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Received: 18.09.2024

Accepted: 20.12.2024

Published: 27.12.2024

Citation: Pillai RR. (2024). Estimation of Surface Water Hydrochemical Pollution Due to Pilgrimage Tourism in Regions of Pamba River Basin. *Geo-Eye*. 13(2): 1-5. <https://doi.org/10.53989/bu.ge.v13i2.pillai>

* **Corresponding author.**
rengithpillai1996@gmail.com

Funding: None**Competing Interests:** None

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Published By Bangalore University,
Bengaluru, Karnataka

ISSN

Print: 2347-4246

Electronic: XXXX-XXXX

Estimation of Surface Water Hydrochemical Pollution Due to Pilgrimage Tourism in Regions of Pamba River Basin

Rengith R Pillai^{1*}

¹ Research Scholar, Department of Geography, Sree Sankaracharya University of Sanskrit, Kalady, Ernakulam, 683574, Kerala, India

Abstract

Water pollution is a state of deviation from the pure condition, where the normal conditions of the chemical property of the water get changed by the addition of foreign contaminant. The presence of these materials lowers the quality of water and results in its depletion causing health hazards. Bacteria, protozoans, and other microorganisms which get injected by means of dumping of waste materials causing to higher contamination. River monitoring is an integral part of the present world because of the greater human population. Proper analysis of the water quality provides a detailed structure of the condition of the water body which affects the entire ecosystem. The present study was conducted in selected portion of the Pamba River which comes under the study area, to monitors the level of water pollution and its impact using various chemical parameters. The main aim and objective of the present study is to inverse distance weighted (IDW) method has been used to represent the parameters. The varying quality of aquatic ecosystem is dependent on the physical, chemical qualities of water and also on biological diversity of the entire system. The derived result brings out the alarming rate of water degradation due to the improper waste management, impact of tourism etc.

Keywords: Pamba; Water Quality; Geoinformatics; IDW

1 Introduction

Upper Catchment regions of river Pamba is having the famous Sabarimala, a temple complex situated on a hilltop surrounded by mountains and dense forest called Poomkavanam at an altitude of 480 m MSL is considered to be one of the holiest pilgrim centre in the world. The temple is situated in the Periyar wildlife sanctuary which projects some of environmental degradation due to the impact

of the mass pilgrimage intrusion. It is one of the famous seasonal pilgrimage centers for the lord Ayyappa in South India with an estimated more than 10 to 20 million devotees visiting every year. The massive entry results in the floristic changes in the region and along with other sources of environmental degradations. The Pamba river pollution is a notable impact, in which are mainly by means numerous pollutants which are dumped to river during the times of pilgrimage. Solid waste

generation including residual clothes, plastic waste and others lead to accumulation of non-biodegradable waste materials. The present study is based on the water quality assessment in Sabarimala.

2 Study Area

Sabarimala temple is located in the Periyar Tiger Reserve. It is one of the few temples possessing the largest annual number of pilgrimages, in the world, having more than 40 to 50 million devotees from different parts visiting every year (Figure 1). The temple is enshrined with the Hindu deity Ayyappan also known as Darmashastha, who according to mythology is the third son of Shiva and Mohini, the famine character of Vishnu. The temple provides a vast opportunity for the seasonal development of pilgrimage tourism. Annual growth in the pilgrimage potential in turn projects some disturbances in the existing flora and fauna.

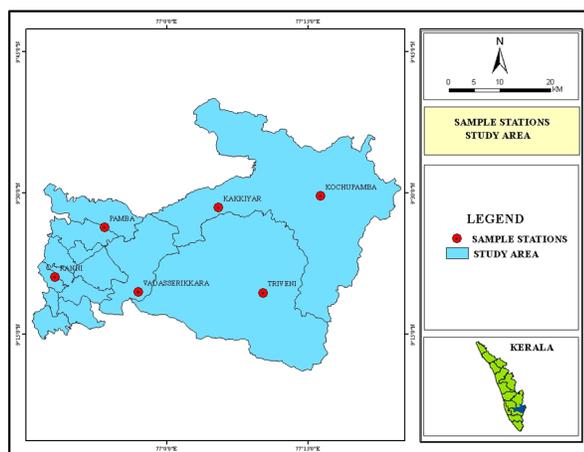


Fig. 1. Study area map

3 Methods and Materials

The water samples for the study were collected from six sample sites in the Pamba River for a period of twelve months. Averages of each chemical parameter in a region are calculated and are represented in the form of bar in selected stations. Ranni, Vadasserikkara, Pamba, Triveni, Kakkipamba and Kochu Pamba. The important parameters that are normally associated with the measurement of water quality monitoring analysis are Ph, Dissolved oxygen, Biological oxygen demand, Total coliform and Fecal coliform.

4 Result and Discussion

4.1 Potential of hydrogen (Ph)

Ph is a measure of the hydrogen ion concentration. Concentration of hydrogen ion index in water quality analysis helps

to analyse the acidic and basic nature of the water body. A Ph value of 7.0 indicates a neutral solution, a value lesser than 7.0 indicate acidic condition and a value greater than 7.0 indicates alkalinity. The nature of the water gets more corrosive with decreasing Ph values. It calculates the hydrogen ion (H+) potentiality in a solution. The permissible limit of Ph for drinking water according to WHO standards is 7 - 8.5. The entire region marks an acidic composition, the regions of Pamba and Triveni recorded a very high Ph value greater than 6.7 and Vadasserikkara having 6.8 (Figure 2 (A)). The region is merely concentrated with numerous waste materials including the waste generated from numerous hotels, sanitation points, cloth dyes and so on. The water is unfit for drinking purpose and also results in serious health problems related to skin, stomach and intestines. There is an increase in the value of the Ph at the time of the pilgrimage season and also in the summer months which demarcate a shortage in the amount of water. The tested samples reveal that Triveni and Pamba regions possess values 3.26 mg/L and 3.9mg/L respectively which marks a moderate level of pollution Vadasserikkara also having a value of 4.05mg/L. Non polluted samples have been obtained from Kakkipamba and Kochu Pamba values of having 4.3 and 5.83mg/L respectively. Dissolved oxygen also reveals there is some sort of pollution in the regions of Triveni, Pamba and Vadasserikkara regions which may increase over decades along with the increase in pilgrims over the time beyond.

4.2 Dissolved Oxygen (OD)

Dissolved Oxygen is one of the parameters in higher forms for aquatic life to survival. It is the measurement of oxygen dissolved in water and available for fishes and other aquatic organisms. This is one of the basic parameters for assessing the quality of water. If the dissolved oxygen is low the quality of the water is also decreased, and that water is not good for anything. It indicates the health of an aquatic system. According to EPA standard $DO \geq 6.5$ is considered as non-polluted, $6.5 > DO \geq 4.6$ is considered as lightly polluted, $4.5 \geq DO \geq 2.0$ is considered as moderately polluted and $DO < 2.0$ is severely polluted. The tested samples reveal that Triveni and Pamba regions possess values 3.26 mg/L and 3.9mg/L respectively which marks a moderate level of pollution Vadasserikkara also having a value of 4.05mg/L (Figure 2 (B)). Non polluted samples have been obtained from Kakkipamba and Kochu Pamba values of having 4.3 and 5.83mg/L respectively. Dissolved oxygen also reveals there is some sort of pollution in the regions of Triveni, Pamba and Vadasserikkara regions which may increase over decades along with the increase in pilgrims over the time beyond.



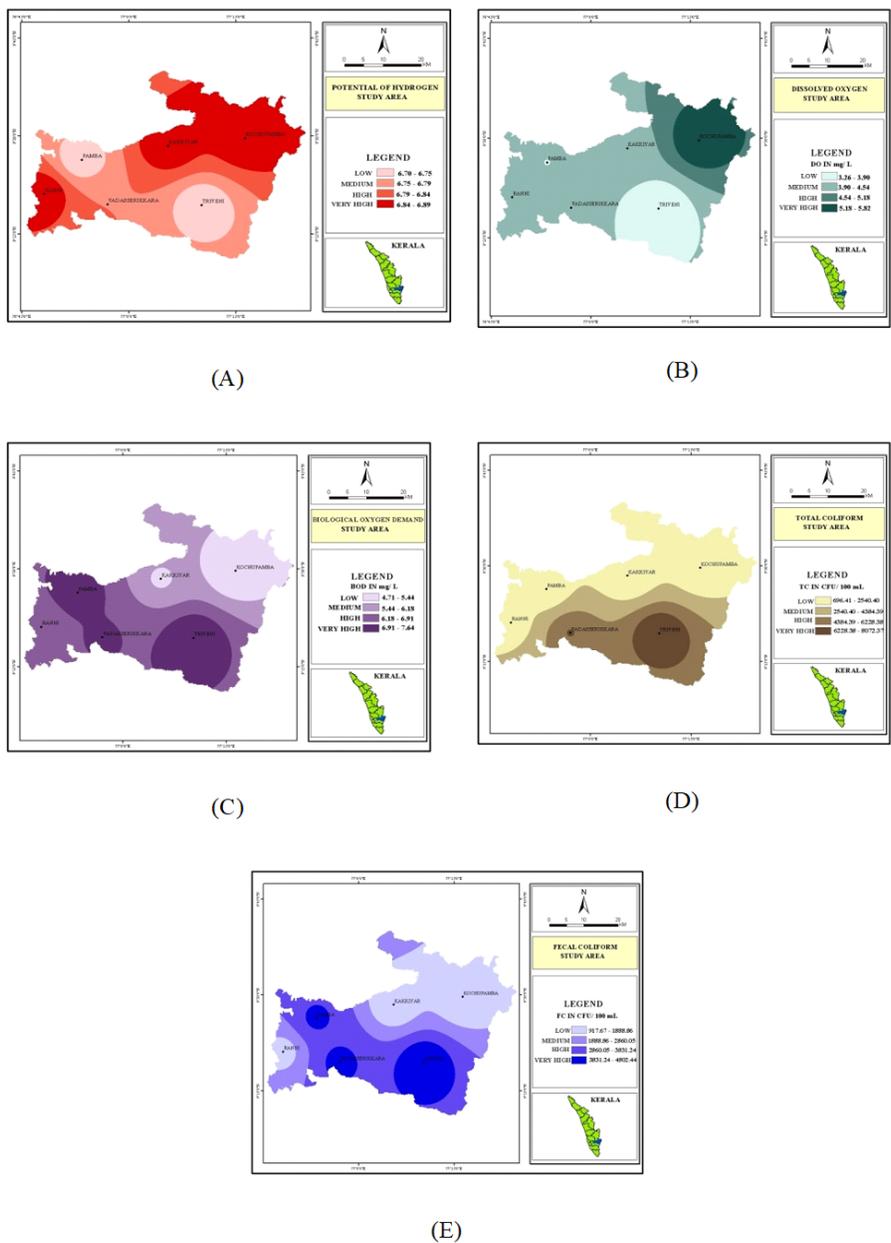


Fig. 2. Spatial interpolation of water quality parameters

4.3 Biological oxygen demand (BOD)

Biochemical Oxygen Demand or B.O.D is the amount of dissolved oxygen needed by the organisms in the water body to break down the organic compounds in specified temperature and in given time period. The BOD value usually expressed in milligrams of oxygen in a given sample at a temperature of 20° C for a time period of 5 days of incubation. It also projects the growth of organic particle matters in the water body. According to EPA standards $BOD \geq 3.0$ is

considered as non-polluted, $3.0 > BOD \geq 4.9$ is considered as lightly polluted $5 \geq BOD \geq 15$ is considered as moderately polluted and $BOD < 15$ is severely polluted. There is increase in the value the BOD in the regions of Triveni station of 7.85mg/L which is mainly by the cause of accumulation of the waste materials namely flowers, food items etc. The accumulation and outflow of sewage is also a factor for the generation of organic matter in the water body. The higher concentration is mainly during the time of pilgrimage season namely December and January. Pamba also possess a higher

BOD with a value of 7.35mg/L, hence the region having some sort of pollution. Lower values are identified in the regions of Kakkiyar and KochuPamba with 5.65mg/L and 4.71mg/L (Figure 2 (C)).

4.4 Total Coliform

Coliform are type of bacteria which are found in the digestive tracts of the living beings usually in human and animal intestines and are also ejected through their waste. They are also found in certain plants and in soil materials. It is one of the basic tests for the analysis of the bacterial contamination in a water body. Total coliform counts demarcate the condition present sanitary of the water supply. The EPA standard for fecal coliform is 394 colonies forming per 100ML. The coliform group has been used as the standard for analysing the water contamination in drinking water. The proper analyses of the coliform content in water help to get rid of many water borne diseases thereby ensuring a hygienic ecosystem. The Triveni region is highly polluted by means of numerous toilets, hotels, and it's out flow towards the river (Figure 2 (D)). Vadasserikkara also possess a high range of total coliform amount. There is a sewage treatment plant which lacks its capacity and also leads to the overflow of the waste materials towards the river also leads to the accumulation of bacterial growth in this region causing water contamination. The region is highly concentrated with total coli form content at the time of pilgrimage season mostly in the month of January, which marks the peak month.

4.5 Feal Coliform

Fecal coliform bacteria usually present in waste materials of human and animal. The environmental protection agency uses fecal coliform as a measurement to analyse the presence of disease causing bacteria, protozoan's and virus. The higher concentration results in the presence of higher the concentration of fecal coliform. It is measured in colony

forming units. The EPA standard for fecal coliform is 394 colonies forming per 100 ML. The Triveni, Vadasserikkara, and Pamba region is highly polluted by means of fecal coliform content (Figure 2 (E)). This is caused due to the accumulation of human excreta which get dumped from the toilets and other waste materials towards the river. The sewage treatment plant which lacks its capacity and also leads to the overflow of the waste materials towards the river also leads to the accumulation of bacterial growth in this region causing water contamination. The region is highly concentrated with fecal coliform content at the time of pilgrimage season mostly in the month of January, which marks the peak month. Among all Triveni region is highly polluted as it is the place where pilgrims use to perform their practices before entering way to the temple.

5 Conclusion

Sabarimala temple, dedicated to the deity, Lord Ayyappa, is situated the most sensitive part of the western ghat. The entire shrine is surrounded by means of dense reserved forest which is a part of the Periyar wildlife reserve. The temple is an example of annual mass pilgrimage tourism which in turn affects the environment in a higher concentration. The clearing of reserved forest by the Devaswom board for the development of new infrastructure depletes the species diversity. The improper practices among the field of waste management leads to the contamination of the river water there by leading to the entire destruction to the ecosystem and development. Proper strategies are needed for the conservation of the environment and for the betterment of the society. There is a need for environmental based developmental activities. There is a need for more vertical development than horizontal development. There should be proper monitoring of the government authorities against the activities of the people and the Devaswom board. Strict laws should be implemented against the people, contaminating the environment.

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