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Characterization of Water Quality and Carbon Flux in the Karuvannur River Basin, Southern Western Ghats, India

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Abstract

River water quality is receiving increasing attention worldwide due to its vital role in supporting ecosystems, agriculture, and human livelihoods. To maintain the stability of the ecosystem, it is essential to assess the water quality and contamination status of surface water resources. To create baseline data on the water quality and pollution status, surface water samples were taken from 20 different locations of the Karuvannur River, originating from the Southern Western Ghats and traversing the Kole Wetlands in the Thrissur District of Kerala state, India. The samples were analysed for physico-chemical parameters such as pH, EC, TDS, Cl^-, SO_4^{2-}, NO_3^-, Ca^{2+}, Mg^{2+}, Alkalinity, Hardness, DO, and BOD. The concentration of the tested parameters was within the permissible limit for domestic and agricultural purposes recommended by the World Health Organization and the Bureau of Indian Standards. The Water Quality Index (WQI) was calculated, and according to the results, all the samples fall under the 'good' category, ranging from 26.42 to 46.84 with an average of 34.48, and are presently devoid of any potential contamination risks. The partial pressure of CO_2 (pCO_2) of the surface water of the Karuvannur River ranges from 1,076 to 13,908 µatm, which is comparatively higher than the typical atmospheric concentration of 380µatm. The oversaturation of pCO_2 signifies that the river actively contributes to the global carbon budget by releasing CO_2 into the atmosphere. By quantifying pCO_2 and linking it with hydrochemical characteristics, this study provides critical insights into carbon flux dynamics in tropical river systems, improving understanding of their contribution to regional and global carbon budgets and informing strategies for sustainable watershed management.

Keywords: Karuvannur River Basin, Kole Wetlands, pCO_2, Water Quality Index, Western Ghats

Introduction

The primary source of fresh water is the river system. It transports a sizable amount of matter, either in dissolved form or as particulate matter, along its path and the tributaries. These could have come from both manmade and natural sources. Rivers are well known for being important in the transfer of goods and services. Additionally, they are involved in the transportation of domestic, commercial, and industrial waste. Runoff from farms and other sources that produce pollution eventually gets deposited in river water columns, introducing pollutants to the river. Discharges of garbage into the aquatic environment are increasing as a result of the constant population growth, which is accompanied by fast urbanization and industrial activity (Krishnakumar *et al.,* 2022; Reza and Singh, 2010; Krishnakumar *et al*., 2025; Khatri and Tyagi, 2014; Devic *et al*., 2014; Kumar *et al*., 2016; Krishnakumar *et al*., 2017a,b; Nair *et al*., 2018; Ramachandran *et al.,* 2018; Kaliraj *et al*., 2019). Since aquatic plants and wildlife are constantly in contact with water, every change in water quality must have a direct impact on them. Toxic compounds are deposited in the ecosystem as a result of overusing and exploring the natural world without following established laws or principles. When contaminants from agricultural waste, factory discharges, and effluent sources are released into the environment, the overall contamination burden of the receiving ecosystem is enhanced or increased. Likewise, the characteristics of the source and receiving environments influence the extent of contamination. The long-term interaction between the water and the surrounding environment reflects on the hydrochemical composition of water (Lin *et al*., 2023).

It is significant that around 70 percent of Indian rivers have been reported to be contaminated to varying degrees (Singh *et al*., 2020). Numerous physicochemical factors affect the water quality of riverine ecosystems. These factors are crucial in assessing whether the water is suitable for various uses, including drinking, agriculture, industry, and fisheries. In many developing countries, water pollution and its management demand immediate attention, as nearly 80% of disease outbreaks and related deaths are associated with the consumption of unsafe water (Jose and Krishnakumar,

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