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Water Quality Index for the Groundwater Analysis in Pedana Mandal, Krishna District, Andhra Pradesh, India

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Abstract Water quality index is a mathematical method to applied for assess the water quality levels and for easy understand the water quality either in ground or surface water and using the standards, the present study was conducted in the pedana mandal groundwater quality for domestic and drinking purpose, there are 10 sampling stations were selected based on the more consumption and analyzed the physicochemical analysis in the pre monsoon season in 2019, the water quality parameters are pH, total hardness, Total dissolved solids, Calcium, Magnesium, Sulphtes, Chlorides, Fluorides and Iron, because each and every parameter is correlated to other parameter except iron and fluoride. The result reveals that average WQI value 428.02 is maximum and the value 137.24 is minimum in the study area, all water samples are high values and unfit for the drinking purpose, the values shows that 137.24 is poor water, the water is not suitable for direct consumption and required treatment before consumption.

Keywords: *groundwater, physicochemical, water quality index, drinking*

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1. Introduction

Water is one of the most indispensable resources hence life is not possible on this planet without water. Day by day the population of the country was increasing, so for drinking and other regular activities the people are depending on ground water for various purposes , Surface and sub-surface water resources are finite and subject to change as climate and environmental conditions [1], the groundwater contributes only 0.6% of the total water resources on earth, this accounts for nearly 80% of the rural domestic water requirement and 50% of the urban water needs in the developing countries like India [2] and hence the water quality is an important factor to judge the environmental changes, which are strongly associated with social and economic and cultural development. The evaluation of water in the developing countries has become a critical issue, in recent years, especially due to the concern that fresh water will be scarce in near future. [3]. WQI is defined as a rating and reflecting the composite influence of different water parameters, the concept of Water Quality Index (WQI) was represented the gradation in water quality, first proposed by Horten [4]. It is one of the most effective tool for communicate the information on the quality of water to the concerned communities [5], and the suitability of groundwater for human consumption. The water quality index (WQI) was summarizes large amounts of water quality data into simple terms (e.g., excellent, good, poor, very poor and unfit for utilization, etc.) for reporting to management and the public in a consistent manner, for computing the water quality index (WQI), the methods also reported by Singh. [6], and stated that the water quality data into simple information that is comprehensible and useable by the public**.** [7], This index allows for a general analysis of water quality on many levels that affect a stream's ability to host life [8], and this index has been widely field and applied to data from a number of different geographical areas all over the world to calculate WQI for various water bodies [9], Similar studies were conducted by the several researches on water quality Index. [10], were summarized large amounts of water quality data into simple terms (e.g., excellent, good, bad, etc.) in a consistent manner, [11], studied the ground water in Tumkur Taluk, Karnataka state, was assessed WQI, [12], Used the WQI technique in their research area, S. Kota, Vizianagaram district also, the present study objective is to study the water quality levels because the water consumption is as directly by the community for various purposes without any proper treatment.

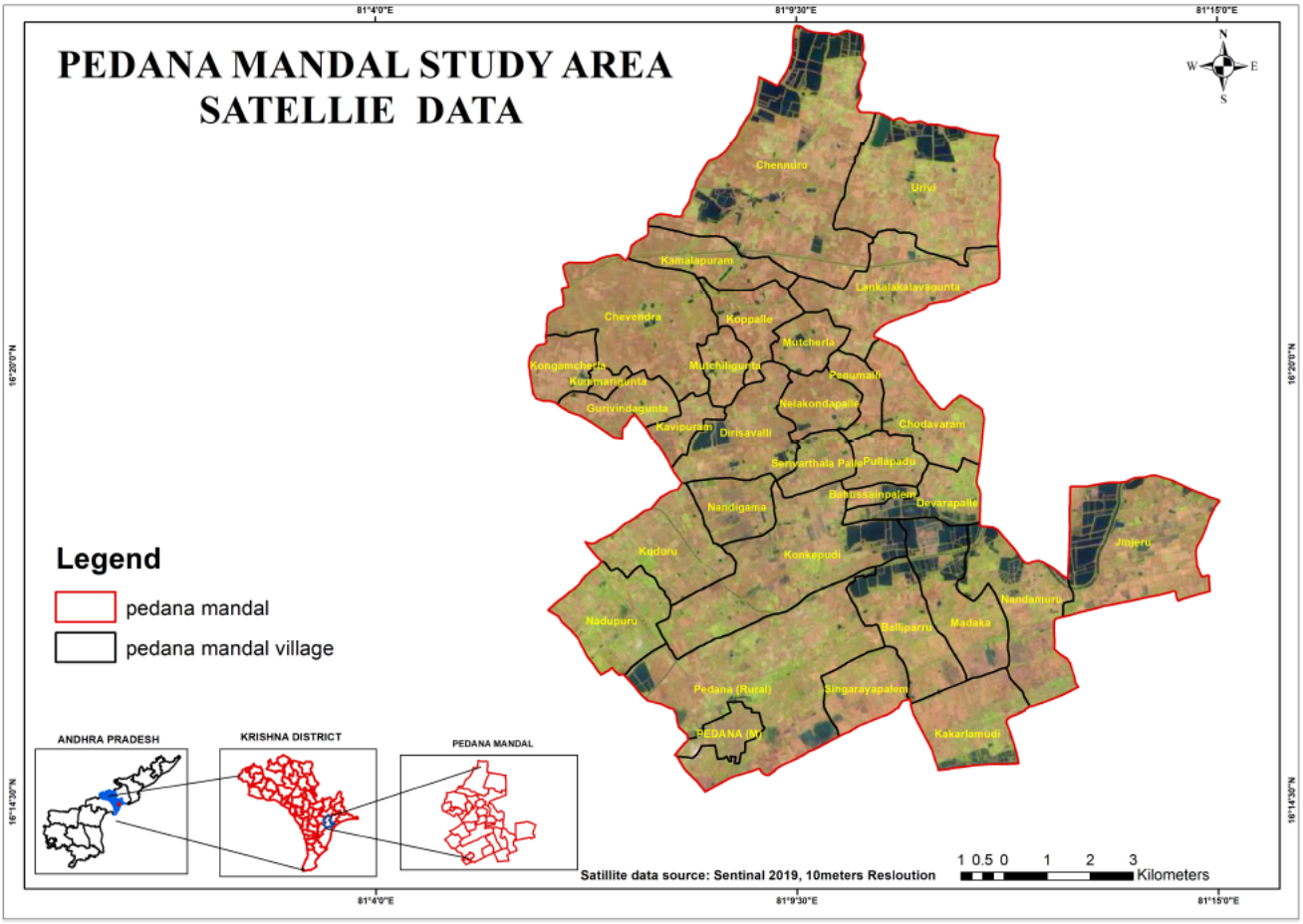

Figure 1. Study area map

2. Materials and Methods

2.1. Study Area

Pedana mandal is one of the 50 mandals in Krishna district in the state of Andhra Pradesh, India. Pedana latitude and altitude values are 16.2667°N, 81.1667°E, and it has an average elevation of 0.5 metres (3 feet) from the sea basin (Bay of Bengal). It is under the administration of Machilipatnam revenue division and the headquarters are located at Pedana and bounded by Gudlavalleru, Mudinepalle, Bantumilli, Gudur and Machilipatnam mandal (Figure 1).

2.2. Methods

The method has been adopted by Ramakrishnaiah [11] developing Water Quality Index to determine the suitability of groundwater for drinking purposes and conforming to World Health Organization (WHO) standards was followed. However the present study, the Bureau of Indian Standards standard values have been adopted. The parameters considered for the calculation of the index included pH, TDS, TH, Ca, Mg, NO_3, Cl^-, SO_4, F, Fe. These are the common parameters and easy to understand the either micro or macro nutrients in water but change the water quality and based on the field observations these parameters have been selected. The quality rating scale and accordingly the weight values were assigned to the selected parameters to estimate the overall WQI. Based on the actual groundwater scenario most of the researchers have established the weight value to assess the water quality depending on criteria and standard. Respective weight used in the present study are highlighted in Table 3

There were three steps to computing the WQI of a water sample.

In the first step, each of the chemical parameters was assigned a weight (wi) based on their perceived effects on primary health. The highest weight of five was assigned to parameters, which have the major effects on water quality. (Table 3)

The second step involved computing the relative weight (Wi) of each parameter using the equation given below;

$$Wi = \frac{wi}{\sum_{i=1}^{n} wi}$$

Where, $\sum$ wi is the sum of the weights of all the parameters. To compute quality rating scale, qi by using the equation given below;

$$q_i = C_i / S_i * 100$$

Where, Ci and Si –concentration and the BIS standard for each parameter, in mg/l

$$SI_i = W_i * q_i$$

$$WQI = \sum SI_i$$

Where SI i is the sub index of I th parameter
qi is the rating based on concentration of ith parameter and n is the number of parameters. The computed WQI values are classified into five types, “excellent water” to “water, unfit for drinking (Table 1).

Table 1. Water quality Index scale and water category

S.No	WQI Scale	Category
1	< 50	Excellent
2	50 – 100	Good
3	101 – 150	Poor
4	151 – 200	Very Poor
5	>201	Unfit for drinking

3. Results and Discussion

The average value of physico-chemical parameters and WQI of 10 samples are given in Table 2 & Table 3, respectively. The results observed that the minimum and maximum value of WQI was found to be 137.24 (S3- Chevendra) and 428.02 (S9- Kakarlamudi) delineated as per the Table 1 ‘Excellent’ and ‘unfit’ category, respectively. In the present study it is observed that all groundwater samples are unfit for drinking purpose category which needs ‘Filtration and disinfection’ treatment. The physico chemical parameters particularly like pH, F, Fe Nitrates values are within the permissible limits at all the sampling stations. [13] where as remaining all parameters like Total hardness, Total Dissolved solids, Sulphtes, chloride, calcium and magnesium are beyond the permissible limits when compared with BIS standards (Table 2), The high value of WQI in the study area has been found to be mainly from the higher values of total dissolved solids, hardness, Sulphtes, chlorides and magnesium in the groundwater. High values of TDS in groundwater is 4500 mg/l, the high concentration of TDS is affect to human beings, which is more affect to those who suffering from kidney and heart diseases [14,15]. Total hardness varies from 524 to 1616 mg/L**.** The hardness values are in the study area are found to be high for almost all locations and determined to fall above the desirable limit of WHO specification, according to [16]. The source of chloride is a widely distributed element in all types of rocks in one or the other form. Its affinity towards sodium is high. Therefore, its concentration is high in ground waters, where the less rainfall and high temperature, soil porosity and permeability also has a key role to increase the chlorides concentration [17,18] in any region, in the study area the values are varies from 432 to 1530 mg/l, all the sampling stations were showed that beyond the permissible limit, water containing high solids may cause laxative or constipation effects [19], remaining parameters are also very high concentration in the study area. The WQI was summarizes large amounts of water quality data into simple terms (e.g., excellent, good, bad, etc.) for reporting to management and the public in a consistent manner [10]. The values of water samples are falls under different quality. The results observe in present sampling stations water quality index hierarchical order at sampling stations S3, S4, S5, S7, S10, S6, S8, S2, S1 and S9. Due to improper drainage system and over utilization of fertilizer it may cause the fluctuations in the parameter levels in various sampling stations which reflect abnormal condition of groundwater.

Table 2. Groundwater quality in the sampling stations of study area

S.No	Sampling station	pH	TDS	TH	Ca	Mg	SO_4	NO_3	Cl	Fe	F
1	Balliparru	7.52	4406	1616	432	127.8	691	38	1530	0.14	0.36
2	Chennuru	7.09	4500	1450	400	78	400	42	1520	0.08	0.36
3	Chevendra	7.45	1264	584	110	76	108	8.4	520	0.07	0.12
4	Chodavaram	7.04	1160	524	78	64.54	101	10.4	432	1.01	0.12
5	Devarapalli	7.31	1348	626	121	78.5	105	11.6	542	0.09	0.15
6	**Dirisavalli**	7.34	3011	1010	115	166	291	21	1054	0.1	0.32
7	**Guruvindagunta**	7.02	2620	948	103	128	254	28	980	0.06	0.16
8	**Jinjeru**	7.31	3021	1010	113	176.7	291	25	1102	0.1	0.23
9	**Kakarlamudi**	7.59	4472	1576	291	206.2	402	31	1834	0.12	0.34
10	**Kamalapuram**	7.34	3462	1224	258	132	202	27	1600	0.18	0.21

Table 3. Process of WQI for groundwater quality in the study area

S.No	Sampling station	R weight	Qi	Sli	WQI
1	Balliparru	1.666	3775.144	427.2	427.2
2	Chennuru	1.666	3200	384.16	384.16
3	Chevendra	1.666	1240.133	137.24	137.24
4	Chodavaram	1.666	1996.87	156.07	156.07
5	Devarapalli	1.666	1875.01	191.13	191.13
6	Dirisavalli	1.666	2413.96	278.53	278.53
7	Guruvindagunta	1.666	2062.55	242.56	242.56
8	Jinjeru	1.666	2466.056	284.78	284.78
9	Kakarlamudi	1.666	3691.889	428.02	428.02
10	Kamalapuram	1.666	2372.26	265.78	265.78

Table 4. Water quality index and category of groundwater in the study area

S.No	Sampling station	WQI	Category
1	Balliparru	427.2	Unfit for drinking
2	Chennuru	384.16	Unfit for drinking
3	Chevendra	137.24	poor
4	Chodavaram	156.07	Very poor
5	Devarapalli	191.13	very poor
6	Dirisavalli	278.53	Unfit for drinking
7	Guruvindagunta	242.56	Unfit for drinking
8	Jinjeru	284.78	Unfit for drinking
9	Kakarlamudi	428.02	Unfit for drinking
10	Kamalapuram	265.78	Unfit for drinking

4. Conclusion

the water quality Index for groundwater in pedana mandal study area results showed that the study area is contaminated and not fit for direct consumption in human bodies because all values are poor, very poor and unfit for drinking, The prime causes of deterioration of groundwater quality are the excess amount of TDS, EC, Total hardness, Calcium, Magnesium, Fluoride and sulphate in water samples, this study also reveals that natural weathering, anthropogenic sources, excess ground water extraction, rock–water interaction in aquifer and different polluting agents contaminating the groundwater in the study area. Apart from the groundwater assessment, WQI model can be used for wide range of applications such as establishing the water treatment plant, control over extraction of water from ground layers etc. Among other uses, it can help the planner and decision makers when selecting areas for waste disposal and industrial sites. The overall view of higher WQI of the present study zone indicates the deteriorated water quality the present study and literature review depicts that the overall groundwater quality is poor and requires some pre-treatment before use for drinking purpose.

References

[1] Yogesh S. Patel, and Dr. G.P.Vadodaria. Groundwater quality assessment using water quality index, 20th *International conference on hydraulics, water resources and river Engineering, IIT, Roorkee*, India, 2015. Feb-17-19, (conference paper)

[2] P.bhuvana Jagadeeswari and K.ramesh. Water Quality Index for Assessment of Water Quality in South Chennai coastal Aquifer, tamil Nadu, India, *Int.J.of ChemTech Research*. 4 (4). 1582-1588. 2012.

[3] Kalaivani.S and K. Ramesh. Groundwater Quality Assessment using WQI In South Coimbatore, Tamil Nadu, India, *International journal of chem. tech Research*. 7 (1). 316-322. 2015.

[4] Horten R.K. An Index number for rating water quality. *Journal of Water Pollution. Cont. Fed*. 37 (3). 300-306. 1965.

[5] Sudhakar.G, Swarnalatha G, V.Venkataratnamma. Water quality index for groundwater of Bapatla mandal, Coastal Andhra Pradesh, India". *International Journal of Environmental Sciences* (IJES). 5 (1). 23-33. 2014.

[6] Singh R.P, Krishan G, Takshi K.S. Water level fluctuation as the sum of environmental and anthropogenic activities in southeast, Punjab (India). *Journal of Environmental and Analytical Toxicology*. 5. 298-312. 2015.

[7] Mangukiya Rupal, Bhattacharya Tanushree and Chakraborty Sukalyan. Quality Characterization of Groundwater using WaterQuality Index in Surat city, Gujarat, India *Int. Res. J. Environment Sci*. 1(4). 14-23. 2012.

[8] Mahesh Kumar Akkaraboyina and B.S.N.Raju. Assessment of Water Quality Index of River Godaveri at Rajahmundry, *Universal Journal of Environmental Research and Technology*. 2(3). 161-167. 2015.

[9] Jonathan YISA, Tijani Oladejo JIMOH, and Ohiemi Michael OYIBO. Underground Water Assessment using Water Quality Index, *Leonardo Journal of Sciences*. 21. 33-42. 2012.

[10] A.K.Khambete and R.A.Christian. *Statistical analysis to identify the main parameters to effecting WWQI of sewage treatment plant and predicting BOD*. 03 (1). 186-195. 2014.

[11] Ramakrishnaiah C.R, Sadashivaiah C and Ranganna G. Assessment of water quality index for ground water in Tumkur Taluk, Karnataka state, *India, E-J. Chem*. 6 (2). 523-530. 2009.

[12] Swarna Latha P, Nageswara Rao K, Ramesh Kumar PV and Hari Krishna M. Water quality assessment at village Level- a case study. Indian *J. Environ. Prot*. 27 (11). 996-1000.2007.

[13] N.K. Dhakad, Deepak Shinde, and Preeti Choudhary. Water Quality Index of Ground Water (gwqi) of jhabua town, m.p. (india), *Journal of Environmental Research And Development*. 2 (3). 443. 2008.

[14] G.Arunkumar, P.Sankara Pichaiah, Sudhakar.G, G.Swarna Latha. Physico-Chemical Analysis of Selected Groundwater Samples of Inkollu Mandal, Prakasam District, Andhra Pradesh, India. *International Journal of Engineering Research and Applications.* 5 (4). 65-70. 2015.

[15] Gupta S, Kumar A, Ojha C K and Singh G. Groundwater and water quality index, *Journal of Environmental Science and Engineering*, 46(1).74-78. 2004.

[16] Sawyer G N, Carthy Mc D L, *Chemistry of sanitary Engineers, 2nd Ed., McGraw Hill*, New York. 1967. p- 518.

[17] Chanda D K, groundwater quality, *Hydrology Journal*, 7 (5). 431-439. 2013.

[18] Sudhakar G, and Latha S G. Seasonal Variation of Groundwater Analysis from Bapatla Mandal, Guntur District, Andhra Pradesh *Int. Jrnl of sci & research*, 10.12-19. 2013.

[19] Kumaraswamy N, *Journal of Pollution and research*, 10(1).13-20. 1999.