ISSN No.: 2454- 2024 (online)

International Journal of Technical Research & Science

WATER QUALITY ASSESSMENT IN TERMS OF WATER QUALITY INDEX IN GUDUR AREA, NELLORE DISTRICT, ANDHRA PRADESH

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Abstract-The present study was intended to calculate water quality index (WQI) of Gudur area, Nellore district.Andhrapradesh.in order to ascertain to the quality of water for the public consumption, irrigation, agriculture, Recreation and other purpose In the present study area water samples were collected and analyses the different physico-chemical parameter such as P^H, electrical conductivity, total dissolved solids, bicarbonate, chloride, sulphate, calcium, magnesium, sodium, potassium, alkalinity and total hardness of the water sample, determine the presence of the quantity levels in the 40 water samples. Based on that calculate the water quality index for the all samples. In this area the water quality ranges from 88.26 to 186.55.It represented the poor water quality based on water quality index in the study area.

Key Words: water quality index, physico-chemical parameter, Correlation matrix.

1. INTRODUCTION

Groundwater resources are dynamic in nature and are affected by such factors as the expansion of irrigation Activities, industrialization and urbanization; hence monitoring and conserving this important resource is essential. The quality of water is defined in terms of it ascertaining the quality is crucial before its use of various purposes such as drinking; agricultural, recreational and industrial uses etc [Mohan Babu et.al,, 2013].The WQI was first developed by Horton in the early 1970s, is basically a mathematical means of calculating a single value from multiple test results. The index result represents the level of water quality in aim study area, such as Bore wells, ponds or stream. After Horton a number of workers all over the world developed WQI based on rating of different water quality parameters. Basically a WQI attempts to provide a mechanism for presenting a cumulatively derived, numerical expression defining a certain level of water quality (Miller et al., 1986). In Gudur area contains the world richest and high quality minerals are present such as muscovite mica, biotite mica, feldspars minerals ,garnets, tourmaline, beryl, quartz and some eastern part of the gudur area contains the vermiculite deposits. The surface and ground water interact with minerals in this area leads to take pollution. This research aimed at determining water quality status of gudur area, such as drinking purpose, irrigation, agriculture and livestock.

2. STUDY AREA

The present study area is included in the toposheet No.57 N/16 and covers an area of area of 19 km². It is located between longitudes 79° 42' 30" E – 79° 54' 30" E and latitudes 14° 13' 0" N -14° 16' 30" N (Fig.1).

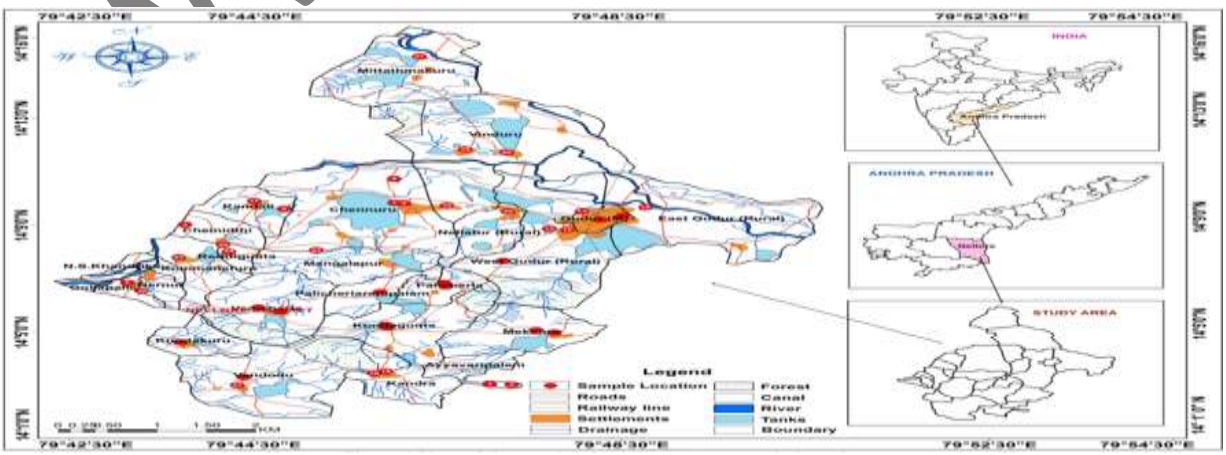

Fig. 1 Map of the Study Area With Water Sample Locations

DOI Number: 10.30780/IJTRS.V3.I1.2018.020

The study area enjoys a sub tropical climate with a mean annual temperature of 24.3ºCto 32.9ºC. The humidity is usually in the range of 6–84 %. The annual normal rainfall of the study area is about 1084 mm. The mean daily maximum temperature in the district is about 40°C in May and the mean daily minimum temperature is about 20°C in December/ January. Gudur area is underlain by various geological formations from ancient underlain Achaean to the Recent Alluvium. The important geological formation were Amphibolites and schist's (migmatised), migmatised – garnetiferous and quartzite .The predominate soil is red loamy, block cotton soils, lateritic soil and alluvial soil. The alluvial soils consist of sand, silt and clay.

3. MATERIALS AND METHODS

The water samples from the water body were collected at an interval of 30 days and analyzed for 40 samples physicochemical parameters by following the established procedures.P^H, electrical conductivity, total dissolved solids, bicarbonate, chloride, sulphate, calcium, magnesium, sodium, potassium, alkalinity and total hardness. The results were evaluated and compared with world health organization (WHO), Indian council of medical research and Bureau of Indian standard (BIS) water quality standards.

In this study, for the calculation of water quality index, 11important parameter were chosen .the WQI has been calculated by using the standards of drinking water quality recommended by the world health organization, bureau of Indian standards and Indian council for medical research. The weighted arithmetic index method has been used for the calculation of WQI of the water body. Further quality rating or sub index was calculated using the following expression (Yogendra et al., 2007).

$$q_n=100[V_n-V_{io}]/[S_n-V_{io}]$$

(Let there be n water quality parameter and quality rating or sub index ($\mathbf{q_n}$) corresponding to $\mathbf{n^{th}}$ parameters a number reflecting the relative value of this parameter in the polluted water with respective its standard permissible value.)

$\mathbf{q_n}$= quality rating for the $\mathbf{n^{th}}$ water quality parameter
$\mathbf{V_n}$=estimated value of the nth parameter at a given sampling station
$\mathbf{S_n}$= standard permissible value of the nth parameter
$\mathbf{V_{io}}$ = ideal value of n^{th} parameter in pure water (i.e., 0 for all other parameter except the parameter $\mathbf{p^H}$ and dissolved oxygen (7.0 and 14.6 mg/l respectively)

Unit weight was calculated by a value inversely proportional to the recommended standard value Sn of the corresponding parameter

$$W_n=K/S_n$$

$\mathbf{W_n}$= unit weight for the nth parameters
$\mathbf{S_n}$= standard value of the nth parameter
K=constant for proportionality

The overall water quality index wax calculated by aggregating the quality rating with the unit weight linearly.

$$WQI=\sum q_n W_n/\sum W_n$$

Table-3.1Status of Water Quality Based on Water Quality Index (WQI)

WQI range	Status
< 50	Excellent
50-100	Good
100-200	Poor
200-300	Very poor
>300	Unfit for drinking

Table-3.2 Minimum, Maximum, Standard Deviation and Average Values of Different Constituents of Water Samples

S. No.	Constituents	Min	Max	Average	S.D	SE
1	Calcium (Ca) (mg/l)	113	359	172.65	48.26	7.63
2	Magnesium (Mg) (mg/l)	24	250	131.89	46.36	7.33
3	Sodium (Na) (mg/l)	60	310	154.33	60.07	9.50
4	Potassium (K) (mg/l)	1	40	8.83	8.67	1.37
5	Bicarbonate (HCO_3) (mg/l)	144	598	407.23	129.13	20.42
6	Carbonate (CO_3) (mg/l)	4	72	26.20	17.57	2.78
7	Sulphate (SO_4) (mg/l)	80	200	138.70	33.25	5.26
8	Chloride (Cl) (mg/l)	166	726	475.13	129.96	20.55
9	Fluoride (F) mg/l	0.80	2.00	1.30	0.23	0.04
10	Total dissolved solids (mg/l)	406	910	113	112.89	17.85
11	Hardness as $CaCO_3$ (mg/l)	120	915	553.18	112.89	28.43
12	Alkalinity as $CaCO_3$ (mg/l)	160	321	251.40	43.19	6.83
13	pH	6.40	9.0	7.25	0.57	0.09
14	Specific conductance (µmhos/cm)	625	1400	851.05	173.67	27.46
15	Non-carbonate hardness	213.32	1248.88	597.31	259.57	41.04
16	Sodium adsorption ratio (SAR)	0.94	4.75	2.17	0.85	0.13
17	Adj. SAR Sodium adsorption ratio	2.64	14.24	6.48	2.65	0.42
18	Cations Ratio of Structural Stability (CROSS)	1.17	5.32	2.50	0.97	0.15
19	Sodium percentage	13.13	46.87	25.96	7.58	1.20
20	Potential salinity	5.94	21.62	14.84	3.65	0.58
21	Residual sodium carbonate	-24.98	-4.27	-11.95	5.19	0.82
22	Permeability Index	20.49	55.73	35.42	8.16	1.29
23	Kelley's Ratio	0.13	0.84	0.35	0.15	0.02
24	Magnesium Ratio	11.47	73.16	54.72	13.11	2.07
25	Chloro-alkaline indices 1	-0.19	0.80	0.43	0.28	0.04
26	Chloro-alkaline indices 2	-0.18	2.62	0.73	0.65	0.10
27	Gibbs Ratio I	0.39	0.89	0.66	0.12	0.02
28	Gibbs Ratio II	0.24	0.60	0.44	0.10	0.02

Table -3.3 Drinking Water Standards Recommending Agencies and Unit Weights (all values except pH and Electrical Conductivity is in mg/l)

S.No	PARAMETER	ICMR STANDARD (S_n)	UNIT WEIGHT (W_n)
1	pH	8.5	0.141
2	Total hardness	600	0.002
3	Sulphate	250	0.005
4	Fluoride	1.0	1.200
5	chloride	250	0.005
6	TDS	500	0.002
7	Calcium	75	0.016
8	Magnesium	30	0.024
9	Sodium	200	0.006
10	Bi-carbonate	100	0.012
11	Alkalinity	200	0.012

Table-3.4 Water Quality Index

S.NO	WQI =∑qnWn/∑Wn	Status
1	128.7876	Poor
2	106.9177	Poor
3	145.0444	Poor
4	157.3535	Poor
5	186.5557	Poor
6	132.0461	Poor
7	131.2659	Poor
8	147.0903	Poor
9	148.7832	Poor
10	122.8691	Poor
11	146.7784	Poor
12	106.3324	Poor
13	122.6518	Poor
14	148.7944	Poor
15	132.1873	Poor
16	138.2163	Poor
17	122.9131	Poor
18	97.11732	Good
19	135.6809	Poor
20	88.26635	Good
21	122.6724	Poor
22	130.5737	Poor
23	139.2917	Poor
24	156.1042	Poor
25	133.2348	Poor
26	150.0199	Poor
27	141.9887	Poor
28	150.7115	Poor
29	140.5673	Poor
30	141.0215	Poor
31	124.841	Poor
32	130.7792	Poor
33	130.0637	Poor
34	133.1285	Poor
35	106.2859	Poor
36	108.1806	Poor
37	109.0208	Poor
38	109.8526	Poor
39	154.1119	Poor
40	127.9082	Poor

Table-3.5 Correlation Matrix (r2) of Studied Physico-Chemical Parameters and Major ions (N = 40) of Groundwater sample

S.No	EC	pH	Ca	Mg	Na	K	HCO_3	CO_3	Cl	SO_4	F	TDS	Hardness as $CaCO_3$	Alkalinity as $CaCO_3$
EC	1													
pH	-0.197	1												
Ca	0.032	-0.032	1											
Mg	0.021	0.061	-0.318	1										
Na	-0.201	0.398	-0.026	0.115	1									
K	0.275	0.262	0.207	0.106	0.258	1								
HCO3	-0.462	0.286	-0.205	-0.242	0.203	-0.144	1							
CO3	0.045	0.454	0.250	-0.419	0.055	-0.014	0.231	1						
Cl	0.197	-0.018	-0.177	0.525	0.058	0.035	-0.229	-0.089	1					
SO4	-0.025	-0.217	-0.285	0.258	-0.301	-0.251	0.136	-0.133	-0.167	1				
F	-0.059	-0.046	0.302	-0.241	-0.045	-0.325	-0.117	0.225	-0.089	-0.069	1			
TDS	1.000	-0.197	0.032	0.022	-0.201	0.275	-0.461	0.045	0.197	-0.024	-0.059	1		
Hardness as CaCO3	0.266	-0.236	-0.219	0.399	-0.309	-0.091	-0.285	-0.029	0.428	0.180	-0.204	0.266	1	
Alkalinity as CaCO3	-0.099	0.502	-0.170	0.126	0.392	0.082	0.201	0.127	0.003	-0.174	-0.307	-0.098	-0.237	1.00

Statistical analysis was performed on the physico-chemical parameters and major ion concentration to detect the relationship and differences between the groundwater samples. In order to discuss the data, the values grouped with respect to the geochemical parameters. The average value of all the variables (pH, EC, TDS,CO_3-, HCO_3-, Cl-, SO42-,$Ca2^+$, $Mg2^+$, Na^+, K^+, Alkalinity) determined and tabulated as matrix (14 x24) in Table-5.(S. Krishna Kumar et al.,2004)

CONCLUSION

The WQI for 40 samples ranges from 88.26 to 186.55. Almost ninety nine percent of the samples exceeded 100, the upper limit for drinking water. The high value of WQI at these stations has been found to be mainly from the higher values of total dissolved solids, calcium, hardness, fluorides, bicarbonate, chloride and manganese in the groundwater. About 99% of water samples are poor in quality. In this part, the groundwater quality may improve due to inflow of freshwater of good quality during rainy season. Magnesium and chloride are significantly interrelated and indicates that the hardness of the water i.e. permanent in nature. The analysis reveals that the groundwater of the area needs some degree of treatment before consumption and it also needs to be protected from the perils of contamination.

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