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ASSESSING THE WATER QUALITY INDEX (WQI) OF LOHARA VILLAGE, CHANDRAPUR DISTRICT, CENTRAL INDIA

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ABSTRACT:
Water quality index alters the complex water analysis data into single digit that present the overall quality of water based on the parameters at that particular place and time. The groundwater samples were collected during the three seasons from the five sites of Lohara village, Chandrapur district. Analysis of water parameters were carried out in the Institute of Higher Learning, Research and Specialized Studies in Environmental Science, Sardar Patel Mahavidyalaya, Chandrapur. For the endurance of any species on the earth the most essential necessity is water. This requirement is fulfilled through surface and groundwater. In India a major portion of population i.e. approximately 80% depends on the groundwater and is considered as one of the major sources for various purposes. The present study focus on the physical and chemical parameters of the groundwater of Lohara village located in Chandrapur District. The samples were collected from the five different sites during the three seasons and their physical and chemical parameters were analyzed. On the basis of the results, the water quality index was determined. In water quality index, value below 25 indicates the water quality as excellent, value between 26-50 represent good water quality, among 51-75 indicates poor water quality, very poor water quality values exist between 76-100, while above 100 value in the water quality index shows that the water is unsuitable for drinking purpose. It is concluded that the seasonal variation slightly influenced the physico-chemical characteristics of study area. According to the Water quality Index, it is revealed that in all the three seasons that are summer, monsoon and winter, the water quality was found to be 103.29, 97.47 and 106.46 respectively indicating in summer and winter the groundwater was unsuitable for drinking while in monsoon the quality of groundwater was very poor of Lohara village, Chandrapur district.

Keywords: - Water Quality Index, Groundwater, Seasons variation, Lohara village, Chandrapur district.

INTRODUCTION :

An important ecological resource located below the land is the groundwater mainly used by urban and rural community for various activities (Singh *et al.*, 2008). In many countries for the development of rural area a major aspect that considered is groundwater (Foster *et al.*, 2022). From the past decade, the withdrawal of groundwater in rural areas has increased (Nowak and Imperowicz-Pawlaczyk, 2018). However, a statement was given by World Health Organization, 2011 that 80% of infection originated by water in human beings (WHO, 2011). The quality of groundwater depends on the place as it does differ as per their location which directly affects the suitability of its consumption (Jain *et al.*, 1995). Groundwater quality degraded by natural but mostly by anthropogenic activities (Nowak and Imperowicz-Pawlaczyk, 2018). Waste generated through domestic, commercial, and industrial while the augmented use of fertilizers and pesticides are the major intimidation to groundwater (Ofodile, 2002). Lack of awareness and maintenance in rural areas near to groundwater sources leading to its contamination. In rural areas, domestic activities like cloth washing, utensil washing, bathing, cattle drinking escort to discharge of

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pollutant in groundwater (Rajankar *et al.*, 2011). Groundwater contamination can create a severe health hazards (Yadav *et al.*, 2015). Groundwater quality varies on the basis of place, depth and season as the processes and reactions started from the moment it condensed in the environment to its discharged by the well acted on the water (Aher *et al.*, 2020).The quality of water depends on the factors varied with seasons (Xu *et al.*, 2019). Hence, it is an essential to investigate about the annual period in which season the groundwater quality was mostly affected by the pollution (Ishaku, 2012). The main objective of the study was to estimate the groundwater quality and seasonal effect on physicochemical characteristics of groundwater in rural area.

MATERIALS AND METHODS :

Study Area

Lohara positioned in Chandrapur district, is a medium sized village, belong to the Vidarbha region of Maharashtra, Central India. As per the geography terms, it is located between 20.750415 North latitude and 76.77465 East longitude (Lohara- WikiEdit.Org, 2022). It is located 5 km far from district headquarter Chandrapur. The total geographical area occupied by the village is about 430.07 hectares, having a population of about 1468 as per Census 2011 (Indian Village Directory, 2022).

Sampling and Analysis

To assess the groundwater quality water samples were collected from the five different sites of the Lohara village in three seasons, i.e., summer, winter and monsoon during 2019 - 2020. The samples were collected in clean polyethylene bottles and analyzed for different physical and chemical parameters using methods prescribed by the Standard methods for Examination of Water and Waste Water 18th Edition 1992, American Public Health Association (APHA) and National Environmental Engineering Research Institute (NEERI) manual.

A physicochemical analysis was carried for 11 different parameters such as pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS),Turbidity, Total Hardness (TH), Total Alkalinity (TA), Chloride, Iron, Sulphate, Nitrate and Flouride to estimate the water quality index of groundwater. The pH of groundwater samples was measured by using Microprocessor based model pH system ESICO 1012. Electrical Conductivity and TDS were carried on Microprocessor based Conductivity/TDS meter model ESICO 1601. Turbidity of samples was determined by Digital Turbidity meter model EI 33. Total Hardness, Total Alkalinity and Chloride of samples were analysis by titration. The concentration of Iron, Sulphate, Nitrate and Flouride in groundwater samples from selected sites was estimated by using Double Beam UV-Visible Spectrophotometer Model EI 1372. Iron was determined by using O- phenanthroline method, Sulphate by Barium Chloride method, Nitrate by Phenoldisulphonic acid (PDA) method and Flouride by SPADNS method.

Water Quality Index (WQI) system

A most universal method used for analyzing the quality of water and its fitness for different uses is Water Quality Index (Sadiq *et al.*, 2010). Water quality Index is obtained by calculating Weighted Arithmetic Index method developed by Brown *et al.*, 1972. Its calculation included three steps are as follow below:

Step 1: Calculate the unit weight (Wn) factors for each parameters by given formula

$$\text{Where, } K = \frac{1}{1/S1 + 1/S2 + 1/S3 + \ldots\ldots\ldots\ldots + 1/Sn} \qquad Wn = K/Sn = \frac{1}{\sum 1/Sn}$$

Sn: Standard desirable value of the number of parameter.

On summing up of all selected parameters unit weight factors, Wn=1 (unity).

Step 2: Calculate the Sub Index (Qn) value by given formula

Qn = [(Vn-Vo)] / [(Sn-Vo)]×100

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Where, Vn : Mean concentration of number ofparameter

Sn: Standard desirable value of number of parameter

Vo: Actual values of the parameter in pure water (Vo=0) for most of the parameter except for pH (Vo=7).

Step 3: Combine Step 1 and Step 2 and WQI is calculated as given below

Overall WQI= ∑WnQn/ ∑Wn

RESULT:

The values recorded range and average values of the seasonal variation in physicochemical analysis of Summer, Monsoon and Winter for Lohara village are presented in Table 2.

The standards values of water parameters for drinking purposes mentioned by Bureau of Indian Standard (BIS) (IS 10500:2012) and the Indian Council of Medical Research (ICMR) 1975, were used for the calculation of WQI giving in Table 3.

The value of Water Quality Index for three season showed that 60. 27 for summer, 55.86 for monsoon, and for 52.26 for winter respectively, showing poor status of water.

DISCUSSION :

The analysis of physicochemical parameters of groundwater samples collected from Lohara village from the study sites during the three seasons showed that the parameters like pH, Electric Conductivity, Total Dissolved Solids and Sulphate on basis of average values was found to be higher during summer season of study period. Similar results seemed in Adnani *et al.,* 2020 were maximum value obtained in dry season of parameters such as pH, Electric conductivity, Total Dissolved Solids, while in Yadav, 2015 studies show that the concentration of Sulphate was found higher in pre- monsoon season. Turbidity and Total Hardness of ground water samples found to be maximum in monsoon season related as Rajankar, 2011 for turbidity and Jhariya *et al.*, 2018 for total hardness. During winter of the study period, Chloride, Iron and Nitrate found to be higher in concentration of groundwater samples comparable with Rajankar 2011 results of season variation in groundwater study. The Water Quality Index (WQI) was also little seemed to be varied as per seasons. In both season such as summer and winter the status of groundwater was unsuitable for drinking while in monsoon it was very poor in quality.

CONCLUSION :

The study focus on assessing the quality of groundwater of Lohara village located in Chandrapur district and also the impact of seasonal variation on some selected physic-chemical characteristics of groundwater. The study shows that groundwater of selected sites was between the slightly alkaline to neutral in nature. The most of parameters such as electric conductivity, total dissolved solids, turbidity, chloride, sulphate and nitrate are found in limited permissible limit in the groundwater samples. While 100% samples were above the permissible limit as mentioned for total hardness, 53% samples for total alkalinity and iron. A slight variation observed in the parameters on the basis of three seasons. However, on an average the water quality of groundwater in Lohara village was considered as very poor quality due to total hardness and iron concentration present in groundwater.

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Table 1: Water Quality Index (WQI) and status of the water

Sr. No.	Water Quality Index level	Water Quality Status
1	0-25	Excellent
2	26-50	Good
3	51-75	Poor
4	76-100	Very Poor
5	Above 100	Unsuitable for Drinking Purposes

Source: Brown *et al.*, (1972)

Table 2: Seasonal Variation in Physico-Chemical Characteristics of Groundwater

Parameter	Summer			Monsoon			Winter		
	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average
pH	6.7	7.5	7.02	6.3	7.10	6.78	6.3	7.1	6.72
EC (µS/cm)	229	276	253.6	211	260	233.8	218	269	241.6
TDS	146.56	176.64	162.3	135.04	166.40	149.6	139.53	172.16	154.6
Turbidity (NTU)	4.3	4.5	4.4	4.6	4.8	4.72	4.5	4.7	4.58
Total Hardness	268	432	333.6	296	440	352.8	252	400	322.4
Total Alkalinity	156	248	200.8	196	236	208.8	156	252	208.8
Chloride	12	17.99	15.19	16	19.99	18.39	16	33.99	20.79
Iron	0.22	0.41	0.34	0.19	0.41	0.30	0.22	0.43	0.35
Sulphate	64.06	84.08	73.17	54.01	72.97	63.23	60.10	79	68.88
Nitrate	10.17	19.97	15.16	8.96	18.48	13.78	9.8	21.6	15.44
Flouride	0.59	0.95	0.77	0.67	1.13	0.85	0.60	0.98	0.78

***All values except pH, EC and turbidity are in mg/l**

Table 3: Standards for Drinking water, BIS Standard (IS 10500:2012) and ICMR, 1975

Sr. No.	Parameter	Standard Value	Recommended Organization
1	pH	6.5-8.5	ICMR/BIS
2	EC (µS/cm)	300	ICMR
3	TDS (mg/l)	500	ICMR/BIS
4	Turbidity (NTU)	5	BIS
5	Total Hardness (mg/l)	200	BIS
6	Total Alkalinity(mg/l)	200	BIS
7	Chloride(mg/l)	250	ICMR/BIS
8	Iron(mg/l)	0.3	BIS
9	Sulphate(mg/l)	200	BIS
10	Nitrate(mg/l)	45	BIS
11	Flouride(mg/l)	1.0	BIS

Table 7: Comparative analysis of WQI of groundwater during three season of Lohara Village

Sr.No.	Season	WQI Value	Quality
1	Summer	103.29	Unsuitable for Drinking Purposes
2	Monsoon	97.47	Very Poor
3	Winter	106.46	Unsuitable for Drinking Purposes

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