in mg/l	16	16.8	20.86
Mg-Hardness in mg/l	3.2	12.64	32.53
Ca (as Ca) mg/lit	7.68	6.72	8.344
Mg (as Mg) mg/lit	0.78	3.084	7.94
DO in ppm	6.8	6.5	4.8
BOD in ppm	1.4	Not done	Not done
COD mg/lit	55.2	Not done	Not done
Turbidity in NTU	1.57	1.65	1.28
NO_3 mg/lit	4.5	Not done	Not done
Mn mg/lit	0.25	Less than 0.25	Less than 0.25
Fluoride mg/lit	0.56	0.75	1.17
Iron as FeS mg/lit	0.1508	0.0483	0.0526
Ortho Phosphate (moles/Lit)	0.1797×10^{-6}	5.063×10^{-6}	5.231×10^{-6}
Arsenic (mg/lit)	Less than.01	Less than0.01	Less than0.01

[*The parameters regarding Karola and Tista already published in (Das A., 2017) Comparative Study of Pollution Status of Two Main Rivers: Karola and Tista of Jalpaiguri, West Bengal, India, Journal of Chemical and Pharmaceutical Research, 9(7):76-81]

V. Conclusion

According to the preliminary parameters water quality of River Jaldhaka is better than other two rivers, but not beyond the threat of pollution. So the water is not safe for daily use without any treatment. It is necessary to take immediate action to control over it. On the other hand the work shows that the sources of water pollution of town Jalpaiguri is more hazardous. It proves that the load of urbanization has a prominent effect on pollution as well as to our civilization. Immediate action must be taken to cope with the problem, if not the situation may continue to out of control. The load of urban pollutant must be reduced through

introducing water prices and effluent charges, sewage treatment, strengthening regulations, enforcing monitoring and introducing basin plans. Enforcement of Well maintained drainage system and good sewage disposal system is very necessary in residential areas. The residential People should aware about the common problem. The rural people are illiterate; they don't have any awareness about safety of their own. So work must be done on this ground.

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