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WATER QUALITY INDEX METHOD FOR QUALITY ASSESSMENT OF DUG WELL SAMPLES OF PERAYAM PANCHAYATH, KOLLAM DISTRICT, KERALA

P.G. REJI[a1] AND SABU JOSEPH[b]

[ab]Department of Environmental Sciences, University of Kerala, Karyavatom, Thiruvanathapuram, Kerala, India

ABSTRACT

Water quality indices (WQI) were introduced with the aim of reducing great amount of parameters into a simpler expression and enabling easy interpretation of monitoring data. In the present study Water quality of ground water samples of Peryam Grama Pachayath (PGP)evaluated by Water Quality Index (WQI) technique , in order to assess the suitability of water from different areas of the Panchayath. It was calculated that serious water quality concerns exist in the groundwater samples representing the northeastern, eastern and western segments of PGP, near Onambalam, Peryam and Padappakkara.

KEYWORDS: Physico-Chemical Parameters, Water, Water Quality Index

Perayam Gramma Panchayath (PGP) is one among the 70 gramma panchayaths in Kollam district of Kerala, India. PGP belongs to the Chittumala block panchayath, and is bounded by East Kallada Gramma Pachayath in the north, Kundara Gramma Panchayath in the east, Perinad and Panayam Gramma Panchayaths in the south and Mantrothuruthu Gramma Panchayath in the west (Fig.1). The PGP has an area of 15.48 km^2, which is divided into 14 wards.

As a result of increased population growth, industrialization and modern agricultural practices, groundwater resource faces severe challenges with respect to quantity as well as quality. Being connected with human health and social welfare, groundwater quality has vital importance, especially in the coastal areas worldwide. In respect of groundwater, the chemical composition of groundwater in coastal region is determined by the unique physical, chemical, and biological systems of the environment. The WQI concept was proposed by Horton (1965) using the weighted arithmetic index method, and provides the combined influence of various water quality parameters on the overall quality of water. In order to compute the WQI for groundwater samples of PGP, methodology discussed by several researchers (Horton, 1965; Pradhan et al., 2001; Dwivedi and Pathak, 2007; Saeedi et al., 2010; Yidana and Yidana, 2010; Manjusree, 2014) was used.

MATERIALS AND METHODS

Dug well water samples (N=20, DW1 to DW 20) were collected during monsoon (MON), post-monsoon (POM) and pre-monsoon (PRM) seasons in 2008 and 2009. The samples were collected in HDPE bottles, prewashed with 1N HCl, followed by double distilled water two to three times prior sampling using sampling water. Before acquisition of the groundwater sample from the dug well, the sample bottles were pre-rinsed (two to three times) with sample water. Further, the collected samples were transported to laboratory for further chemical analyses. Whatman No. 42 filter papers were used to remove the suspended sediments/grit particles in the samples, and the filtrate was used for screening various physico-chemical parameters following the methods of APHA (Eaton et al., 2005). Appropriate techniques were applied for preservation of the samples for various analyses in the lab.

RESULTS AND DISCUSSION

In general, WQI is derived in five stages, and in the first stage, the water quality parameters relevant to the study area were chosen (i.e., pH, TDS, Ca^{2+}, Mg^{2+}, Na^+, K^+, Cl^- Fe, TC, FC, Pb and Cr) and assigned a weight (w_i) based on the relative importance and their perceived effects on primary health (Table 1). For this, a scale of 1-5 was used, where a maximum weightage of 5 was given to pH and FC, while a score of 4 was given to TDS, Cl^-, Pb and Cr. Other parameters were also assigned weightages depending on their importance in the overall quality of water for drinking purposes.

In the second stage, relative weight of each parameter has been calculated by using the Eq (1):

$$W_i = \frac{w_i}{\sum_{i=1}^{n} w_i} \qquad (1)$$

where, W_i is the relative weight of i^{th} water quality parameter, wi is the weightage of i^{th} parameter, n is the number of water quality parameters used. The w_i and W_i values of each water quality parameter are given in Table1.

In the third step, a quality rating scale (q_i) was calculated for each water quality parameter using Eq. (2):

[1]Corresponding Author

$$q_i = \frac{C_i}{S_i} \times 100 \qquad (2)$$

where, q_i is the quality rating of i^{th} water quality parameter, C_i is the concentration of i^{th} parameter for each water sample and S_i is the water quality standard for i^{th} parameter.

In the fourth stage, a WQI sub index was calculated for all the water quality parameters using Eq. (3):

$$SI_i = W_i \times q_i \qquad (3)$$

In the final stage, all the sub indices were integrated to calculate the WQI for a water sample from a particular location (Eq.4):

$$WQI = \sum_{i=1}^{n} SI_i \qquad (4)$$

The WQI calculated for the groundwater samples of PGP for the three sampling seasons, viz., MON, POM and PRM is presented in Table 2. During MON, the WQI for the groundwater samples vary from 1341 (DW4) to 11461 (DW14), during POM, the range is between 555 (DW20) and 3239 (DW9), and during PRM it varies between 563 (DW6) and 2655 (DW9). Except during MON, DW9 shows high value for WQI, indicating the high loading of the water quality parameters.

WQI values can be categorized into five groups (after Manjusree, 2014) as excellent, good, poor, very poor and unfit for drinking (Table3).The classification scheme was chosen in this study because of the similarity in the environmental settings of the study area. According to the classification scheme, WQI < 50 is designated as 'excellent' water for drinking purposes, while WQI between 50 and 100 is considered as 'good', 101 to 200 as 'poor' and 201 to 300 as 'very poor'. Further, WQI greater than 300 is considered as unsuitable for drinking purposes. Even though all the groundwater samples have high WQI than the threshold for drinking water purpose, spatial variation of WQI of groundwater samples was generated using spatial interpolation techniques (Inverse distance Weighted method) in ArcGIS 9.3 to identify the spatial controls, if any, of water quality deterioration and is given as Fig.2 to 4. In general, serious water quality concerns exist in the groundwater samples representing the northeastern, eastern and western segments of PGP (i.e., near Onambalam, Peryam and Padappakkara).

In PGP, all the water samples have WQI greater than 300 in all the sampling seasons, implying that the water samples are not suitable for drinking purposes. Although the chemical quality of the groundwater samples seems satisfying, the microbial contamination and the elevated levels of heavy metals made them unsuitable for drinking purposes. Further, pH as well as Fe content in the water samples is also responsible for such high WQI of the groundwater samples.

Table 1: Unit weightage of parameters based on drinking water standards.

Sl. No.	Parameter	WQ Standard	Weightage (w_i)	Unit weightage (W_i)
1	pH	6.5 - 8.5	5	0.125
2	TDS	500	4	0.100
3	Ca^{2+}	75	2	0.050
4	Mg^{2+}	30	2	0.050
5	Na^{+}	200	2	0.050
6	K^{+}	10	2	0.050
7	Cl^{-}	250	4	0.100
8	Fe	0.3	3	0.075
9	TC	0	3	0.075
10	FC	0	5	0.125
11	Pb	0.01	4	0.100
12	Cr	0.05	4	0.100
Total			40	1.00

Table 2: WQI of dug well samples of PGP during different sampling seasons

Sample ID	MON	POM	PRM
DW1	4304	1519	1215
DW2	5433	1246	1102
DW3	3136	885	763
DW4	1341	891	704
DW5	2881	1080	868
DW6	1973	974	563
DW7	2464	775	775
DW8	3375	920	751
DW9	8801	3239	2655
DW10	7944	2470	2188
DW11	7564	1330	1009
DW12	9968	1387	1627
DW13	8463	2337	2137
DW14	11461	1378	1952
DW15	3393	1678	1772
DW16	4284	1352	1620
DW17	4575	1039	944
DW18	3691	788	932
DW19	2135	693	780
DW20	3833	555	872

Table 3: Classification of quality of water in dug wells based on WQI.

WQI	Class	MON	POM	PRM
< 50	Excellent	-	-	-
50-100	Good	-	-	-
101-200	Poor	-	-	-
201-300	Very poor	-	-	-
> 300	Unsuitable	20	20	20

Figure 1: PGP and adjacent gramma panchayaths in Kollam district, Kerala

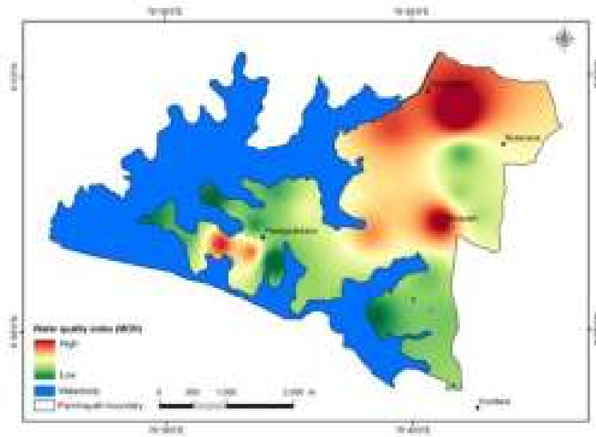

Figure 2: Spatial distribution of WQI of groundwater samples of PGP during monsoon

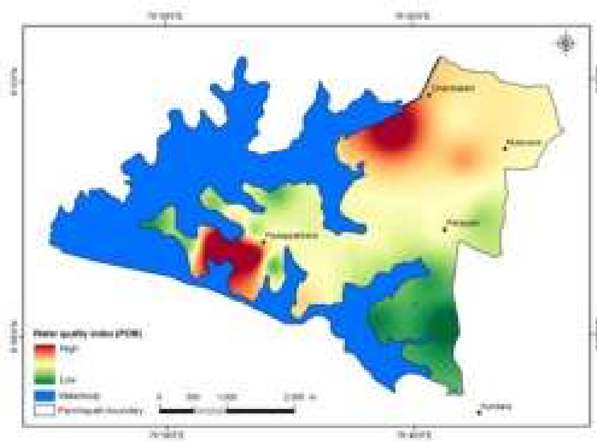

Figure 3: Spatial distribution of WQI of groundwater samples of PGP during post monsoon

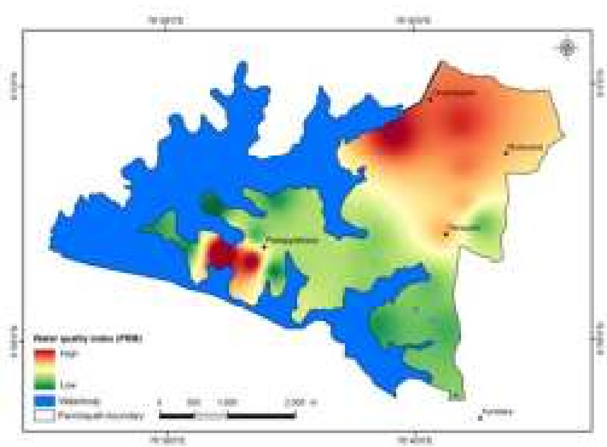

Figure 4: Spatial distribution of WQI of groundwater samples of PGP during pre monsoon

CONCLUSION

The WQI of MON samples are significantly high (*$p \leq 0.05$*), compared to POM and PRM samples, while POM and PRM samples do not show a significant difference in WQI. Such high WQI values during MON might be the result to the leaching of pollutants through the recharging process during heavy monsoon rainfall. Hence, suitable measures need to be taken for removal of microbial contamination, heavy metals and also for pH buffering, for using the water for drinking and cooking purposes.

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REFERENCES

Dwivedi S.L. and Pathak V., 2007. A preliminary assignment of water quality index to Mandakiniriver, Chitrakoot. Indian J. of Environ Protection, **27**:1036–1038.

Eaton A.D., Clesceri L.S., Rice E.W., Greenberg A.E. and Franson, 2005. Standard methods for the examination of water and wastewater, 21st Edition. American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Environment Federation (WEF), M.A.H. Eds.

Hem J.D. and Durum W.H., 1973. Solubility and occurrence of lead in surface water. J. American Water Works Association, **65**:562-568.

Manjusree T.M., 2014. Studies on groundwater characteristics of Chennam-Pallipuram and Thykkattussery Panchayat, Alappuzha district, Kerala. Ph.D. Thesis, University of Kerala, India.

Saeedi M., Abessi O., Sharifi F. and Meraji H., 2010. Development of groundwater quality index. Environmental Monitoring and Assessment, **163**: 327–335.

Yidana S.M. and Yidana A., 2010. Assessing water quality using water quality index and multivariate analysis. Environmental Earth Science, **59**:1461–1473.