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Study of water quality index of groundwater on the bank of Noyyal river at Tiruppur, Tamil Nadu, India

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ABSTRACT

Groundwater is the most important natural resource required for drinking to people around the world, especially in rural and urban areas. The present study is accomplished to evaluate the quality of groundwater on the bank of Noyyal River for the purpose of drinking and domestic usage by using Water Quality Index (WQI). The study was carried out in rainy season 2013. The results were evaluated and compared with WHO water quality standards. The present study indicates that most of the groundwater samples are very poor and unfit for drinking purpose.

Key words: Groundwater, Noyyal River, WQI and WHO standards.

INTRODUCTION

Tiruppur is an industrial hub for the textile sector and is one of the most important export centers of India. It is located on the bank of Noyyal River. Tiruppur is also known as the textile city of India, located 50 km east of Coimbatore city in Tamil Nadu. It is a semi arid region with a tropical climate [3, 4]. In cities, large sections of the population have been using ground water for human as well as agricultural consumption. Rapid increases of industrialization and urbanization have led to deterioration of water quality. Hazards chemical substances, fertilizers, organic wastes and dumping of sewage wastes are letting into the river without proper treatment which can be seepage into the groundwater [1]. Prolonged discharges of industrial effluents, domestic sewage and solid wastes disposal are caused groundwater to become polluted and the results cause many health problems [2]. Most of the industries are discharged the effluents into the river without proper treatment which are percolated into the groundwater and affect groundwater quality. Ground water contamination is generally irreversible i.e., once it is contaminated it is difficult to restore the original quality of the acquifer. Therefore, it is necessary to assess the quality of groundwater in the study area.

MATERIALS AND METHODS

The groundwater samples were collected from the bore wells on either side of the river Noyyal (1A-5A and 1B-5B) of each station. Two other groundwater samples were collected from nearly ½ km away from the river of all five stations (1C-5C and 1D-5D). They are represented as Authupalayam (S1), Mangalam (S2), Karuvampalayam (S3), Mannarai (S4) and Ponapuram (S5). The groundwater samples were subjected to Physico-chemical analysis using standard procedures [5, 9 and 11].

Calculation of Water Quality Index (WQI)

Water quality index is a tool to determine the quality of water [6]. It is a well-known method of expressing water quality that offers a stable and reproducible unit of measure which responds to changes in the principal characteristics of water [7]. WQI is a mechanism for presenting a cumulatively derived numerical expression defining a certain level of water quality [8]. Water Quality Index (WQI) is calculated by using the Weighted Arithmetic Index method. By this method, different water quality components are multiplied by a weighting factor and are then aggregated using simple arithmetic mean. For assessing the quality of water in this study, the quality rating scale (Qi) for each parameter was calculated by using the following equation:

$$Q_i = \{[(V_a - V_i) / (V_s - V_i)] \times 100\}$$

Q_i = Quality rating of i^{th} parameter for a total of n water quality parameters
V_a = Actual value of the water quality parameter obtained from laboratory analysis
V_i = Ideal value of that water quality parameter obtained from the standard Tables.
V_i for pH = 7 and for other parameters it is equivalent to zero, but for DO Vi = 14.6 mg/L
V_s = Recommended WHO standard of the water quality parameter.

Then, after calculating the quality rating scale (Qi), the Relative (unit) weight (Wi) is calculated by a value inversely proportional to the recommended standard (Si) for the corresponding parameter using the following expression;

$$W_i = K/S_n$$

Where,
K [constant] = $1/[(1/S_1) + (1/S_2) + (1/S_3) + \ldots.. + (1/S_n)]$

Here,
W_i = Relative (unit) weight for nth parameter
S_n = Standard permissible value for nth parameter
Finally, the overall WQI is calculated by aggregating the quality rating with the unit weight linearly by using the following equation:

$$WQI = \Sigma^n{}_{i=1} (QiWi) / \Sigma^n{}_{i=1} Wi$$

Table 1: Classification of water quality index

WQI	Quality of water
0-24	EXCELLENT
25-49	GOOD
50-74	POOR
75-100	VERY POOR
>100	UNFIT FOR DRINKING

RESULTS AND DISCUSSION

The WQI values are found in the range of 76-100 at stations 1A, 1B, 2D, 3A and 5A. All the above stations are come under very poor water quality category. Similarly the stations 1C, 1D, 2A-2C, 3B-3D, 4A-4D and 5B-5D come under the category of Unfit for drinking. The maximum TDS values are observed at stations 2A and 4A which are located nearer to the river. The river water along with domestic sewage may be percolate into the groundwater, which may lead to increase the TDS values [12]. The water quality index map showed that the sampling stations are highly polluted by intrusion of river water, solid wastes disposal, agricultural waste, organic matter, total hardness, landfills, dumping of sewage and anthropogenic activities which may lead to high concentration of dissolved solids [10]. Hence the above mentioned stations are come under the category of unsuitable for drinking purposes [13]. The contaminants also get added up due to unscientific practices of agriculture waste and letting of sewage into water bodies without proper treatment in the study area [14].

Table 2- Water quality classification based on WQI value

Water Quality Index Level	Water Quality Status	No. of Stations
0-25	Excellent	---
26-50	Good	---
51-75	Poor	---
76-100	Very Poor	1A, 1B, 2D, 3A and 5A
ABOVE 100	Unfit for drinking	1C, 1D, 2A-2C, 3B-3D, 4A-4D and 5B-5D

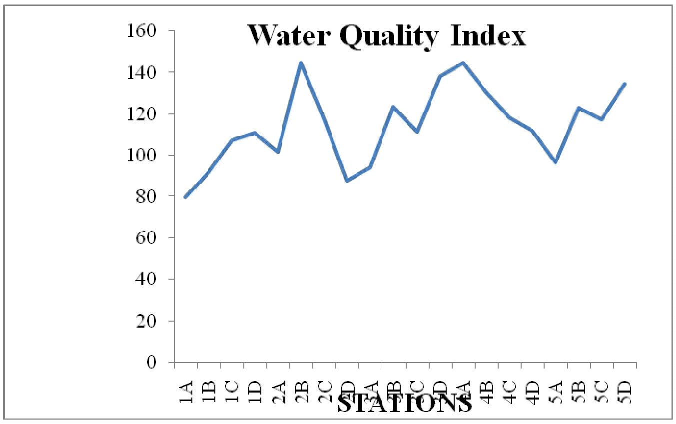

Fig 2. Rating of Water Quality Index

CONCLUSION

The result obtained in the present study indicates that the water quality index which are well above the permissible levels as per the standards. The groundwater quality of the study area is highly impaired owing to the seepage of solids waste and sewage. The high concentrations of the above water samples are lead to the alarming situation for the viewpoint of health risk. By comparing the standard procedure BIS and WHO, it is obvious that as seen from the most of the groundwater samples are polluted. The analysis reveals that the groundwater of the area needs some important treatment before consumption, and it also needs to be protected from the perils of contamination. Hence there is a crucial need to extend the groundwater studies in the present study area.

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