Ground Water Quality Analysis of Nagpur City

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Abstract- *Water is the most essential, abundant and useful natural resources on the earth because no life is possible without water. It is important for the survival of all living beings and plays an important role in our life. Ground water is generally considered to be much cleaner than the surface water but manmade activities are responsible for its pollution. Water quality index (WQI) is valuable and unique rating to depict the overall water quality status in a single term that is helpful for the selection of appropriate treatment technique to meet the concerned issues. Groundwater samples were collected from different locations of Nagpur city and were subjected to comprehensive physiochemical analysis which includes parameters such as colour, odour, turbidity, pH, electrical conductivity, alkalinity, total dissolved solids, fluoride, total hardness, chloride, sulphate, iron, calcium, magnesium. After calculating water quality status of considered parameters, results are compared with IS: 10500-2012.*

Keywords- Groundwater, physiochemical, Pollution, Water quality index.

I. INTRODUCTION

The Water is one of the most important and yet the most neglected resources and being the elixir of life, it must be judiciously used. Water occupies about 70% of the body weight of almost all the life forms. Life is not unimaginable on our planet without this precious resource. About 97.2% of water on earth is saline and only 2.8% exists as fresh water. Out of the available fresh water, about 20% constitutes groundwater. Certain properties that are not possessed by surface water is fulfilled by the groundwater. Hence, it is highly valued resource.

The rapid urbanization has further affected the groundwater quality due to misuse and overexploitation of resources and improper disposal of waste particles. Since time immemorial, human civilizations have settled and centered near spring and streams. A large number of civilizations flourished post developing reliable supply of water collapsed when the supply was disrupted, deteriorated or exhausted.

This natural resource has been used for different purposes, namely for domestic, irrigation and industrial purposes and most importantly for drinking purpose. The utility of water for aforementioned purposes mainly depends on its acceptability and usability which is closely related to its intrinsic quality. Hence, it is vital to have extensive information on quality of the available water resources in the region, while planning developmental projects or for human settlements. A large population of humans and also plants and other animals are dependent on ground water sources. Thus, the value of groundwater lies not only on the factor of occurrence and availability but also in its consistent good quality, for its acceptability as an ideal supply of drinking water. Thus, assessment of water quality is very important for attaining the information and knowledge to understand its acceptability for widespread purposes.

Water Quality Index (WQI) is considered as the most effective way to elucidate water quality. The WQI, was developed in the early 1970s, and is still being used monitor water quality changes in a particular water supply over time. Additionally, it can also be used to compare a water supply's quality with other water supplies in the region from any part of the world. The results can finally be used to determine whether a particular stretch of water can be satisfactorily accepted as "healthy".

Area covered

As it has been observed that in recent times there is an increasing dependence of urban population on ground water for domestic consumption, particularly in the expanding urban-fringe areas of Nagpur. Hence more samples are being collected from newer urban localities. Geographical location and topographical features of Nagpur is shown in Fig.1 and Fig.2 respectively**.** 'Zero mile stone' located in city is the geopgrphical centre of India. The topographical features with respect to 'Zero mile stone' are as follows.

i. Futala to NW, Shukrawar/jumma tank.
ii. River Kanhan flowing from N to SE at about 25 km
iii. River Kolar at Koradi.

iv. Industrial areas at Hingna to west, Butibori to south and Uppalwadi north east of Nagpur.

v. The Nag & Pilli rivers carrying sullage/wastewater from residential areas along their banks.

Fig.1: Geographical location

Fig.2 : Topological features

Approach

In this paper, there are two types of classification of ground water viz, first is dug wells which represents relatively shallow aquifer and the second is bore wells /hand pumps - which draw water from relatively deeper aquifers. Results of analyses for routine water quality parameters from these sources were used. The Fig.3 shows the various wells whose sample were used for consideration.

Fig.3 Samples obtained from various wells

II. LITERATURE REVIEW

Literature review was performed to study the major methodology for testing and experiments. In order to analyze water quality there are a number of methods and the data obtained vary depending on informational goals, the size of the sampling area, the type of samples etc. One of the most excellent ways to collect and collate information on water quality status is by use of the suitable indices (Dwivedi & Pathak, 2007). Indices are based on the values of various biological and physiochemical parameters in a water sample. Initially, WQI was developed by Horton (1965) in United States by selecting 10 most commonly used water quality variables like dissolved oxygen (DO), pH, coliforms, specific conductance, alkalinity and chloride etc. Ramakrishnaiah et al. 2009) used water quality index to assess groundwater quality of Tumkur Taluk, Karnataka State. The various parameters discussed are as follows pH, electrical conductivity, TDS, total hardness, bicarbonate, carbonate, chloride, sulphate, phosphate, nitrate, fluoride, calcium, iron and manganese etc. are used to calculate water quality index. Muthulakshmi et al. (2013) studied inter relation of water quality parameters and determined linear regression models for highly correlated factors.

III. EXPERIMENTAL

Groundwater samples taken from tube wells and dug wells bore wells from the Khaperkheda region of Maharashtra, India during the year 2017-18 covering summer, post monsoon, and winter periods were assessed and analysed for the present study. Samples were collected in sterilized glass bottles for physicochemical analysis and also bacteriology analysis of the samples. The samples were analyzed mainly on nine parameters of water quality index (pH, Faecal coliforms, BOD, DO, Nitrate, TDS, Temperature change,Turbidity and

Total phosphate) using standard methods. Dissolved nutrients was evaluated spectrophotometrically. In bacteriological examination, faecal coliforms and total coliforms were determined by Membrane Filtration (MF) technique, and the average values were recorded. . The TC was enumerated by M-Endo Agar, (Hi-Media Mumbai) which appeared as metallic sheen colour colonies, and FC was enumerated by M-FC Agar, (Hi-Media Mumbai) which appeared as blue colour colonies. After filtration of sample, Chloride content and hardness was determined by titration method while barium chloride method was employed for the determination of sulphates. The above mentioned parameter were studied and the respective results were compared with the Indian Standard and WHO standard. The following table shows the values for various parameters mentioned as per Indian and WHO standards.

Table: Indian and WHO standard values for various parameters.

Parameters	Indian Standard	Percent compliance	WHO Standard	Percent compliance
PH	6.5-8.5	100	7-8	77
Turbidity, NTU	1	32	5	82
Total hardness as $Caco_3$ (mg/l)	300	73	100	0
Chloride (mg/l)	250	100	250	100
Total Dissolved solids (mg/l)	500	95	1000	100
Flouride (mg/l)	1	95	1	95
Sulphate (mg/l)	200	100	250	100
Nitrate (mg/l)	45	100	50	100
Iron	0.3	40	0.3	40

IV. RESULTS AND DISCUSSION

The WQI was evaluated using the method of standard Q-value of each parameter and comparing factors by using NSF information software and tallied with standard water quality rating as shown in Table 1. The minimum, maximum and average of total 24 values of WQI rating for the post monsoon, summer and winter season are presented in graphical form in Fig.4 The average WQI rating of groundwater sources in different seasons in given in Table 2.

Table 1. Water Quality Index scale recommended by NSF.

Source		Post monsoon	Summer	Winter
	Min	46	47	55
	Max	65	66	69
Dug well	Average	52.5	55.37	61
	Min	59	59	61
	Max	63	62	64
Bore well	Average	61	60.5	62.5
	Min	46	53	59
	Max	55	60	70
Hand Pump	Average	49	57.5	66.25

Table 2. Average WQI rating of groundwater sources in different season.

WQI Rating	Quality of Water
91-100	Excellent water quality
71-90	Good water quality
51-70	Medium or average water quality
26-50	Fair water quality
0-25	Poor water quality

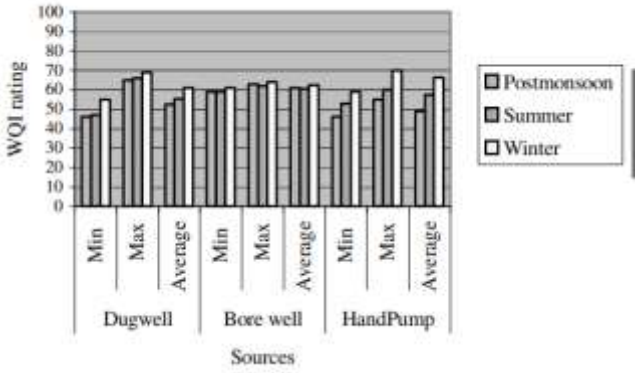

Fig.4 Graphical representation of WQI rating in all seasons.

The observed range of WQI in post monsoon was 61, 52.5 and 49 in bore wells, dug wells and hand pump respectively, in winter it was found 62.5, 61 and 66.2 in bore wells, dug wells and hand pump respectively and in summer it was 60.5, 55.4 and 57.5 in bore wells, dug wells and hand pump respectively. The water at almost all the sites showed the increasing trend of the WQI index in all seasons.

V. CONCLUSION

On the basis of the above results and discussion, it can be concluded that the underground drinking water was moderately polluted in the catchments study area and at almost every site at Industrial areas at Hingna, Butibori, Uppalwadi, and khaparkheda was found to be highly polluted as indicated by WQI. The drinking water is polluted with reference to almost all the water quality physicochemical parameters was studied.

The quality of drinking water was found to be deteriorated post monsoon.

The quality of dug well and bore well water was found better than the water of ordinary hand pumps. Therefore, the use of ordinary hand pumps should limited and cautiously used. People dependent on this source of water are often at risk to health hazards due to polluted drinking water. Therefore, some effective measures are urgently required to enhance and elucidate the drinking water quality by proposing an effective water quality management plan for the mentioned areas of Nagpur India.

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