PRINT ISSN 2319-1775 e-ISSN 2320-7876, www.ijfans.org
Volume.11, Issue13, Nov- 2022
Research Paper

UGC CARE Listed (Group -I) Journal

Groundwater Analysis of Pune City in the Mutha River Watershed, Pune District Maharashtra

Pacharne Sunil.B[1],Barakade Ankush.J[2].

[1]Research Scholar, Department of Geography Mahila Mahavidyalaya, Karad. [2]Department of Geography Dahiwadi College Dahiwadi, Satara.

[2]Research Guide Prof., Affiliated to the University of Shivaji Kolhapur, Maharashtra, India.

Email- sunil443977@gmail.com,

Abstract

The water quality index is foremost important for all people to understand the quality of water on an interval scale. In this work has attempted on the third level of assessment to find out groundwater quality status of Pune city in the Mutha river watershed area. In this study, groundwater samples were collected post, and pre monsoon 2020 and 2021. The hydrochemical parameters were selected for this work like pH, TDS, CI, TH, ALKY, SO_4, NO_3, Ca, Mg. The water quality index (WQI) has calculated through the Weighted Arithmetic Water Quality Index (WAWQI) method. The minimum and maximum index values were observed the range between 27 to 55 respectively. This study concluded that the growth of urbanization as well as natural factors has an affected groundwater quality.

Keyword: Groundwater, Analysis, Watershed, WAWQI.

1. Introduction

The water quality index plays a vital role in categories water on the basis of their quality in numeric form, for this the first attempted to form of WQI was made by Harton (1965). The groundwater is readily available to all people for various purposes, whether drinking quality groundwater is limited. The earth's surface has covered by volume of water 1.4 billion cubic kilometres, the saline water 97.5 percent of water, while amount of quality water is very few percent which is 1.76 %, (Kizar 2018). The India has an erratic monsoon nature, most of the cities are dependent on reservoir water but during the summer season the water level of reservoir decreases so citizens face problem of drinking as well as domestic water, in the Ethiopia over 60 % communicable diseases are spreading due to insufficient water supply (Meride 2016). The groundwater is a primary potential source of drinking water so citizens need to be aware of the groundwater quality status, the rapidly growing economy due to globalization has direct and indirect effects on groundwater quality and the natural environment. The most of the industrial effluents and crop management, sewage, excessive effluent and human activities are might responsible for groundwater pollution. Kupwade & Langade (2013); Lodhi et al. (2022). The assessing water quality status WQI is the vital rating scale of various water parameters to indicate the compound effect of water (Mohammed 2013). The surface water quality can be easily detected by monitoring but groundwater is difficult to detect quality as it is a hidden source, so regular periodic monitoring is required to understand the status of groundwater quality. The objective of this study is to find out the quality of groundwater and its suitability for human consumption based on Weighted Arithmetic Water Quality Index (WAWQI).

2. Study Area

The study area located in the Mutha basin it is a part of the Pune city. The area extent from 18^0 17'N latitude to18^0 31'N latitude and 73^0 25E to 73^0 53E longitude, total area cover by Pune city in the Mutha watershed is 147 sq., km. It is the eastern part of the Mutha watershed which is rapidly spreading in the watershed area. This part covers the area from confluence point of Mula-Mutha to Khadakwasla reservoir, this study part administrated by under the control of the Pune Municipal Corporation (PMC).

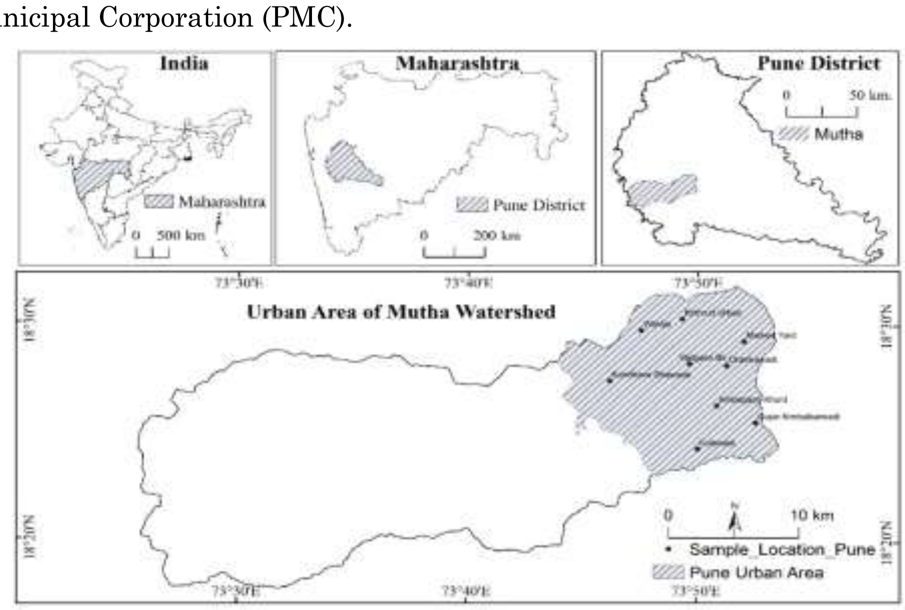

Fig. 1: Study area

3. Material and Methodology

3.1 Data Used

In this study, average data from post-monsoon 2020 and pre-monsoon 2021 have been used respectively. The nine hydrochemical parameters were selected for analysis which are pH, TDS, Cl, $CaCO_3$, Alkalinity, SO_4, NO_3, Ca, Mg and all were analysed on the third level with standard procedures.

3.2 Methodology

The Weighted Arithmetic Water Quality Index (WAWQI) method has used to assess water quality of the study area for drinking purpose. The selection of parameters based on the background of the study area, purpose and surrounding environment on that basis nine parameters have selected for groundwater analysis. The water samples were collected using 500 ml plastic container with the nine locations S1 to S9 (figure 1and 2) during November-December 2020 and May June 2021 during post-monsoon and pre-monsoon respectively, collected samples were analyzed on the third level of testing with standard of IS: 10500:2012. The calculation of water quality index obtains by steps of Weighted Arithmetic Water Quality Index method first calculate the unit weight of all parameters and bring them all to equal weight by the equation W_n =K/Si, K=1/(∑(1/Si)). In second step subindexes were calculated to assign quality ratings according to their concentration in water through the equation $Q_n = 100[(V_n-V_i)/(S_n-V_i)]$, In the third step as the water quality of each parameter was calculated by the equation $WQI=Q_nW_n/W_n$, all values vary between 0 to 100 and all water quality indices were calculated by the equation $WQI = \sum Q_nW_n/\sum W_n$, this calculated index was classified into five classes according to Brown et al 1972.

Table 1. Water quality index

Range	**WQ status**	**Use**
0-25	Excellent	Drinking, Irrigation and Industrial
26-50	Good	Domestic, Irrigation and Industrial
51-75	Poor	Irrigation
76-100	Very Poor	Restricted use for Irrigation
Above 100	Unsuitable	Proper treatment required before use

*(**Source:** Brown et al. 1972, Gangwar, et al. 2013, Tyagi, et al. 2013)*

3.3 Steps of applied formula's

For assign unit weightage formula- $W_n=K/S_n$ ………………… (1) Whereas, W_n = unit weightage for nth parameter, S_n = standard permissible value of nth parameter as per BIS or WHO, K = constant for proportionality K, proportionality constant is derived from, $1/S_n$

$K=1/(\sum 1/S_n)$ ………………………… (1a)

For Calculation the sub index values or quality rating (Q_n)

Formula-$Q_n = 100[(V_n-V_i)/(S_n-V_i)]$ …………………… (2)

Whereas, Q_n = quality rating for the n^{th} water quality parameter, V_n = mean estimated value of the n^{th} parameter, V_i = ideal value of n^{th} parameter in pure water, S_n = standard permissible value of n^{th} parameter as per BIS or WHO. All the ideal values (V_i) are taken as zero for drinking water exception of pH, the pH ideal value = 7.0 (Tripathy and Sahu 2005). W_n*Q_n ……………………… (2b)

For Calculate the overall (WQI) values

Formula- $WQI=\sum W_nQ_n/\sum W_n$ …………………………… (3)

3.4 Statistical analysis

The Karls Pearson correlation analysis technique has used through SPSS 26 software. The strong positive correlations were found between the parameters which are: TDS- $CaCO_3$, Alkalinity, SO_4, Ca, Mg; $CaCO_3$ - Alkalinity, SO_4, Ca, Mg; Alkalinity - SO_4, Ca and Mg; SO_4 - Ca and Mg and Ca - Mg. Whereas negative correlations were observed in (table 5) pH and Cl, exception of NO_3 and SO_4 respectively, all parameters were analysed at the significance level of 0.01 and 0.05.

4. Result

Table 2. Mean values of Post-monsoon and Pri-monsoon 2020-2021

Si. Code	**PH**	**TDS**	**Cl**	**$CaCO_3$**	**ALKY**	**SO_4**	**NO_3**	**Ca**	**Mg**
S1	7.4	365	20.95	321.5	318	26	3	79.5	29
S2	7.6	214.5	36.5	27.5	81.5	15	2.1	6.9	2.4
S3	7.4	422	36.5	326.5	360	37.5	3.65	68	37.5
S4	7.7	283.5	74	230	225.5	24	2.7	54	23
S5	7.3	299	33.5	220.5	214.5	18.5	3	43.5	27
S6	7.6	310	25	243	260.5	22	7.25	50.5	28.5
S7	7.5	349	50	256	231.5	30	2.55	65.5	18.5
S8	7.4	473.5	44.5	370.5	361	39	3.55	80	40.5
S9	7.2	422.5	38.5	365.5	322	40.5	3.25	86.5	36

PRINT ISSN 2319-1775 e-ISSN 2320-7876, www.ijfans.org
Volume.11, Issue13, Nov- 2022

UGC CARE Listed (Group -I) Journal

***(Source:** Computed by researcher)*

Table 3. Unit weightage

Parameters	**IS standard Sn**	**1/Sn**	**Wn=K/Sn**	**Ideal value (V_i)**	**Mean. value site 1 (Vn)**	**Vn/Sn**	**Quality rating (Q_n) Vn/Sn*100**	**$W_n Q_n$**
pH	8.5	0.1176	0.5669	07	7.4	0.2666	26.66	15.11
TDS	500	0.0020	0.0096	0	365	0.7300	73.00	0.70
Cl	250	0.0040	0.0193	0	20.95	0.0838	8.38	0.16
$CaCO_3$	200	0.0050	0.0241	0	321.5	1.6075	160.75	3.87
ALKY	200	0.0050	0.0241	0	318	1.5900	159.00	3.83
SO_4	200	0.0050	0.0241	0	26	0.1300	13.00	0.31
NO_3	45	0.0222	0.1071	0	3	0.0660	6.67	0.71
Ca	75	0.0133	0.0642	0	79.5	1.0600	106.00	6.81
Mg	30	0.0333	0.1606	0	29	0.9666	96.67	15.53
∑1/Sn =0.2074			**∑Wn=1**				**∑ W_nQ_n= 47.04**	
K=1/(∑1/Sn) = 4.8184								

***(Source:** Computed by researcher)*

Table 4. Groundwater quality index of the study area

Sr. No.	**Site code**	**Site Name**	**Index**	**Status**
1	S1	Gujarnibalkarwadi	47.04	Good
2	S2	Kolewadi	27.24	Good
3	S3	Kothrud	51.70	Poor
4	S4	Warje-Malwadi	50.92	Poor
5	S5	Dhankawadi	36.53	Good
6	S6	Market-Yard	51.10	Poor
7	S7	Ambegaon-Kurdh	42.31	Good
8	S8	Kondhave-Dhavade	55.03	Poor
9	S9	Vadgaon-BK	44.88	Good

***(Source:** Computed by researcher)*

Table 5. Karl Pearson correlation Matrix

	pH	TDS	Cl	$CaCO_3$	ALKY	SO_4	NO_3	Ca	Mg
pH	1								
TDS	-0.638	1							
Cl	0.433	-0.095	1						
$CaCO_3$	-0.612	.925**	-0.061	1					
ALKY	-0.537	.932**	-0.148	.967**	1				
SO_4	-0.524	.941**	0.101	.854**	.842**	1			
NO_3	0.143	0.112	-0.402	0.212	0.286	0.015	1		
Ca	-0.591	.883**	-0.021	.976**	.913**	.842**	0.109	1	
Mg	-0.577	.883**	-0.128	.936**	.955**	.776*	0.361	.838**	1

***. Correlation is significant at the 0.01 level (2-tailed)*

**. Correlation is significant at the 0.05 level (2-tailed), N=9*

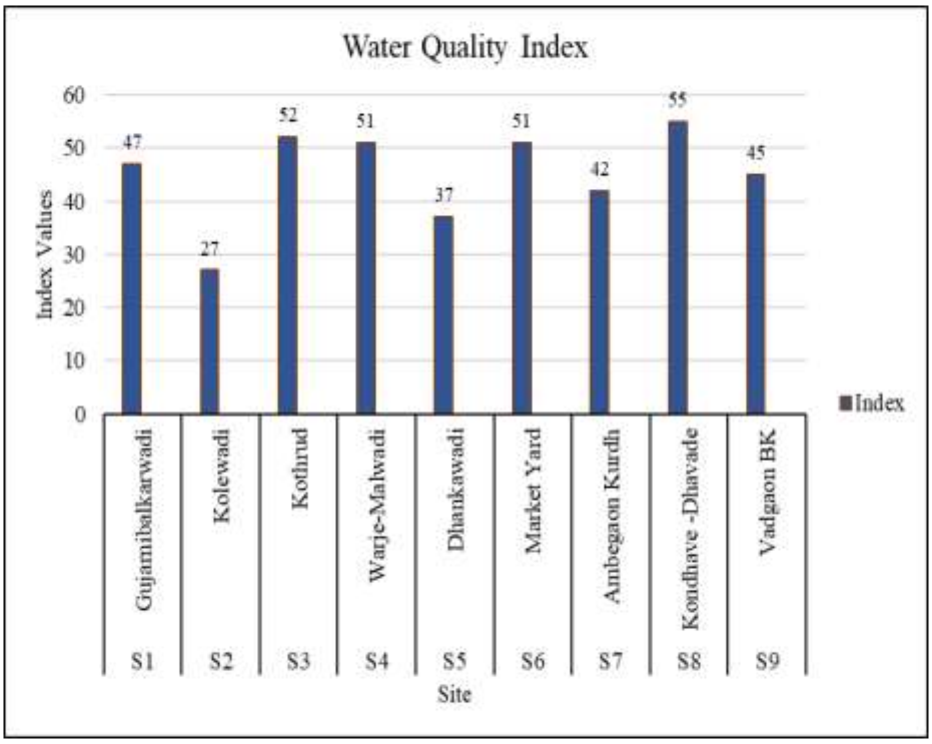

Fig. 2: Groundwater quality index of the study area

5. Discussions

The water quality index is very useful to describe water quality of surface water as well as groundwater, in this study WAWQI has used for the groundwater assessment, this index has divided in to five class (table 1), and varies from zero to above hundred for different purpose. The post and pre monsoon samples were collected and analyzed in approved laboratories with Indian standard (IS) on the third level of analysis, and both seasons mean values were considered for calculation table 2, these values have used in a formula as (Vn) mean estimated value, (Vatkar et al. 2021). In this mean value table has observed $CaCO_3$ and alkalinity were exceeded of Indian standard (IS) limit in all site exception of Kolewadi site (S2) while the maximum concentration of Ca has found in the site of Gujarnibalkarwadi (S1) and Kondave-dhawade (S8), and Vadgaon-Bk (S9), while Mg was exceeded limits in Kothrud (S3), Kondave-dhavade (S8) and Vadgaon Bk (S9) as per Indian standard table 2 and 3. In the table 3 have calculated site Gujarnibalkarwadi (S1) index which is 47 has good quality of groundwater, as per this all site index were calculated in the table 4 which is 27.24, 51.70, 50.92, 36.53, 51.10, 42.31, 55.03 and 44.88 were classified them into interval scale, in the study area groundwater quality were found among good to poor which is depicted in table 4 and figure 2 among the nine site Kolewadi was lowest index which is 27.24 and Kondhave-dhawade was heights index which is 55.03, The result showed that the urban centers are responsible for groundwater quality degradation like Kothrud, Market Yard, and Warje-Malwadi areas in the study area, this result was similar to Tikle et al. 2012. Although Dhankawadi is part of urban core, its WQI was better than other core sites, which means that natural factors also affect groundwater quality. The groundwater quality was found to be good in places away from urban centers such as Gujranibalkarwadi, Kolewadi, Ambegaon-Khurd, while Kondve-Dhavde was found to be poor in quality of groundwater even though it was far from urban centers. In table 5 the Karl Correlation Matrix depicts the correlation as weak, strong and very strong, here TDS, $CaCO_3$, Alkalinity, SO_4, Ca and Mg has a very strong positive correlation with other parameters exception of pH, Cl and NO_3 whereas pH and Cl were observed mostly negative correlation with others parameters table 5. However according to Indian standard (IS) all-study area have found total hardness and Alkalinity exceeded limit exception of Kolewadi site (S2).

6. Conclusion

Most of the urban centers are responsible for groundwater quality degradation like Kothrud, Market Yard, Warje-Malwadi etc. areas in the study area. Although Dhankawadi is part of urban core, its WQI was better than other core sites, which means that natural factors also affect the groundwater quality. The groundwater quality was found to be good in places away from urban centers such as Gujranibalkarwadi, Kolewadi, Ambegaon-Khurd, while Kondve-Dhavde was found to be poor in quality of groundwater even though it was far from urban centers. This study concluded that most of the urbanization detreating the quality of groundwater, and hand in hand natural factors also responsible to bring positive or negative change in groundwater. In the study area no any one site is suitable for drinking propose, while Gujarnibalkarwadi, Kolewadi, Dhankawadi and Ambegaon Khurd site is suitable for domestic, irrigations' and industrial propose while Khothrud, Warje-Malwadi, Market-Yard and Kondhave-dhavade are suitable only for irrigations. The sites in the study area which have good groundwater quality are on the verge of deterioration, and those who are poor groundwater quality are on the verge of becoming very poor.

PRINT ISSN 2319-1775 e-ISSN 2320-7876, www.ijfans.org
Volume.11, Issue13, Nov- 2022

UGC CARE Listed (Group -I) Journal

7. Acknowledgement

The authors would like to express their gratitude to the CSMNRF for providing funding for this study, and thanks to University of Shivaji, Kolhapur, for providing the necessary facilities for this research.

References

1. Brown, R.M., Mcclell, N. I., Deininger, R.A., Tozer, R.G. (1970). A water quality index: do we dare? Journal of Water & Sewage Works, vol. 117, 339-343.
2. Gangwar, R. K., Singh, J., Singh, A. P., & Singh, D. P. (2013). Assessment of Water Quality Index: A Case Study of River Ramganga at Bareilly U.P. India. International Journal of Scientific & Engineering Research, Volume 4, Issue 9, ISSN 2229-5518, 2325-2329.
3. Horton, R. K. (1965). An index number system for rating water quality. J Water Pollut Control Fed, 37(3), 300-306.
4. ISI, Indian standard specification for drinking water. IS: 10500 (2012) Bureau of Indian Standard, New Delhi.
5. Kizar, F. M. (2018). A comparison between weighted arithmetic and Canadian methods for a drinking water quality index at selected locations in shatt al-kufa. IOP Conference Series: Materials Science and Engineering 433.
6. Kupwade, R. V., & Langade, A. D. (2013). Pre and post monsoon monitoring of ground water quality in region near Kupwad MIDC, Sangli, Maharashtra. International Journal of ChemTech Research, 5(5), 2291–2294.
7. Lodhi, S., Agarwal, A. K., & Scholar, M. T. (2022). Development of Water Quality Index of Sindh River by using Weighted Arithmetic Method at Dabra. 7(1), 609–614.
8. Meride, Y., & Ayenew, B. (2016). Drinking water quality assessment and its effects on residents' health in Wondo genet campus, Ethiopia. Environmental Systems Research, 5(1), 1–7.
9. Mohammed R. A. (2013). Water Quality Index for Basrah Water Supply. Eng. Tech. J. 31 15438.
10. Tikle S, Saboori M.J, Sankpal R. (2012). Spatial Distribution of Ground water Quality in Some Selected parts of Pune city, Maharashtra, India using GIS. Current World Environ 7(2), 281-286.
11. Tripathy J. K. and Sahu, K. C. (2005). Seasonal hydrochemistry of groundwater in the barrier-spit system of Chilika lagoon, Journal of Environmental Hydrology, Vol. 12 (7), 1-9.
12. Tyagi, S., Sharma, B., Singh, P., Dobhal, R. (2013). Water quality assessment in terms of water quality index. American Journal of Water Resources, 1(3), 34-38.
13. Vatkar, Y. S., Vatkar, S., & Vatkar, A. S. (2016). Assessment of WQI by Weighted Arithmetic Index Method for Engineering Colleges in Kolhapur City, Maharashtra, India. 6(8), 2919-2927.