PHYSIOCHEMICAL AND BIOLOGICAL PROPERTIES AT PREFERRED SITES OF THE NEYYAR RIVER

Abstract

Rivers are included in the hydrologic cycle. The water in the river is from surface runoff, drainage basins, springs, groundwater, and melting ice. Rivers have a major role in shaping the cultural, natural, and economic aspects of any country (Rafiq, 2016). The Neyyar River is one of the most popular rivers in Kerala. It is in the southern part of Kerala, in the Trivandrum district. The importance of this river is that it provides drinking water, serves agricultural purposes, and makes the earth fertile. So, there is a need to check certain parameters of the water. In this study, physical, chemical, and biological parameters are analyzed for the selected sites of the river Neyyar. The analyzed results were compared with drinking water standards. It shows deviations in some parameters. And results in the lower stream were higher than in the upper stream. The results indicate the degradation of river water due to anthropogenic activities. There is a need to control such activities to protect the river from degradation.

Keywords: River water; Parameters; Selected sites; Deviation; Protection.

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I. INTRODUCTION

Food and water are the primary needs for humans as well as all the other living organisms on earth. Three-fourths of the earth's surface is surrounded by water. Water is an inorganic compound that is made up of two molecules of hydrogen and one molecule of oxygen. The sources of the water are rivers, oceans, ground water, reservoirs, rain, ponds, streams, fresh water, wells, surface water, etc. More than 400 rivers are present in India, of which 44 flow through the state of Kerala. Among the 44 rivers, the Neyyar River is a major river that flows through the Trivandrum district in Kerala, India. This river originates in the Agasthyarkoodam Hills of the Western Ghats, flows through the Neyyattinkara, and reaches the Arabian Sea at Poovar. The river has a length of 56 kilometres. The river is mostly used for drinking water supply through municipalities to the public and agricultural purposes. Rather than the water used for construction of buildings at the bank of the river and domestic purposes. So, it is most important to analyse the present status of the Neyyar River. A thorough examination of the river ecosystem reveals that all of India's major rivers are heavily polluted, especially on the city sides (Srivastava, 1992). The present study, "Physiochemical and Biological Properties at Preferred Sites of the Neyyar River," indicates the study of physical, chemical, and biological parameters of the Neyyar. Seasonal variation in surface water quality is used to evaluate variations that occur in river pollution (Ouyang *et al.,* 2006).

II. MATERIALS AND METHOD

1. **Study Area:** The Neyyar River is in Trivandrum district, Kerala. The river has a length of 56 kilometres (Figure 1). This river originates from the Agasthyamala, the second-highest peak of the Western Ghats. And reaches the Arabian Sea near Poovar. Neyyar River Basin has an area of 128 km². The latitude and longitude of the river range between 80º17'2" N and 80º53'2" N, 76º40'2" E and 70º17'2" E. The sites selected for the current study were Arakunnu (S1), Vadakkekotta (S2), Palakkadavu (S3), Alatharackal (S4), and Pirayummodu (S5). The sites S1, S2, and S3 are from the upper stream, and S4, S5, are from the lower stream of the Neyyar river. The period of study was three months, from January 2023 to March 2023. The river's water is used for irrigation and drinking purposes. Neyyar Dam is located on this river at Kallikadu.

2. **Collection of Sample:** Sampling of water was done at the selected sites of the Neyyar River. 2-litre polythene bottles are used for sample collection. Sample collection from selected sites was done early in the morning. The period of study was three months, from January 2023 to March 2023.

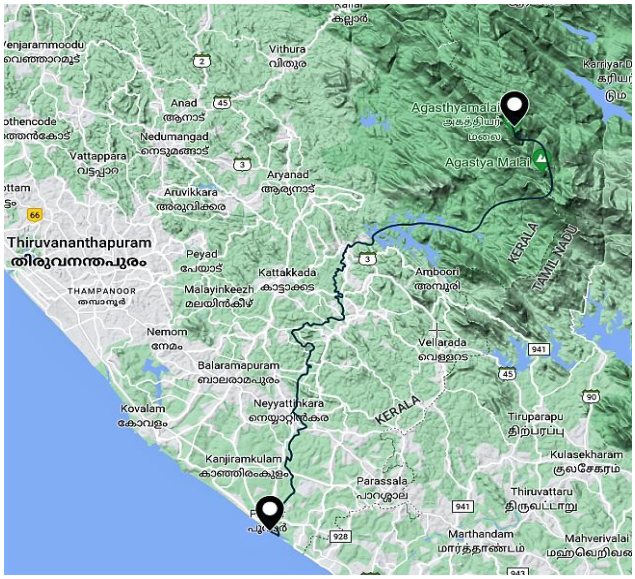

Figure 1: Water sampling location of Neyyar River

Some physicochemical parameters such as appearance, turbidity, total dissolved solids, electrical conductivity, pH, Total Hardness as $CaCO_3$, Calcium, Sodium, iron, and biological parameters such as fecal coliform were done for the collected water samples. The results of the study were obtained using the following standard methods: APHA 1995 and BIS, IS:10500. And the results are compared with the limits of the standard method (Table 1).

Table 1: BIS, IS: 10500, WHO Standards of some Physical, Chemical and Biological Quality of Drinking Water

Parameters	BIS, IS:10500 (1991)		WHO (1995)	
	A	B	A	B
Appearance	-	-	-	-
Turbidity (NT Units)	1	5	5	25
Total Dissolves Solids (mg/L)	500	2000	500	1000
Electrical Conductivity (µS/cm)	-	-	400	2000
pH	6.5	8.5	6.5	8.5
Total Hardness as $CaCO_3$ (mg/L)	200	600	-	-
Calcium (mg/L)	75	200	75	200
Sodium (mg/L)	-	-	20	1756
Iron (mg/L)	0.3	1	0.3	1.0
Fecal Coliform (CFU/100ml)	0	0	0	0

III. RESULT

Table 2: Physical, Chemical and Biological Analysis of Selected Sites of Neyyar River

Sl. No.	Parameters	Site	Month		
			January	February	March
1	Appearance	S1	Clear	Clear	Clear
		S2	Clear	Clear	Clear
		S3	Clear	Clear	Clear
		S4	Clear	Clear	Clear
		S5	Clear	Clear	Clear
2	Turbidity (NT Units)	S1	2	3	4
		S2	0	5	9
		S3	5	7	12
		S4	3	3	5
		S5	5	2	5
3	Total Dissolved Solids (mg/L)	S1	95	205	415
		S2	107	198	458
		S3	84	118	571
		S4	117	145	514
		S5	121	226	448
4	Electrical Conductivity (µS/cm)	S1	154	350	443
		S2	275	375	395
		S3	256	298	425
		S4	224	330	515
		S5	197	275	453
5	pH	S1	6.69	7.45	6.34
		S2	7.03	6.86	6.56
		S3	6.68	7.04	7.5
		S4	6.24	8.01	7.67
		S5	6.33	7.79	6.06
6	Total Hardness as $CaCO_3$ (mg/L)	S1	256	375	276
		S2	210	345	255
		S3	176	350	173
		S4	258	296	185
		S5	311	457	212
7	Calcium (mg/L)	S1	38	42	57
		S2	45	48	53
		S3	31	34	75
		S4	57	65	86
		S5	32	38	45
8	Sodium (mg/L)	S1	18	25	37.56
		S2	34.03	29	54
		S3	24	18.8	53
		S4	25	33	28
		S5	34.21	36.51	47.5

9	Iron (mg/L)	S1	0.36	0.45	0.45
		S2	0.35	0.42	0.37
		S3	0.24	0.45	0.45
		S4	0.44	0.33	0.38
		S5	0.32	0.35	0.42
10	Fecal Coliform (CFU/100ml)	S1	350	468	210
		S2	110	510	1080
		S3	227	200	315
		S4	260	370	415
		S5	210	240	227

Water is important to our day-to-day lives. It is a natural resource of the earth. This study aims to describe the present status of the Neyyar River. The period of study was about three months, from January 2023 to March 2023. The study indicates the properties of river water. It is important because most living organisms depend on it, including humans. The parameters such as appearance, Turbidity, total dissolved solids, electrical conductivity, pH, Total Hardness as $CaCO_3$, Calcium, Sodium, iron, and fecal coliform were calculated. The calculations were compared with BIS, IS 10500, and WHO (1995) standards and are described below (Table 2).

1. **Appearance:** An essential substance, i.e., water, is the major component of all living things (Sharp, 2001). The water is colourless, tasteless, and odourless. Water is colourless, odourless, and tasteless and is a pure substance, but it is generally found in an impure state (Stroll, 1989). The appearance of the water is determined by direct observation of the water. The appearance of the water sample shows clear water at all sites. There is a slight coloration of green, which indicates the presence of phytoplankton. The coloration of water is due to the presence of organic compounds, which include humic and fuvic acids. Here, the river is clear in appearance.

2. **Turbidity:** The turbidity of river water occurs because of the presence of colloidal and suspended matter, including silt, clay, organic and inorganic matter, microorganisms, and plankton. Turbidity can be described as the property of the scattering and absorbing of light rather than its transmission. Which indicates the intensity of light that gets scattered in water. An increase in the scattering of light leads to an increase in the value of turbidity. The nephelometric method is followed here for turbidity analysis. Turbidity is represented as Nephelometric Turbidity Units (NTU). The maximum turbidity shown here is 12 NTU in S3 of March and a minimum of 0 NTU in S2 of January (Table 2). The highest turbidity is found in the month of March (Figure 2).

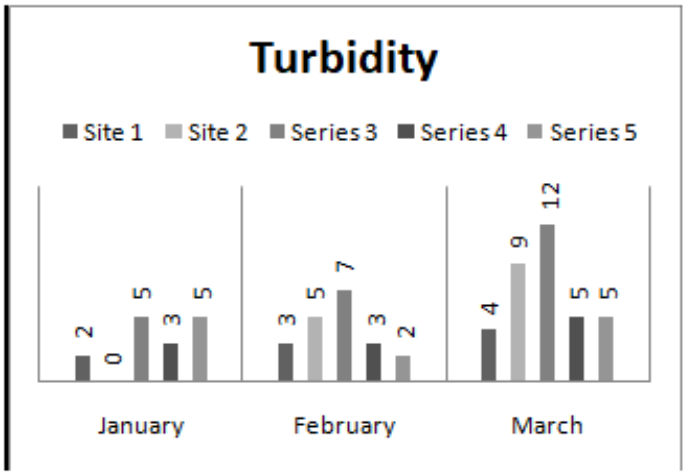

Figure 2: Turbidity in the water at different sites of the Neyyar River

3. **Total Dissolved Solids:** Total dissolved solids, which indicates the material kept in the vessel after evaporation of the water sample. Well-mixed samples were filtered through a glass fibre filter. This filter is transferred to a pre-weighed dish and evaporated to get dry in an oven at 180 ± 2 ˚C. A maximum total dissolved solids concentration of 571 mg/L was recorded in the S3 site during the month of March, and a minimum of 84 mg/L was recorded in the S3 site during the month of January (Table 2). The peak value of TDS was found in March (Figure 3).

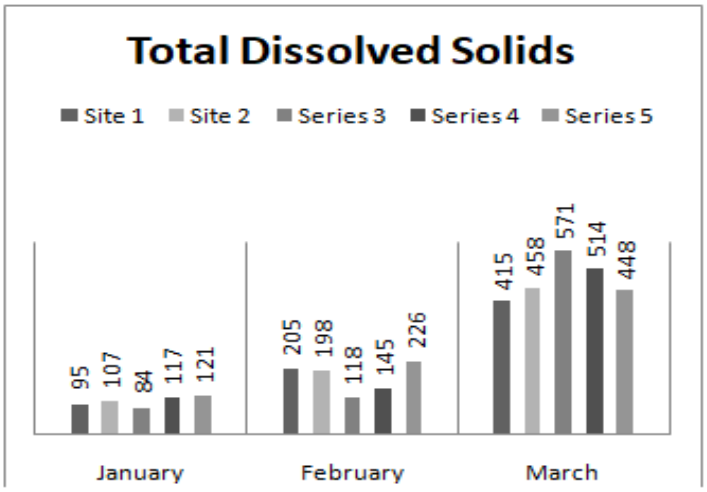

Figure 3: TDS in the water at different sites of the Neyyar River

4. **Electrical Conductivity:** Electrical conductivity can be defined as the measure of the amount of electric current that flows in water, which is proportional to the minerals that are already present in it. This indicates the presence of salt in the water. A maximum electrical conductivity concentration of 515 µS/cm was recorded in the S4 site during the month of March, and a minimum of 154 µS/cm was recorded in the S1 site during the month of January (Table 2). The peak value of electrical conductivity was found in March (Figure 4).

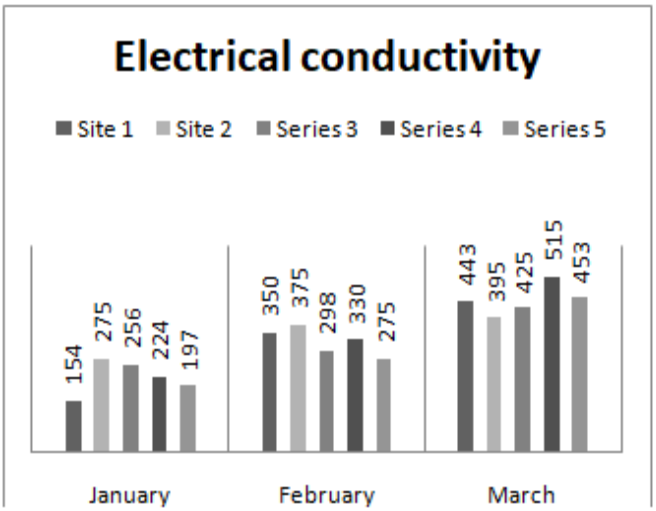

Figure 4: Electrical Conductivity in the water at different sites of the Neyyar River

5. **pH:** pH is a measure of the presence of hydrogen ions in water. The level of pH determines whether the water is acidic or basic. A maximum pH concentration of 8.01 was recorded in the S4 site during the month of February, and a minimum of 6.06 was recorded in the S5 site during the month of March (Table 2). The peak value of pH was found in February (Figure 5).

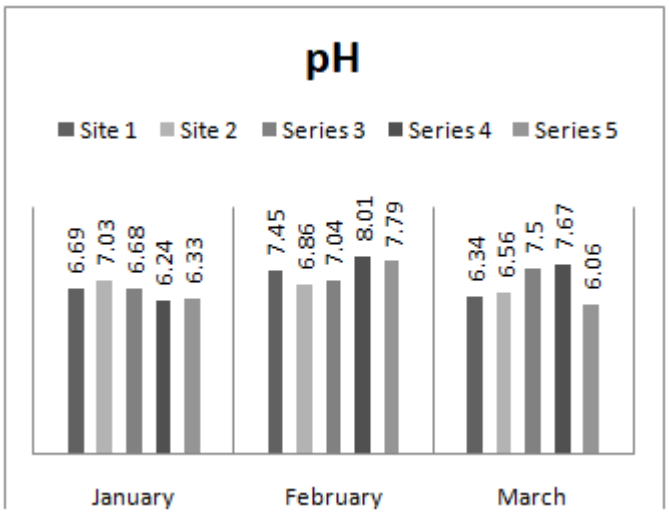

Figure 5: pH in the water at different sites of the Neyyar River

6. **Total Hardness:** Total hardness is the ability of soap to react. A small amount of soap is needed to produce foam. Total hardness ($CaCO_3$) indicates the concentration of alkaline earth metals in water. It includes calcium and magnesium that are found in sedentary rocks, including chalk and limestone. A maximum total hardness as $CaCO_3$ concentration of 515 µS/cm was recorded in the S4 site during the month of March, and a minimum of 154 µS/cm was recorded in the S1 site during the month of January (Table 2). The peak value of total hardness as $CaCO_3$ was found in February (Figure 6).

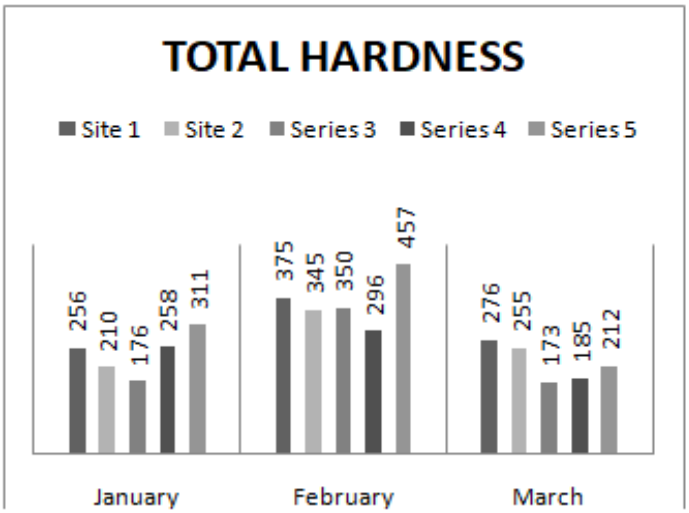

Figure 6: Total Hardness in the water at different sites of the Neyyar River

7. **Calcium:** The amount of calcium is related to the hardness of the water. A maximum calcium concentration of 65 mg/L was recorded in the S5 site during the month of February, and a minimum of 31 mg/L was recorded in the S3 site during the month of January (Table 2). The peak value of calcium was found in March (Figure 4).

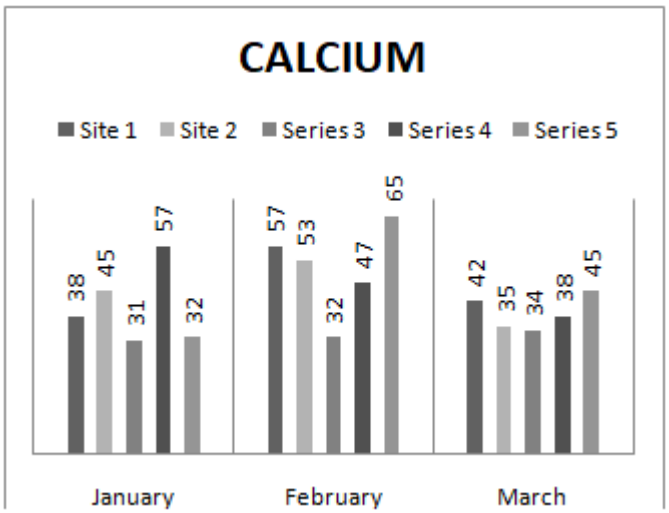

Figure 7: Calcium in the water at different sites of the Neyyar River

8. **Sodium:** Sodium is commonly found in water. The increase in sodium may be due to the dissolving of soaps, detergents, rainwater, and rock salts**.** Flame emission photometric method is used to determine the amount of sodium in water. A maximum sodium concentration of 54 mg/L was recorded in the S2 site during the month of March, and a minimum of 18 mg/L was recorded in the S1 site during the month of January (Table 2). The peak value of sodium was found in March (Figure 4).

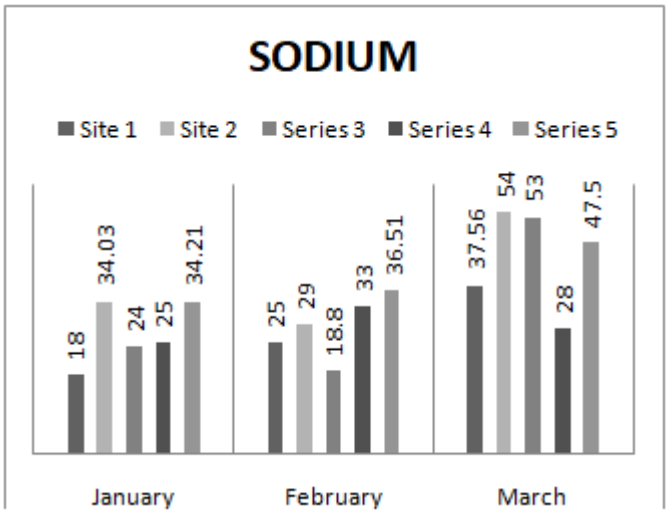

Figure 8: Sodium in the water at different sites of the Neyyar River

9. **Iron:** Iron is included in heavy metals. A maximum iron of 0.45 mg/L was recorded in the S1, S3 sites during the month of February and March, and a minimum of 0.24 mg/L was recorded in the S3 site during the month of January (Table 2). The peak value of iron was found in February and March (Figure 4).

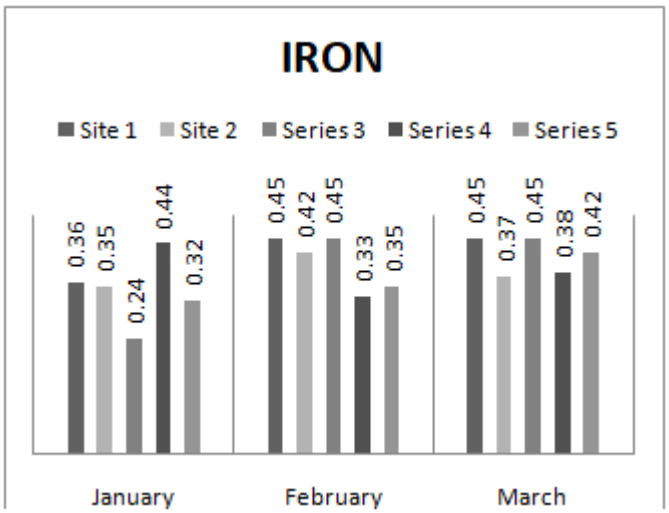

Figure 9: Iron in the water at different sites of the Neyyar River

10. **Fecal Coliform:** Fecal coliform occurs in water from the overflow of sewage and from human and animal wastes that get mixed with it. The presence of the bacteria indicates sewage contamination and the presence of pathogenic organisms. It can be present in the environment and in organisms with warm blood. So, there are chances for the transmission of disease. A maximum fecal coliform concentration of 1080 CFU/100ml was recorded in the S2 site during the month of March, and a minimum of 110 CFU/100ml was recorded in the S2 site during the month of January (Table 2). The peak value of fecal coliform was found in March (Figure 4).

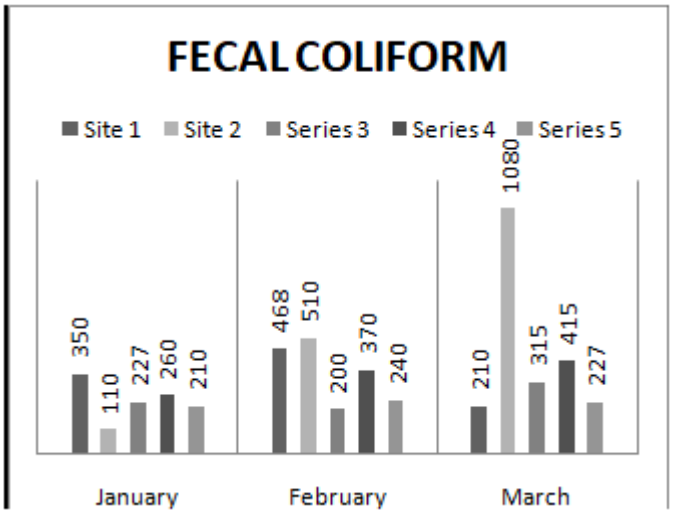

Figure 10: Fecal Coliform in the water at different sites of the Neyyar River

IV. RESULT AND DISCUSSION

The results of water samples are compared with the drinking water standards, including WHO (1995), BIS, IS: 10500. Comparing the results is indicative of the degree of variance observed in certain parameters. Water samples collected from the lower stream show more variation than those from the upper stream of Neyyar. The upper stream sites also show deviations in parameters. The deviation in the parameters was due to environmental problems and human activities. Disposal of municipal waste at the bank of the river, hospital sewage discharge to the river, mixing of sewage water with river water, and domestic uses are some of the problems that cause water pollution. The municipality corporation supplies the Neyyar River water after treating it for drinking. A high amount of fecal coliform in water leads to the transmission of diseases, including diarrhoea, to the public. It also affects other living organisms. The above results show the degradation of river water. And the degradation of water is caused by anthropogenic distribution. Thus, the study shows there is a need to take control measures to protect the river from pollution, damage, and human activities to sustain good water quality.

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