Assessment and Mapping of Seasonal Variation in Water Quality of Periyar River, Kerala, India

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Abstract: *In the view of higher demand of fresh water, water quality assessment has to be done periodically. River Periyar is considered as the lifeline of Kerala. Twenty-five percentage of Kerala's industries are located at the banks of Periyar River. Due to the disposal of untreated or partially treated waste in to the river, the water quality of the river changes. In order to make the water fit for drinking purpose, the water quality parameters should lie in permissible limit. Studies were conducted over a period of one year by collecting samples from seven stations. Assessment indicated that there is a decrement in water quality. This study is intended to estimate water quality Index (WQI) of study area using Weighted Arithmetic water quality index method. WQI is the method used to assess the water quality, which gives the clear idea about water quality. Kalamassery, Eloor and Pathalam stations shows less values of WQI. It gives the clear picture of waste disposal in the river. Maximum WQI values were observed in Bhoothathankettu which is the upstream portion of the study area. Water quality maps were generated with GIS.*

Keywords: Water quality index, water quality rating, GIS, Water Quality Mapping

1. INTRODUCTION

Kerala is blessed with plenty of water bodies. This has to be preserved for future generation also. Periyar is the longest river in Kerala. Life style of the state is highly influenced by Periyar River. The river provides water for irrigation, power generation, domestic and commercial use throughout its course besides supporting a rich fishery. So, water quality of the river must be checked periodically. The quality of water can be assessed on the basis of several characteristics, each of which beyond specified limits, may render the water unfit for use for specific purpose (Stream Keepers Handbook, 2005). Even though many assessment methods are available, water quality indexing (WQI) is the widely accepted one. The water quality index (WQI) is an important tool to determine the drinking water quality in urban, rural and industrial area. WQI is defined as an index reflecting the composite influence of different water quality parameters which is considered and taken for calculation of water quality index. Water quality index was initially proposed by Horton (1965) and Brown et al (1970) [1]. Many researchers had taken this as their topic of research. WQI can be considered as an effective tool to assess the quality of water. The study conducted by A.K. Thukral et al (2005) reveals the importance of water pollution index and water quality index. Q-index of parameters were found out based on the weightage of water quality parameters [2]. Lakshmi E. (2014) et al conducted a study on Periyar River along a stretch of Eloor area as it is an industrial area which influences the water quality of Periyar River [3]. The study was over a period of one year. Statistical analysis was conducted to assess the water quality. From the study it was evident that the water quality of that area is not up to the mark. Present study focusses on a selected stretch of Periyar river, from

Bhoothathankettu to Pathalam Bund. Total length of the stretch is ~60kms. Study was conducted over a period of one year and water samples are collected from seven stations. Correlation and regression analysis with statistical techniques like SPSS will give better assessment of result [4]. The parameters of water quality index are fixed as pH, Temp. Change, Turbidity, FC, BOD_5, DO, TSS, Phosphate and Nitrate.

2. STUDY AREA AND SAMPLING

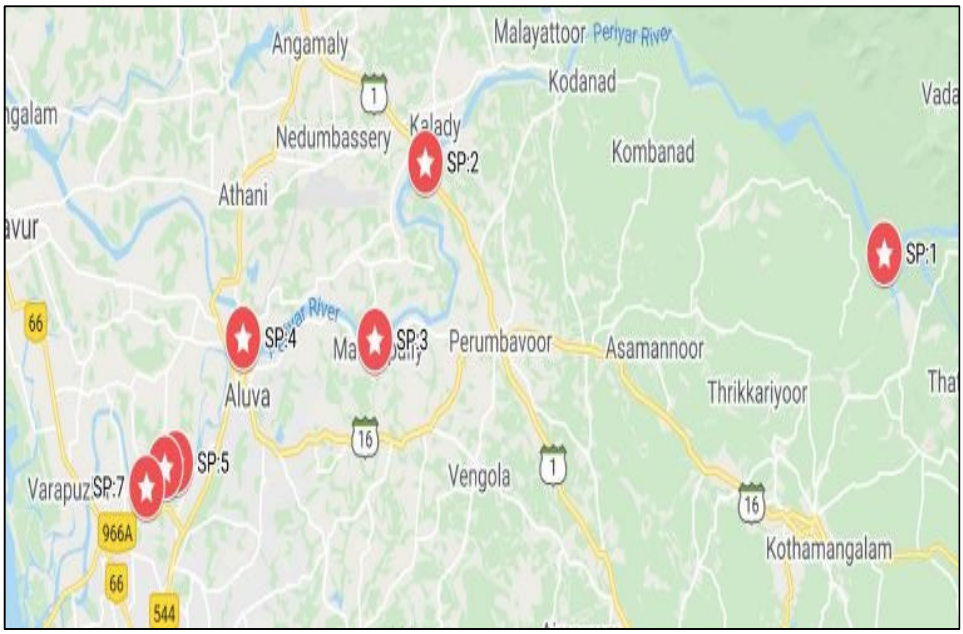

Figure 1. Sampling stations

To perform the investigation, the selected area was divided into segments and samples were collected from seven stations over a period of one year ie. January 2018 to December 2018. Water samples were collected and tested seasonally, ie., Monsoon, Pre-monsoon, Post-Monsoon Period. Selected stretch for the study is from Bhoothathankettu Dam to Pathalam Bund. Sampling stations are SP:1- Bhoothathankettu, SP:2-Kalady, SP:3-Marampally, SP:4-Aluva, SP:5-Kalamassery, SP:6-Eloor and SP:7-Pathalam Bund.

Water quality mapping with GIS will give clear picture of the WQ of the area. The WQI were rated with standard values [5].

3. METHODOLOGY

Water samples were collected from seven stations and tested periodically. Analysis was done based on Standard methods for the examination of water and waste water. After analysis [6], WQI were calculated by standard procedure [7].

Computation of WQI:

Step-1: Assigning of Weight to the selected water parameters.

In order to find WQI, parameters have to be finalized [8]. The parameters of water quality index were pH, Temp. Change, Turbidity, FC, BOD_5, DO, TSS, Phosphate and Nitrate. Based on the literature survey weightages were fixed. The weightages are listed below as Table 1.

Table 1. Weightage of water quality parameters.

Parameter	Weighing Factor(WF)
pH	0.11
Temp. Change	0.10
Turbidity	0.08
FC	0.16
BOD_5	0.11
DO(%)	0.17
TSS	0.07
Phosphate	0.10
Nitrate	0.10

Step-2: Computation of a relative weight (Wi) of the chemical parameter.

This can be done by multiplying weighing factor with Q-Value.

Q- Indices was calculated based on the value of water quality parameters.

Step-3: Summation of relative weights of all parameters.

Step-4: Water Quality Rating (WQR) can be done by referring Table 2.

Table 2. Water quality rating chart.

WQI Range	Quality
90 - 100	Excellent Quality
70 - 89	Good Quality
50 - 69	Medium Quality
25 - 49	Bad Quality
0 - 24	Very Bad Quality

Step-5: Water Quality mapping was done in GIS.

4. RESULTS AND DISCUSSION

Water quality Indices of all station points at different seasons were calculated which is tabulated in table 3.

Table 3: Water Quality Index and Water Quality Rating

Season Code	Station Code	WQI	WQR
PRM-01	SP:1	82.03	GOOD
PRM-02	SP:2	74.87	GOOD
PRM-03	SP:3	73.58	GOOD
PRM-04	SP:4	72.02	GOOD
PRM-05	SP:5	71.94	GOOD

PRM-06	SP:6	56.49	MEDIUM
PRM-07	SP:7	59.04	MEDIUM
MON-01	SP:1	75.16	GOOD
MON-02	SP:2	68.64	MEDIUM
MON-03	SP:3	71.99	GOOD
MON-04	SP:4	68.98	MEDIUM
MON-05	SP:5	65.71	MEDIUM
MON-06	SP:6	64.78	MEDIUM
MON-07	SP:7	64.00	MEDIUM
POM-01	SP:1	76.72	GOOD
POM-02	SP:2	71.41	GOOD
POM-03	SP:3	72.55	GOOD
POM-04	SP:4	66.86	MEDIUM
POM-05	SP:5	66.62	MEDIUM
POM-06	SP:6	64.15	MEDIUM
POM-07	SP:7	64.37	MEDIUM

*PRM: Pre Monsoon, MON: Monsoon, POM: Post Monsoon

Seasonal variation in water quality of all stations are shown in Figure 2.

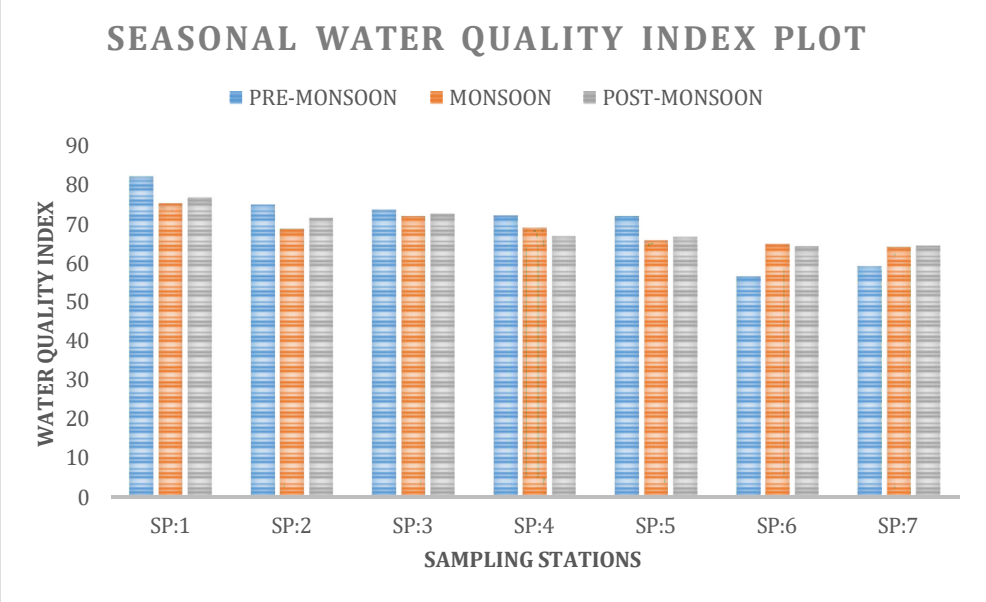

Figure 2: Graphical representation of Water quality index

GIS is a useful tool for generating solutions to issues with water resources, including mapping and assessing the quality of water, comprehending the natural environment, managing water resources on the necessary scale, and determining the vulnerability of freshwater to contamination [10]. GIS makes it easy to monitor the environment using images. In this study, Water quality mapping in GIS was done for three seasons, pre-monsoon, monsoon and post-monsoon.

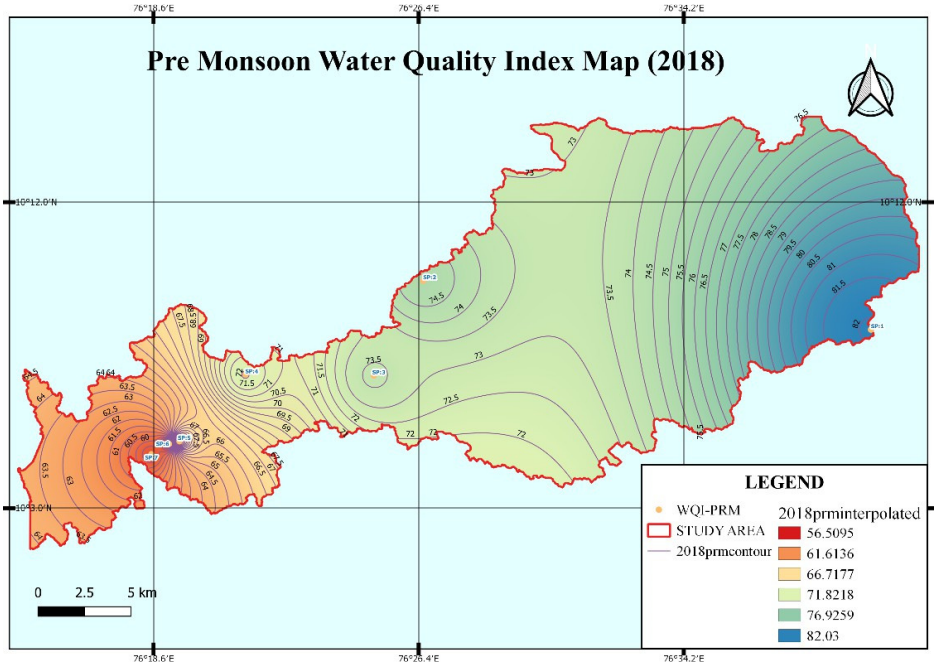

Figure 3: Water quality index in 2018 Pre-Monsoon Season

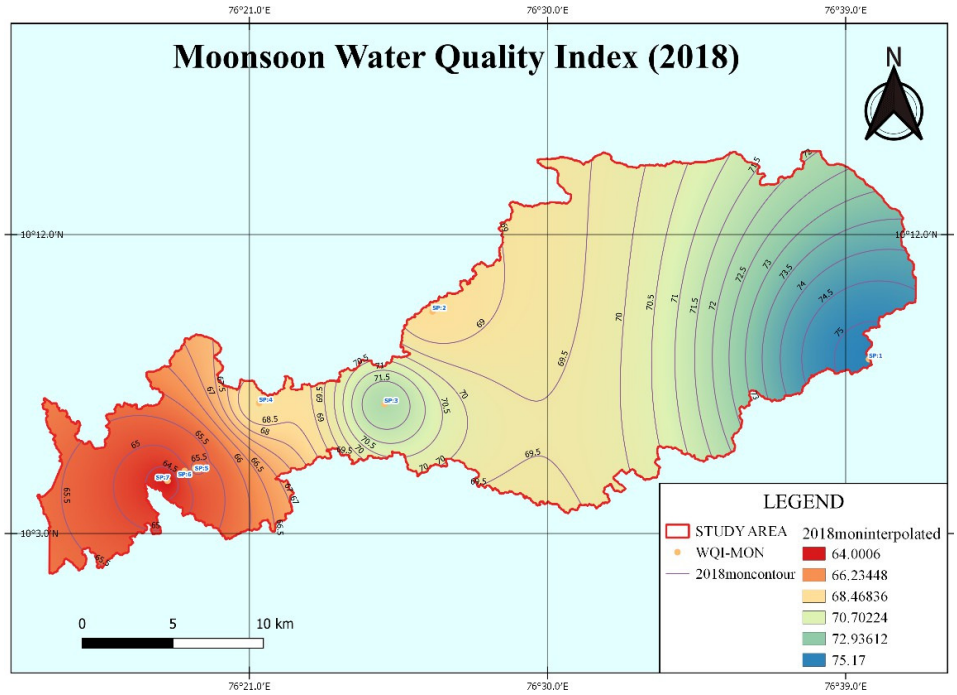

Figure 4: Water quality index in 2018 Monsoon Season

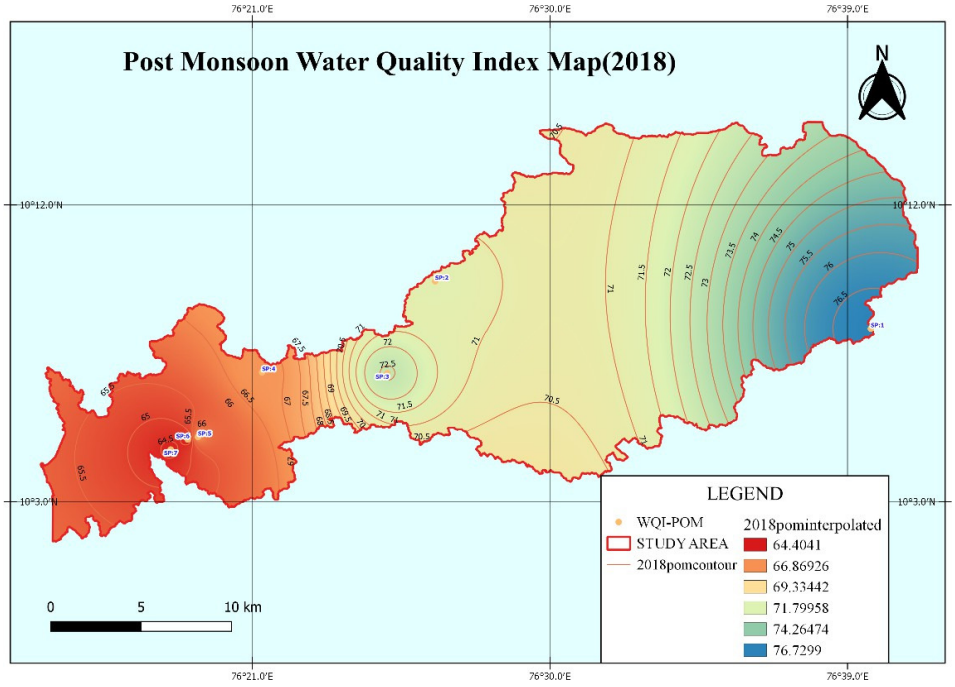

Figure 5: Water quality index in 2018 Post Monsoon Season

In the study it is evident that water quality is relatively good at upstream portion of the river which is a non-industrialized area. Waste disposal without proper treatment is the root cause of water pollution.

5. CONCLUSION

The objective of the study was to calculate the Water Quality Index (WQI) of Periyar River in order to assess its suitability for drinking purposes. The water quality index (WQI) obtained was above 50. WQI of some sampling stations are close to 50, which is at a critical zone. A small deviation in water quality parameter may lead the water unfit for domestic use. Even though it indicates the safe usability of water, the author strongly recommends to treat the same before using it for domestic purposes. Therefore, the authors strongly recommend that importance of water quality and associated water borne diseases should be educated to the society so that waste dumping and sewage disposal to river can be reduced to a great extent. If we can reduce the same, water pollution can be controlled.

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