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Comparative Study of Physico-Chemical Parameters of Karra, Rapti and Samari River Water of Hetauda

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ABSTRACT

The genesis of civilization was directly linked with the quality of water and its resource. Any degradation in the water quality will hamper the development of the society because of its direct impact on human health. Therefore the physical and chemical parameters of the water have to be measured time to time to ensure its standard limit. This research aimed to find out the chemical and physical status of the three rivers located inside as well as at the periphery of Hetauda sub-metropolitan city in Makawanpur district. During the mid-week of January 2023, water sample from Karra, Rapti and Samari Rivers were collected in order to compare and study their Physico-Chemical Parameters. The physical parameters like odour, color, pH value and temperature were measured on site while other physical values such as conductivity, and Total Dissolved Solids (TDS) along with the corresponding chemical parameters like hardness, alkalinity and chemical oxygen demand (COD) were measured at chemistry laboratory in Makawanpur Multiple Campus. The test suggested that the water from these rivers were unfit for direct drinking.

Keywords: Chemical oxygen demand (COD), Physico-Chemical Parameters,Total Dissolved Solids (TDS)

1. Introduction

The survival of life of every form requires water (Panta, et al., 2018) . In Nepal, the principal source of water is river. Therefore, it is necessary to monitor the quality of river water frequently. However, the rivers are exploited because of changed life style of people, urbanization and overpopulation (Shekha, Ismael, & Ahmed, 2013). Any change beyond the permissible range from the physical and chemical parameters makes the water polluted (Anake, Ehi-Eromosele, Siyanbola, A.Edobor-Osoh, Adeniyi, & Taiwo, 2013).The Hetauda valley is located in the southern plain of Bagmati province of Nepal and just 40 km southwest

from Kathmandu valley. It is situated like a valley called as doon due to its unique geographical feature surrounded by the Mahabharata mountain range in the north and its southern portion comprises the Siwalik hill range. The rivers Karra, Rapti and Samari flow southwest of Hetauda and merge ultimately in the Narayani River. The Physico-chemical parameters determine the water quality and essentially required to set the purpose of water usage accordingly. The degradation in the quality of river can be understood from the data of these parameters. Hence, they also notify about the water pollution. The water pollution occurs from rapid economic development, huge application of chemicals and indeed from the imperfection of water management policy (Savage & Diallo, 2005).

The river water provides the facilities for household chores, drinking and other purposes. (Bhandari & K.Nayal, 2008). Several health hazards are observed due to contamination in water (Joshi, Kumar, & Agrawal, 2009).

In Nepal, various experiments were performed throughout the country to access the water quality by analyzing the physic-chemical and microbial parameters of the major river basins (R.Gautam, J.K.Shrestha, & Shrestha, 2013).

2. Materials and Methods

2.1 Geographical Settings

This study was conducted in Karra, Samari and Rapti rivers of Hetauda sub-metropolitan city in Bagmati province. The latitude and longitude of Hetauda are 27.429071° N and 85.029716° E respectively. The rivers used for sample collecting are not snow fed rivers.

2.2. Sampling and Laboratory Analysis

Water samples were collected from three rivers- Karra, Samari and Rapti in the mid-January of 2023. The analyses were performed partly on site and majority in the chemistry laboratory of Makawanpur multiple campus. The experiments on site were performed using digital pH tester (Hanna instruments), laboratory thermometer and Conductometer. The samples were collected into 1000 cc polyethylene bottles just after three times rinsing with respective river waters. The samples were taken at an approximate depth of 20 cm below the water surface. The sample bottles were packed inside the cotton bag before delivering them into the laboratory in 30 minutes and were thoroughly analyzed using corresponding instruments and chemical reagents. The data obtained from laboratory experiments are compared also with the world health organization guideline value for analysis of water quality of the samples collected from respective rivers. (WHO, guidelines for drinking water quality, 2008).

Table 1 *WHO guideline values for Physico-Chemical parameters of drinking water source*

Physico-chemical parameters	Guideline value
pH	6.5-8.5
Turbidity	5 NTU
Total hardness	500 mg/L
Chloride	250 mg/L
Total dissolved solids (TDS)	500 mg/L
Dissolved Oxygen (DO)	5 mg/L
Conductivity	400 ms/cm

Source: *WHO*

3. Result and Discussion

3.1 Temperature

The temperatures were measured at the time of sample collection at their respective sites with the help of laboratory thermometer. The corresponding temperatures recorded were

1 °C for Karra River, 19.5 °C for Samari while 15 °C for Rapti river. The temperature recorded time was 2.05 pm for Karra River and 2.45 pm and 3.05 pm for Samari and Rapti rivers respectively. The average temperature of the site was recorded 21 °C.

3.2 Colour

The site examination of the water samples regarding colour resulted the colourless forms of all. Although among these three samples, the colour of Karra River water was found to be dense because of its turbidity. The colour of Rapti River water was found to be the faintest.

3.3 Odour

Among the three water samples, the examination conducted at the respective sites revealed that the water from Karra River foul smelled. It is because of the industrial sewages passed into the river despite after the treatment of waste water. The sample from Rapti River was found least smelling which suggested the minimum human activities among all the three rivers.

3.4 pH

The values of pH indicate slightly acidic nature of water varying from 6.5 to 6.8. Out of three river water samples, Karra river was found most acidic with pH value 6.5 .The pH of Samari River lied intermediate with pH value 6.7 while that of Rapti river was 6.8. These data indicated that water from Rapti River was least acidic. Although these data revealed that the water is unfit for drinking purposes according to the permissive limit (pH 7-8.5) of world health organization for drinking water. (WHO, 2008)

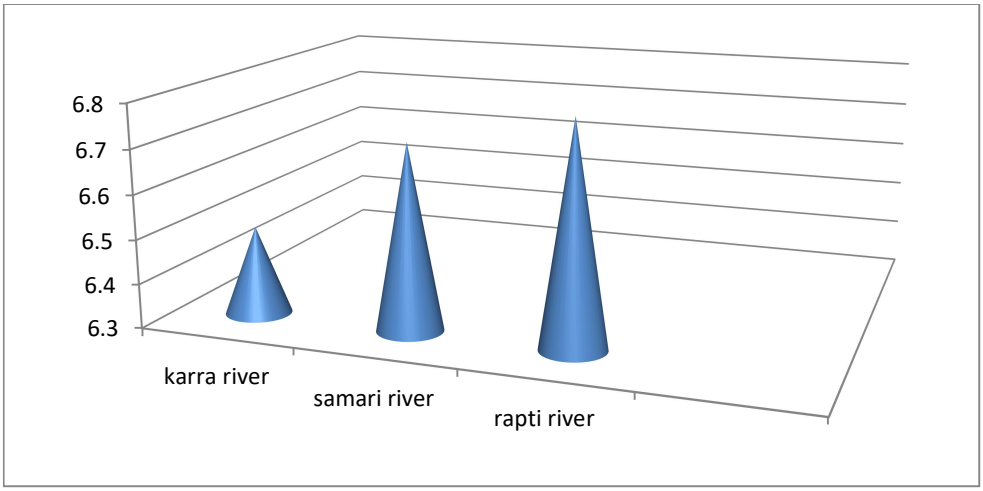

Figure 1 *Comparison of pH values of Karra, Samari and Rapti rivers*

3.5 Electrical Conductivity (EC)

Conductivity measures the capacity to conduct electricity. The electrical conductance of the water depends on the amount of dissolved salts present in the sample. Higher the amount of salts and ions present in the sample higher will be the electrical conductivity. The electrical conductivity of the three river water samples ranges from 132.9 µS/cm to 184.1 µS/cm. The mean value was found to be 193 µS/cm.

3.6 Chemical Oxygen Demand

Chemical oxygen demand (COD) is an indicator of organics in water and usually in connection with biological oxygen demand (Vaidya & Labh, 2017). Out of three rivers, Rapti showed maximum value for chemical oxygen demand. It has the value of COD 110 ppm

while Karra River water sample showed the value of 18 ppm. The sample from Samari showed the value of 48 ppm.

3.7 Total Dissolved Solid

The total dissolved solids (TDS) comprise inorganic salts such as calcium, potassium, sodium, magnesium, sulphates, chlorides and bicarbonates chiefly as well as organic matter in small amount. It is formed from various sources like industry sewage, waste water treatment plants, household sewages and drainages, natural resources, etc. In short, it is the qualitative value of total amount of cations and anions present in the sample. They are the natural pollutants in river water that impart colour, alkalinity, and conducting nature of water (Shrestha & Basnet, 2018). The values of total dissolved solids found the Karra, Samari and Rapti Rivers were 600 ppm, 400 ppm, and 400 ppm respectively.

3.8 Dissolved Oxygen

The value of dissolved oxygen is used to measure the extent of pollution by organic matter, demolition of the organic matter and water's self-purification. (Khanal, Adhikari, Paudel, & Adhikari, 2021). The aquatic life cannot sustain below the limit of WHO guideline which is 5 mg/L. Most fishes die with water of DO value below 2 mg/L. (O.G.Olarewaju, Said, & ayodele, 2012). The DO values of Karra, Samari and Rapti River water samples were found to be 11.7 ppm, 9.65 ppm and 8.75ppm respectively.

Table 2 *Comparative analysis of data regarding various physic-chemical parameters of the samples*

Physico-chemical parameters	Values for following rivers		
	Karra	Samari	Rapti
pH	6.5	6.7	6.8
Temperature /˚C	18	19.5	15
Total dissolved salts (TDS)	600 ppm	400 ppm	400 ppm
Chemical Oxygen Demand (COD)	18 ppm	48 ppm	110 ppm
Dissolved Oxygen (DO)	11.7 ppm	9.65 ppm	8.75 ppm
Temporary hardness	36 ppm	84 ppm	44 ppm
Permanent hardness	24 ppm	78 ppm	38 ppm
Total hardess	60 ppm	162 ppm	82 ppm
Electrical conductivity (EC)	132.9 µS/cm	262.0 µS/cm	184.1 µS/cm
chloride (g/L)	0.028116	0.01278	0.0188744

3.9 Total Hardness

It is the total sum of calcium and magnesium salts (carbonates) in ppm (Shrestha & Basnet, 2018). Water sample from Samari River was found to be maximum indicating the presence of large amount of calcium and magnesium salts. The sample from Karra River was found to contain least amount of salts of calcium and magnesium. The total hardness of the Karra, Samari and Rapti Rivers were found to be 60 ppm, 162 ppm and 82 ppm respectively.

4. Conclusions

The river water quality was in against with the drinking standard of world health organization (WHO, 2008). This referred to the degradation process of the river inevitably.

This level of outcome resulted from urbanization, industrialization, recreational activities on the riverside, cremation ceremonies on the banks of river. If not monitored and checked properly with the implementation of law, the deterioration of water will take place in an alarming rate.

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