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SEASONAL ANALYSIS OF PHYSICOCHEMICAL PROPERTIES IN NEYYAR RIVER, KERALA

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Abstract

Life on earth is impossible without water, because water is known as the source of life. Rivers, as waterbodies, are vital for all living beings to live and prosper. There are forty-four rivers present in Kerala, of which the Neyyar River is located in Trivandrum district. It originates in Agastya Mala, flows through Neyyattinkara Taluk, and reaches the Arabian Sea near Poovar. Five sites namely Arattu Kadavu, Arakkunnu, Vadakkekotta, Alatharackal, and Panchikattu Kadavu along the river stretch were selected for the study. Water from the Neyyar River is used for irrigation and drinking purposes. So, it is necessary to check the purity of water. Thus, the study was focused on the present status of Neyyar River. The analysis of physicochemical parameters in Neyyar River water like water temperature, pH, turbidity, total dissolved solids, electrical conductivity, total hardness, and sodium content was done. It shows some deviation in parameters such as turbidity, electrical conductivity and total hardness, when compared with drinking water standards.

Key words: Neyyar River, Physicochemical parameters, Seasonal, fluctuation, Pollution

Introduction

Water plays a major role in the lives of all organisms, as it is an important source for life on earth. Water is used for various needs like irrigation, transportation, drinking, electricity production and other entertainment activities, including boating and swimming. Overuse of water is a serious threat to life forms as it leads to lowering of water table. Rivers are surface water sources and are included under freshwater category. The river Neyyar is one among the famous 44 rivers in Kerala and it is the southmost river in the state. It has a length of 56 kilometres, originates from Agastya Mala in the Western Ghats, flows through Neyyattinkara taluk in Thiruvananthapuram district and joins the Arabian Sea near the place Poovar. The water is mainly used for domestic, drinking, irrigation and recreational purposes. At present, the entire world, especially developing countries, is facing water-related problems such as scarcity of drinking water, lack of fresh water resources and poor water security. Water-related problems have turned critical in the small catchment rivers of developing countries (Padmalal *et al.,* 2011). The present study aims the analysis of the current water quality status of Neyyar River. The physicochemical parameters such as temperature, pH, turbidity, total dissolved solids, electrical conductivity, total hardness, and sodium content were chosen for the analysis.

Materials and Methods

Study area

The river Neyyar is one of the major rivers of Kerala. It has a length of 56 kilometres and originates from Agastya Mala in the Western Ghats. It flows through Thiruvananthapuram district and joins the Arabian Sea near Poovar. It lies between 8° 36' 56.2428" N and 77° 14' 45.5604" E to 8° 18' 20.0124" N and 77° 4' 47.0064" E (Figure 1). Five sites along the river stretch were selected for the present study and they are Arattu Kadavu (S1), Arakkunnu (S2), Vadakkekotta (S3), Alatharackal (S4), and Panchikattu Kadavu (S5). Sites S1 (Arattu Kadavu), S2 (Arakkunnu) and S3 (Vadakkekotta) are located upstream of the river whereas sites S4 (Alatharackal) and S5 (Panchikattu Kadavu) are located downstream of the river. Sampling was done in the early morning by using 2 litres of clean polythene bottles, and the collected samples were transported to the laboratory for analysis. Study period was from June 2022 to November 2022. The study was done by considering the seasons in Kerala, mainly the southwest monsoon (June 2022 to August 2022) and northeast monsoon (October 2022 and November 2022).

Physicochemical Analysis

Physicochemical analysis was carried out for the water parameters like temperature, pH, turbidity, total dissolved solids, electrical conductivity, total hardness and sodium content by following the standard methods (APHA 2017, IS 3025). Water temperature was measured at the time of sampling using a sensitive mercury thermometer. pH of the water has been recorded in the laboratory using pH meter. Turbidity of water samples was noted using a digital Nephelo Turbidity meter (Systronics 132). Total Dissolved Solids (TDS) in the water samples were calculated using the Total Dissolved Solids dried at 180°C method. Electrical conductivity was measured using conductivity meter (Elico CM 180). Total hardness in terms of $CaCO_3$ was determined using EDTA titrimetric method. Sodium level in water samples was found out by using flame emission photometric method. The data obtained from the study was compared with the drinking water standards of WHO (1995) and BIS, IS: 10500 (1991).

Results

The average rainfall (mm) of Neyyattinkara taluk recorded in the months of June 2022 to November 2022 is shown in Figure 2. A minimum rainfall of 133.4 mm was recorded during the northeast monsoon (November), and a maximum of 444.7 mm was recorded during the southwest monsoon (August). Water temperature (°C) ranged from 24.2 °C to 27.35 °C. Seasonal variation of water temperature in Neyyar River is given in Table 1 and 2. During southwest monsoon, a minimum water temperature was found at S1 (Arattu Kadavu) and a maximum water temperature was found at S5 (Panchikattu Kadavu). In the northeast monsoon, a minimum water temperature was found at S1 (Arattu Kadavu) and a maximum water temperature was found at S5 (Panchikattu Kadavu) (Figure 3). Seasonal variations of pH in Neyyar River are given in Table 1 and 2. During the southwest monsoon, a minimum pH was found at S1 (Arattu Kadavu) and a maximum pH was found at S5 (Panchikattu Kadavu). In the northeast monsoon, a minimum pH was found at S1 (Arattu Kadavu) and a maximum pH was found at S4 (Alatharackal) (Figure 4). The turbidity of water samples recorded seasonally. Seasonal variations in turbidity of Neyyar River are recorded in Table 1 and 2. During the

southwest monsoon, a minimum turbidity was found at S1 (Arattu Kadavu) and a maximum turbidity was found at S5 (Panchikattu Kadavu). In the northeast monsoon, a minimum turbidity was found at S1(Arattu Kadavu) and a maximum turbidity was found at S5 (Panchikattu Kadavu) (Figure 5).

Total dissolved solids in water samples recorded seasonally. Seasonal variations of total dissolved solids in Neyyar River are given in Table 1 and 2. During the southwest monsoon, a minimum value of total dissolved solids was found at S1 (Arattu Kadavu) and a maximum value was found at S5 (Panchikattu Kadavu) (Figure 6). The electrical conductivity of water samples recorded seasonally ranged during the southwest monsoon. During northeast monsoon, minimum value of electrical conductivity was found at S1 (Arattu Kadavu) and maximum value was found at S5 (Panchikattu Kadavu).

Total hardness in terms of $CaCO_3$ of the water samples recorded seasonally ranged. Seasonal variations of total hardness in Neyyar River are given in Table 1 and 2. During the southwest monsoon, a minimum value of total hardness was found at S1 (Arattu Kadavu) and a maximum value was found at S5 (Panchikattu Kadavu) (Figure 7). In the northeast monsoon, a minimum value of total hardness was found at S1 (Arattu Kadavu) and a maximum was found at S5 (Panchikattu Kadavu) (Figure 8). Sodium content in water samples recorded seasonally ranged during the northeast monsoon. Seasonal variations of sodium content in Neyyar River are given in Table 1 and 2. During the southwest monsoon, a minimum sodium level was found at S1 (Arattu Kadavu) and a maximum was found at S5 (Panchikattu Kadavu) (Figure 9).

Discussion

According to the results, fluctuations are noticed in the physicochemical parameters of water at the selected sites along the Neyyar River. Fluctuations in the physicochemical parameters can be correlated to environmental conditions. The average rainfall data of Neyyatinkara taluk from June 2022 to November 2022 indicated that high rainfall occurred during the southwest monsoon rather than the northeast monsoon. So, the rainfall pattern could bring an alteration in the physicochemical parameters of Neyyar River water. The water temperature of the Neyyar River during northeast monsoon is higher than that of southwest monsoon. This is due to the high rainfall observed during southwest monsoon. Other reasons for the fluctuation in river water temperature include early morning sampling, intensity of solar radiation and climatic conditions. Similar observations were also recorded by Abhilash *et al.*, 2015 in Neyyar River. Temperature can alter the chemical reactions in water and also affect the odour and taste of water (Trivedy and Goel, 1986). Normal pH in water ranges from 6.5 to 8.5. The pH of Neyyar River water ranged between these limits. The pH noticed during northwest monsoon is higher than that of southwest monsoon, and S5 (Panchikattu Kadavu) showed the maximum pH value compared to other sites. Similar pH was recorded by Abhilash *et al.*, 2015 in Neyyar River and Gautham *et al.*, 2005 in the Ganga River. According to Abhilash *et al.*, the pH value in Neyyar river water showed an increase from fresh water to coastal areas. In Neyyar River, higher turbidity was observed during the southwest monsoon than the northeast monsoon. Overall turbidity recorded in the study period was found to be above the permissible limits. Similar results were also recorded by Shaniya *et al.*, 2018 in the Thamaraparani River. According to Shaniya *et al.*, during monsoon season, a high range of turbidity was recorded because of plankton inflow and mixing of plankton, suspended and colloidal particles. Reasons for the turbidity in water includes deposition of sediments, sand mining etc.

Total dissolved solids in water comprise the organic and inorganic substances that can be measured. Total dissolved solids have a direct relationship to electrical conductivity. TDS in Neyyar River water was found to be higher at S5 (Panchikattu Kadavu) than at S1 (Arattu Kadavu) during northeast monsoon. A sudden increase in TDS indicates water pollution from extraneous sources (Aboo and Mandal 1967). Conductivity of water depends on its temperature and amount of dissolved salts present, either through human activities or natural processes (Pal *et al.,* 2015). In Neyyar River, the conductivity values were above the permissible limits. High value of electrical conductivity was recorded at S5 (Panchikattu Kadavu) both during the southwest monsoon and northeast monsoon. Similar observations were also recorded by Shaniya *et al.,* 2018 in Thamaraparani River.

Hardness can prevent the lathering of soap in water and thus increase the boiling point (Trivedi *et al.,* 1986). Hardness of Neyyar River showed a slight deviation in some sites and is below the permissible limits. An increase in hardness was observed from S1 (Arattu Kadavu) to S5 (Panchikattu Kadavu). Hardness in water during northeast monsoon is found higher than during southwest monsoon. Hardness of water between 75 mg/L and 150 mg/L could help in the productivity of fish (Basant Kumar, 2011). Among the five sites of the Neyyar River, high sodium was recorded at S5 (Panchikattu Kadavu) and low sodium was observed at S1 (Arattu Kadavu).

Conclusion

The river Neyyar plays an integral part in the lives of people who live nearby the river basin, as they depend on the river water for their daily needs. Results obtained from the present study of the water samples were compared with the general standards prescribed for drinking water. Deviations are noticed for some parameters like turbidity, electrical conductivity and total hardness in comparison with the standards of WHO, BIS: IS 10500. Neyyar River shows an increase in the values of physiochemical parameters on moving from upstream to downstream. Panchikattu Kadavu (S5) near the Poovar, shows higher readings than at Arattu Kadavu (S1) which is near Neyyar Dam. This indicates the deterioration of water quality due to anthropogenic activities, agricultural practices, construction works, disposal of wastes, sand mining, hospital discharges and mixing of drainage as it flows through human settlement. Therefore, the present study indicates the immediate need to protect the river from damage, pollution and unethical human practices in the use of river water. This can ensure good quality of the river water making it fit for human needs and also for other organisms in water.

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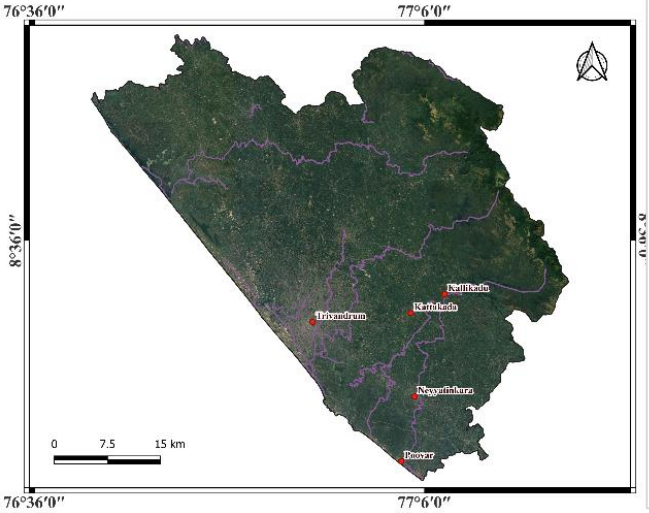

Fig. 1. Map showing the study area

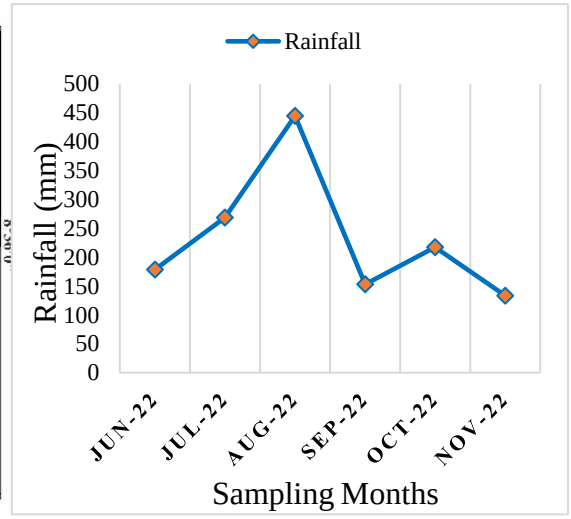

Fig. 2. Average rainfall in Neyyattinkara from June 2022 to November 2022 (India Meteorological Department Trivandrum)

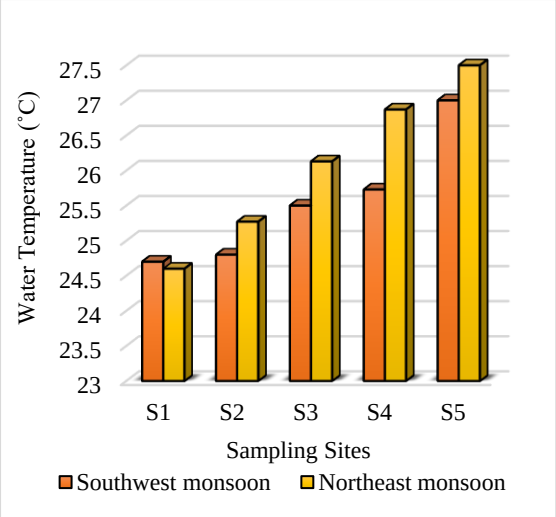

Fig. 3. Seasonal variation of water temperature in Neyyar River

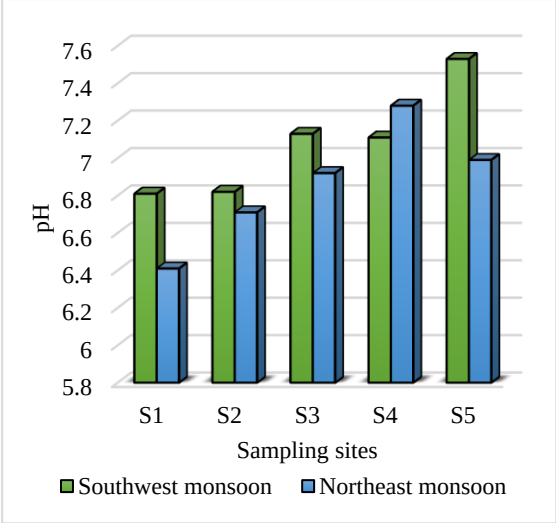

Fig. 4. Seasonal variation of pH in Neyyar River

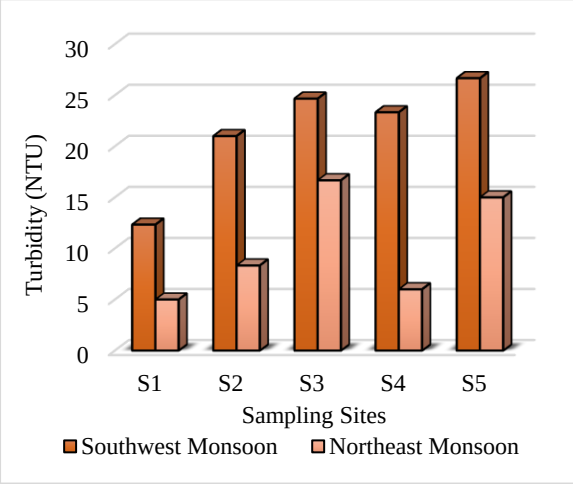

Fig. 5. Seasonal variation of turbidity in Neyyar River

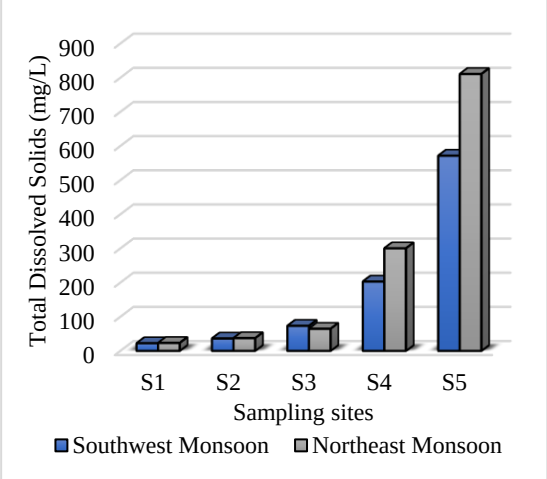

Fig. 6. Seasonal variation of total dissolved in Neyyar River

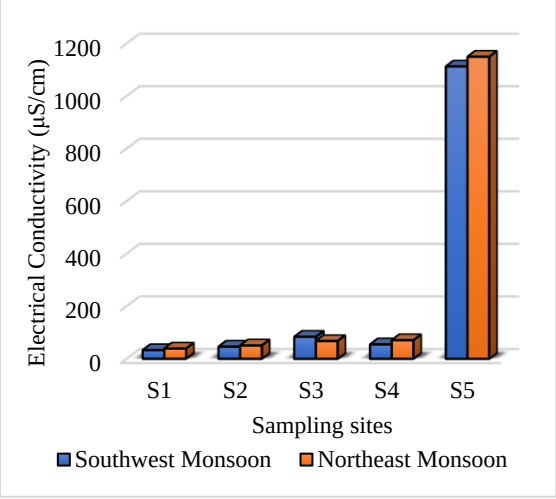

Fig. 7. Seasonal variation of electrical conductivity in Neyyar River

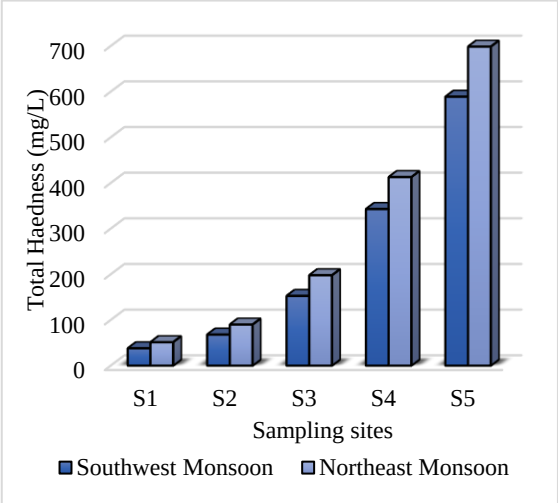

Fig. 8. Seasonal variation of total hardness in Neyyar River

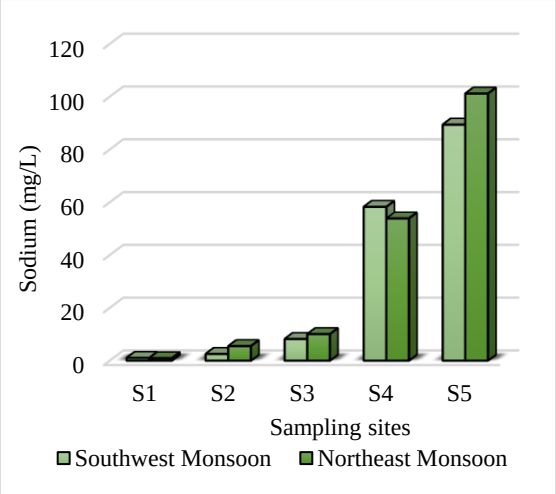

Fig. 9. Seasonal variation of sodium in Neyyar River

Table 1: Average result showing Physicochemical parameters in selected sites of Neyyar River during Southwest monsoon

Sl. No.	Parameters	BIS, IS 10500	WHO	Sites of Neyyar River				
				S1	S2	S3	S4	S5
1	Temperature (°C)	-	-	24.7± 0.50	24.8± 0.33	25.5± 0.73	25.73± 0.66	27± 0.45
2	pH	6.5-8.5	7-8.5	6.81± 0.36	6.82± 0.38	7.13± 0.45	7.11± 0.10	7.53± 0.34
3	Turbidity (NTU)	1-5	5	12.33± 2.05	21± 1.63	24.67± 3.40	23.33± 6.24	26.67± 6.18
4	Total Dissolved Solids (mg/L)	500-2000	500-1000	22.27± 2.50	36.17 ±3.18	73.27± 2.96	202.83± 15.89	571.33± 76.52
5	Electrical Conductivity (µS/cm)	-	400	33.07± 4.35	46.17 ±4.62	83.9± 7.24	54.87± 6.81	1112.87 ±529.69
6	Total Hardness as $CaCO_3$ (mg/L)	200-600	100-500	38± 4.90	68± 18.24	152.67± 47.36	343± 52.20	589± 69.08
7	Sodium (mg/L)	-	200	1.03± 0.63	2.54± 1.40	8.20± 4.95	58.27± 14.84	89.42± 11.11

Table 2: Average result showing Physicochemical parameters in selected sites of Neyyar River during Northeast monsoon

Sl. No.	Parameters	BIS, IS 10500	WHO	Sites of Neyyar River				
				S1	S2	S3	S4	S5
1	Temperature (°C)	-	-	24.6± 0.65	25.27± 0.54	26.13± 0.57	26.87± 0.58	27.5± 0.24
2	pH	6.5-8.5	7-8.5	6.41± 0.30	6.71± 0.11	6.92± 0.23	7.28± 0.18	6.99± 0.39
3	Turbidity (NTU)	1-5	5	5± 3.74	8.33± 2.36	16.67± 4.08	6± 5.66	15± 8.16
4	Total Dissolved Solids (mg/L)	500-2000	500-1000	23.2± 3.19	37.2± 2.82	64.67± 10.25	300.27± 136.77	810.7± 146.02
5	Electrical Conductivity (µS/cm)	-	400	39.13± 2.55	50.73± 5.71	67.5± 7.16	70.83± 4.74	1149.83 ±116.39
6	Total Hardness as $CaCO_3$ (mg/L)	200-600	100-500	51.33± 8.18	90± 9.20	198± 37.56	413± 36.67	698.67± 74.12
7	Sodium (mg/L)	-	200	0.92± 0.07	5.51± 1.51	10.07± 0.83	53.88± 4.07	109.57± 12.67