Determination of Water Quality Index for Groundwater of Bapatla Mandal, Guntur District, Andhra Pradesh, India

Sudhakar Gummadi [1] , Swarnalatha. G [2], V. Venkataratnamma[3], Z. Vishnuvardhan [4]
[1]Research Scholar, Dept of Environmental Sciences, Acharya Nagarjuna University, Guntur, Andhra Pradesh.
[2] Research Scholar, Dept of Environmental Sciences, Acharya Nagarjuna University, Guntur.
[3] Assistant Professor, Dept of Zoology, Acharya Nagarjuna University, Guntur,
[4]Professor, Dept of Botany, Acharya Nagarjuna University, Guntur

***Abstract*— The present study aimed to calculate water quality index (WQI) in order to assess the suitability of water for drinking purposes The analysis of groundwater samples were carried out from ten sampling sites of Bapatla mandal, Guntur district, Andhra Pradesh to determine the groundwater quality by using water quality index (WQI), water quality index is a technique for rating water quality, is an effective tool to assess the ground water quality. The analysis of different parameters such as pH, turbidity, Total hardness, Chloride, Sulphate, Nitrate, TDS, Potassium, Magnesium, and Iron were carried out as per standard methods. The results obtained on WQI from different sampling stations were found to be varied from 27.70. In all the samples are Compare with the standards of WHO, BIS and USPH. The perusal of the results revealed that the water is safe for drinking and domestic purposes in selected sampling regions. The present study also indicates that application of water quality index in estimating the quality of ground water appears to be promising in the field of water quality management. The analysis reveals that some of the groundwater of the area needs treatment before consumption.**

Keywords*— *Drinking and domestic purposes, Ground water, Standards, Water quality index,

I. INTRODUCTION

Water is one of the most indispensable resources hence life is not possible on this planet without water. Recent research conducted by [1]. Groundwater is an important source of water supply throughout the world. [2]. Groundwater has long been considered as one of the purest forms of water available in nature and meets the overall demand for rural and semi-rural people. The quantity and the suitability of groundwater for human consumption and for irrigation are determined by its physical, chemical and bacteriological properties[3-6]. People around the world have used ground water as a source of drinking water and even today more than half of the world's population depends on ground water for survival [7]. This is due to rising water demands from a growing population and an increased electrical conductivity (EC) especially near coastal shallow groundwater in the environment [8]. A major problem in drinking water quality and management of domestic water supply in the water basins is salinization of groundwater in dug wells and in deep boreholes [9,10]. Day by day the population of the city is rapidly increasing, so for drinking and other regular activities the people are depending on ground water and extracted much ground water [11]. This demand has led to the use of ground water not only for its wide spread occurrence and availability but also for its constituent good quality which makes it ideal supply of drinking water [7]. Water quality index is one of the most effective tools to communicate information on the quality of water to the concerned citizens and policy makers [1]. It thus, becomes an important parameter for the assessment and management of surface water.WQI is defined as a rating reflecting the composite influence of different water quality parameters [12]. The concept of Water Quality Index (WQI) to represent gradation in water quality was first proposed by Horten [13]. This was considered as the major source of water for human activities (consumption inclusive) especially in the rural area [14]. WQI was used by Kakati and Sarma in the study of drinking water of Lakshimpur district, Assam [15]. 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. [16]. The quality of ground water in Tumkur Taluk, Karnataka state, was assessed by Ramakrishnaiah et al. Using [17]. Swarna Latha et al. used the WQI in water quality assessment at village level, S. Kota, Vizianagaram district [18]. WQI is defined as a rating reflecting the composite influence of different water quality parameters. WQI is calculated from the point of view of the suitability of groundwater for human consumption [19].

II. MATERIALS AND METHOD

A. *Description of the Study Area:*

The study area Bapatla mandal is one of the major region in Guntur district, Coastal Andhra Pradesh it lies within latitude - 15^0.48'North and longitude- 80^0.17'East, situated in the south east and coastal of Andhra Pradesh,[20]. Nine groundwater samples were collected from Bapatla Mandal, Gutnur District of Coastal Andhra Pradesh. The groundwater samples were collected from different villages of Bapatla mandal such as (S1)-

Marripudi, (S2)-Appikatla, (S3)-Poondla,(S4)-Kondubotlavaripalem, (S5)-Devinuthala, (S6)-Pandurangapuram, (S7)- Gopapuram, (S8)-gudipudi, (S9)-Chundurupalli. The groundwater samples were collected carefully in new 500ml Plastic bottles. The sample bottles are washed with 10% HNO_3 and 1:1 HCl for 48 h. The Plastic bottles were labeled and immediately few drops of $HNO_3$was added in order to prevent loss of metals, bacterial and fungal growth [21]. The nine water samples were analyzed for ten parameters: pH, Total dissolved solids, total hardness, Chlorides, Nitrates, Sulphates, Potassium, Magnesium, Iron, and Turbidity. [22]. the procedure was adopted for the determination of these physico- chemical parameters. Water quality index was calculated from the point of view that the suitability of water for human consumption as seen below. Water quality index is one of the most effective tools to monitor the surface as well as ground water pollution and can be used efficiently in the implementation of water quality upgrading programmes. The objective of an index is to turn multifaceted water quality data into simple information that is comprehensible and useable by the public. [2]**.** 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. [23]. Water Quality Index (WQI) was calculated using fallowing equation

$$\mathbf{WQI=}\left(\sum_{i=1}^{n} qiWi \Big/ \sum_{i=1}^{n} Wi\right)$$

Wi= weight of the parameter

Wi is calculate using the equation Wi= K/ Si

Where K is proportionality constant =1

Si is standard value of the i th quality parameter , n is the total number of water quality parameters;

qi is the quality rating for the i th water quality parameter and is calculated using the following equation

$$q_{i=}\left([Va-Vi]/[Si-Vi]x100\right)$$

Where Va= the value of the ith water quality parameter determinate in laboratory,

Vi = ideal value of the ith water quality parameter obtained from standard tables,

Vi for pH = 7 and for the other parameter the Vi value is 0 [24].In this study, for the calculation of water quality index, ten important parameters were chosen. The WQI has been calculated by using the standards of drinking water quality recommended by the World Health Organization (WHO), bureau of Indian Standards [25] and USPH , has been used for the calculation of WQI of the water samples.

III. RESULTS AND DISCURSION

The overall WQI of all the nine sampling stations are calculated according to the procedure explained above and are presented in Table-1 and Table-2. In Table-3, the WQI calculated with the mean values, are incorporated. The summary of all the results (in the form of WQI at different sampling stations) is presented in Table-3. The results obtained from this study reveal that WQI of Bapatla mandal is well within the permissible limits at all the sampling stations.[26]. The presents a study and literature review depicts that the overall ground water quality is poor and requires some pre treatments before use when compared with the standards. In some sampling points,[21]. In this study, the computed WQI values from 27.70. 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. [16]. The Table-4 shows that the values of water samples are falls under different quality. The results observe in present sampling stations water quality index is suitable for usage, at sampling stations S1, S4,S8,and S9 (> 215), it has been found to be mainly from the higher values of sampling parameters like TDS, Total Hardness levels are exceeding the permissible limits compare with the standards like WHO, BIS. This also agreed with the findings of [20].

IV. CONCLUSION

To know the the ground water quality of selected areas in Bapatla Mandal, Guntur district. After analysis of various physico-chemical parameters, we observe the range of WQI 27.70. The highest values of WQI are observed at sampling stations S1, S4,S8,and S9 (> 215). The high value of WQI at these stations has been found to be mainly from the higher values of Hardness, Magnesium, Chloride and Total dissolved solids. also indicate the contamination of ground water with sea water. Hence these four sampling stations are needs some degree of treatment before consumption and it also needs to be protecting from contamination.

Table 1: Physicochemical parameters of drinking water from Bapatla mandal, Coastal Andhra Pradesh

Constituents	S1	S2	S3	S4	S5	S6	S7	S8	S9
pH	7.59	7.32	7.38	7.5	7.3	7.9	7.58	7.28	7.95
TH	695	460	395	549	450	400	478	512	493
TDS	2088	1560	1488	549	1600	1270	2156	2045	2986
Cl	446.49	176.19	240.26	447.39	159.75	205.85	389.51	276.48	310.89
NO3	0.2	0.1	1.1	1.5	0.2	0.1	0.2	1.6	1.5
SO4	181.12	169.24	160	143.4	140.27	160.72	121.12	135.23	148.65
K	6.5	4.2	3.9	2.5	4.5	6.9	7.2	6.8	5.9
Mg	215	155	130	120	150	145	240	341	138
Fe	0.001	0.01	0.004	0.001	0.002	0.004	0.001	0.01	0.01
Turbidity	2.3	1.4	1.7	2.5	2.4	2.1	2.5	1.9	2.7

Table -2: Drinking Water standards recommending Agencies and unit weights. (All values except pH and Electrical Conductivity are in mg/L)

S.No.	Parameters	Standards	Recommended Agency	Unit Weight
1	pH	6.5-8.5	WHO/BIS/USPH	4
2	TDS	500	WHO/BIS/USPH	4
3	Total Hardness	300	WHO/BIS/USPH	5
4	Chlorides	250	WHO/BIS/USPH	3
5	Nitrates	45	WHO/BIS	5
6	Sulphates	200	WHO/BIS/USPH	3
7	Potassium	20	WHO	2
8	Magnesium	30	WHO/BIS/USPH	2
9	Iron	0.1	WHO/BIS	3
10	Turbidity	10	BIS	3

Table 3. Water Quality Parameters mean, weight, relative weight, Standard Values, quality rating, and Weightage Factors of Water Quality Parameters

S/No	Constituents	Mean	**Weight**	**Relative weight**	**Si**	**K**	**Wi=K/Si**	qi	**qiWi**
1	pH	2.291833	4	0.1177	7.5	1	0.1333	100	13.33
2	TH	51.18683	4	0.1177	300	1	0.0033	256.2	0.8454
3	TDS	84.85818	5	0.1471	500	1	0.002	140.02	0.28
4	Cl	43.01537	3	0.0882	250	1	0.004	669.88	2.6795
5	NO_3	9.36155	5	0.1471	45	1	0.0222	1.6309	0.0362
6	SO_4	35.01553	3	0.0882	200	1	0.005	308.83	1.5441
7	K	5.01815	2	0.0589	20	1	0.05	36.75	1.837
8	Mg	6.8487	2	0.0589	30	1	0.0333	119.79	3.989
9	Fe	2.5147	3	0.0882	1	1	1	0.401	0.401
10	Turbidity	4.031367	3	0.0882	10	1	0.1	27.64	2.76
		244.1422	**34**	**1.0002**			**1.3531**		27.7022

Table -4: Water Quality Index (WQI) and status of water quality

Water Quality Index Level	Water quality status
0-25	Excellent water quality
26-50	Good water quality
51-75	Poor water quality
76-100	Very poor water quality
>100	Unsuitable for drinking

REFERENCE

[1] Yisa J., Jimoh T., (2010)., Analytical Studies on Water Quality Index of River Landzu. American Journal of Applied Sciences, 7(4), p. 453-458.

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

[3] Antony Ravindran A. (2012), Azimuthal Square Array Resistivity Method and Ground water Exploration in Sanganoor, Coimbatore District, Tamilnadu, India, Research Journal of Recent Sciences, 1(4),41-45

[4] Ramesh K. and Bhuvana Jagadeeswari. P, (2012.)Hydrochemical Characteristics of Groundwater for Domestic and Irrigation Purposes in Periyakulam Taluk of Theni District, Tamil Nadu, I Research Journal of Environment Sciences, 1(1), 19-27.

[5] Manimaran D.,(2012) Groundwater Geochemistry Study Using GIS in and Around Vallanadu Hills, Tamilnadu, India, Res. J. Recent Sci.,1(7), 52-58.

[6] Caleb Adwangashi Tabwassah and Gabriel Ike Obiefun.(2012), Geophysical and Geotechnical Investigation of Cham Failed Dam Project, Ne Nigeria, Research Journal of Recent Sciences, 1(2),1-18.

[7] UNESCO.(2000).Groundwater UNESCO environmental development briefs no. 2,14,

[8] Helstrup, T., Jorgensen, N.O., Banoeng-Yakubo, B.,(2007). Investigation of hydrochemical characteristics of groundwater from the Cretaceous–Eocene limestone in southern Ghana and southern Togo using hierarchical cluster analysis. Hydrogeology 15, 977–989

[9] Gill, H.E., (1969). A groundwater reconnaissance of the Republic of Ghana, with a description of geohydrologic provinces. US Geological Survey Water-supply Paper 1757-K Washington, DC, 37 p

[10] Bannerman, R.R., (1994). Appraisal of the limestone aquifer of the Keta Basin, Ghana. In: Soveri, J., Suokko, T. (Eds.), Future Groundwater Resources at Risk. Publ. 222. International Association for Hydrological Sciences, Wallingford, pp. 315–321.

[11] G. Srinivas Rao, G. Nageswararao., (2013). Assessment of Groundwater quality using Water Quality Index2013) Arch. Environ. Sci. 7, 1-5.

[12] Tyagi P.D., Buddhi R., Chaudhary K.C., Sawhney R.L.(2002) Degradation of ground water quality in industrial area in India, Ind. J. Environ. Protect., 20, p. 174-181.

[13] Horten RK (1965). An Index number for rating water quality. J. Water Poll. Cont. Fed. 37(3): 300-306.

[14] Fasunwon O., Olowofola J., Akinyemi O., Fasunwon B., Akintokun O.(2008), Contaminants Evaluation as Water Quality Indicator inAgo-Iwoye, South-western, Nigeria, African Physical Review, 2, p. 12.

[15] Kakati SS and Sarma HP (2007). Water quality index of drinking water of Lakhimpur district. Indian J. Environ. Prot. 27(5): 425-428.

[16] A.K.Khambete, and R.A.Christian ,(2014). Statistical analysis to identify the main parameters to effecting WWQI of sewage treatment plant and predicting BOD, V-03, 01 p-186-195.

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

[18] Swarna Latha P, Nageswara Rao K, Ramesh Kumar PV and Hari Krishna M., (2007).Water quality assessment at village Level- a case study. Indian J. Environ. Prot. 27(11): 996-1000

[19] Ramakrishnaiah C.R., Sadashivaiah C., Ranganna G., Assessment of water quality index for the groundwater in Tumkur Taluk, Karnataka State India., 2009, 6(2), p. 523-530.

[20] Sudhakar. G, and Latha S G,(2013), Seasonal Variation of Ground-Water Analysis from Bapatla Mandal, Guntur District, Andhra Pradesh Int. Jrnl of sci & research, 10.12.

[21] Sudhakar Gummadi , Swarnalatha. G , Z. Vishnuvardhan , Harika.D, (2014). Statistical Analysis of the Groundwater Samples From Bapatla Mandal, Guntur District, Andhra Pradesh, India. Joural of Envi sci, Toxicology & Food Tech. 8(1) PP 27-32

[22] APHA, AWWA, WEF. (1998)Standard Methods for the Examination of Water and Waste waters, 20 th Edition. American Public Health Association, Washington,D.C. 233 pp.,

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

[24] Srinivas P., Pradeep Kumar G.N., Srinivatas Prasad A., Hemalatha T. (2011), Generation of Groundwater Quality Index Map- A case study, Civil and Environmental Research, Volume 1, No.2, 9-21.

[25] BIS., (1991) (Bureau of Indian Standards) 10500, Indian standard drinking waterspecification, First revision, , pp 1- 8.

[26] N.K. Dhakad, Deepak Shinde, and Preeti Choudhary,(2008), water quality index of ground water (gwqi) of jhabua town, m.p. (india), Journal of Environmental Research And Development V, 2. 3 p 443.