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DETERMINATION OF WATER QUALITY INDEX(WQI) FOR GROUNDWATER OF KAKUMANU MANDAL

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Abstract - *Usually, groundwater is clean and free from bacteria. Water is filtered through soil layers and settle in one layer called groundwater. Due to improper disposal of waste collected from domestic, industries tend to pollute the groundwater. The present study is aimed to compute water quality index (WQI) to interface the suitability of drinking water. To determine the quality of groundwater by WQI, nine samples were collected from different regions of Kakumanu Mandal. Laboratory test are performed for the samples collected from various regions of Kakumanu. The samples were analyzed to compute its parameters on quality of groundwater. pH, total dissolved solids, total hardness, turbidity, chloride, nitrate, sulphate, iron, potassium and magnesium are the different parameters that are analyzed as per standards. The obtained results from various regions are compared with WHO, BIS and USPH standards.*

Key Words: Ground water, Water Quality Index (WQI), Standards, Ground water, physicochemical parameters.

1. INTRODUCTION

Groundwater is very essential resource for water supply in drinking water, irrigation and industrial development. Due to the anthropogenic activities, increase in the demand and climatic conditions, the pressure on groundwater resource is also increased. With these extreme demand in irrigation and industrial increase, the demand of water is raised from past years and still raising. Throughout the world, problems in water resources are with qualitative (i.e. caused by contamination of surface and ground water) and quantitative (i.e. caused by climatic change, overuse of surface and ground water, melting water from glaciers and reduction in precipitation).

Industrial waste and municipal solid waste are recorded as leading cause for the surface and groundwater pollution. Groundwater consists of different varieties of chemical constituents in different concentrations lead in result of chemical reactions between water and geological components. Groundwater is the most important source for water supply in every use for world. [10] Many compounds can dissolve in water and some can be suspended. Groundwater has less chance for the contamination of water when compared to surface water (streams, rivers and lakes). Otherwise, contamination can occur through soil cracks. In overlying soil and rock soil, toxic compounds can easily flow into ground.[5]

Contamination of ground water is serious, whether the water supply is for drinking or used for irrigation. Ground water source is the main source for drinking, commercial and industrial needs if the source of water is in god condition. The main aim of this paper is to collect data related to physical and chemical parameters and these parameters are examined to know water status of Kakumanu Mandal.

2. DESCRIPTION OF STUDY AREA

Study area Kakumanu Mandal [6]is in Guntur district of an Indian state Andhra Pradesh shown in Figure 1. It lies within latitude of $16^0 3$ North and longitude $80^0 23$ East in the southeast of Andhra Pradesh [8] and 40kilometers from main city Guntur. Mandal consists of 17 villages namely,[3] Appapuram, Bhallukanudupalem, Bodipalem, Chinalingayapalem, Garikapadu, Garlapadu, Kakumanu, Kollimarla, Kommuru, Kondapatur, Kotivanipalem, Lingamguntapalem, Pandrapadu, Peddivaripalem, Retur, Telagayapalem and Valluru. Samples of groundwater were taken in nine different regions in Kakumanu Mandal are Kakumanu, Kommuru, Kondapatur, Appapuram, Bodipalem, Garikapadu, Kollimarla, Retur and Vallur.

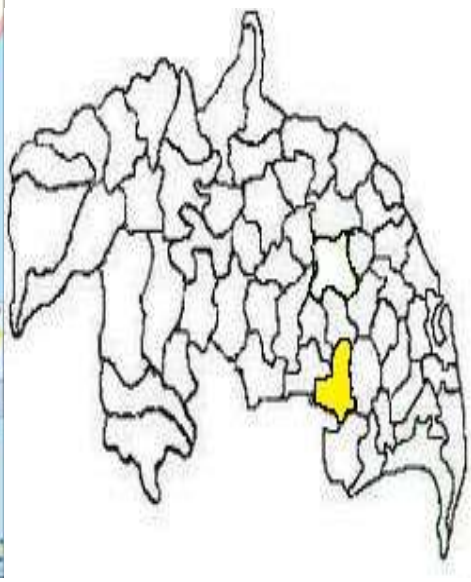


Figure 1: Location of Study area.

3. Determination of WQI

The samples were collected in 0.5-liter bottle and Nitric Acid (HNO3) is added immediately to prevent the loss of bacterial and fungal growth. All these samples were analyzed with pH, total dissolved solids, total hardness, turbidity, chloride, nitrate, sulphate, iron, potassium and magnesium parameters as per standards. Water quality index was calculated for the water suitability for consumption. Water quality index (WQI) is calculated by [1][6][9]:

Water Quality Index, WQI = $\frac{\sum_{i=1}^{n} qiWi}{\sum_{i=1}^{n} Wi}$;

Where, q is i^{th} water quality rating parameter and given by

$q_i = \frac{Va - Vi}{Si - Vi} * 100$

$V_{actual} = V_a$= actual value of water quality parameter determined from laboratory,

$V_{ideal} = V_i$= Ideal value of water quality parameter determined from standard tables,

$V_i = 7$ [for pH] and $V_i = 0$ [for other parameters]

Weight of parameter $W_i = \frac{K}{Si}$

Where, K = proportionality constant = 1

S_i = Standard value for i^{th} quality parameter

n = total number of water quality parameters.

To determine the water quality index WQI, ten parameters were chosen and by using drinking water standards recommend by World Health Organization WHO, Bureau of Indian standards BIS, USPH are used for calculation as shown in Table 2. The observed recordings of each nine samples with parameters are shown in Table 1:

Table 1: Physicochemical parameters of drinking water (Kakumanu Mandal)

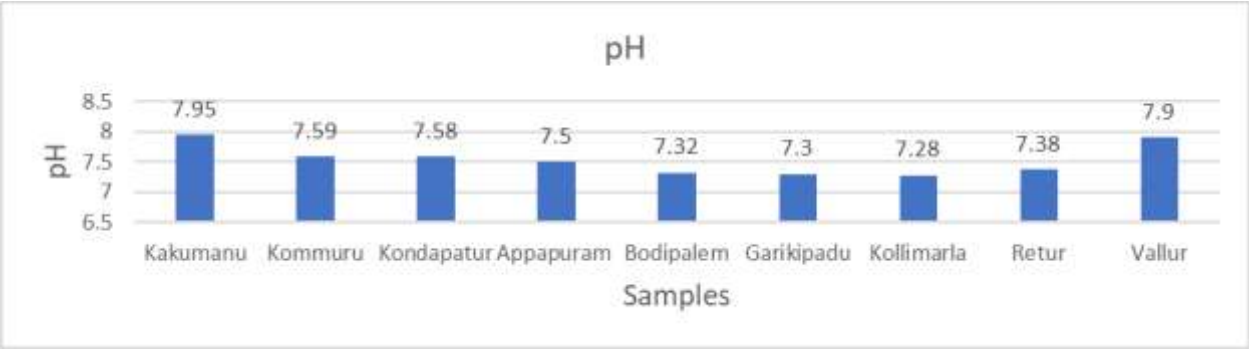
Village name	Kakumanu	Kommuru	Kondapatur	Appapuram	Bodipalem	Garikapadu	Kollimarla	Retur	Vallur
pH	7.95	7.59	7.58	7.5	7.32	7.3	7.28	7.38	7.9
TDS	2089	2034	2136	1460	1271	1488	558	1720	2986
TH	683	461	563	396	400	482	546	518	489
T	2.1	2.5	1.4	2.4	2.5	2.3	2.7	1.9	2.4
Cl	320.88	171.20	159.77	441.35	250.28	211.82	269.50	389.49	436.52
NO_3	1.1	0.2	0.2	1.5	0.1	0.1	1.5	1.6	0.2
SO_4	181.12	143.4	160	148.65	135.23	169.24	121.12	160.72	140.27
Fe	0.01	0.004	0.001	0.001	0.001	0.01	0.01	0.002	0.004
K	6.8	6.5	2.5	3.9	7.2	4.2	5.9	4.5	6.9
Mg	339	217	129	151	154	148	121	230	145

Table 2: Drinking water Standards

Parameters	Standards	Unit weight	Recommended by
pH	6.5-8.5	4	WHO, USPH, BIS
TDS	500 mg/L	4	WHO, USPH, BIS
TH	300 mg/L	5	WHO, USPH, BIS
T	10	3	BIS
Cl	250 mg/L	3	WHO, USPH, BIS
NO_3	45 mg/L	5	WHO, BIS
SO_4	200 mg/L	3	WHO, USPH, BIS
Fe	0.1	3	WHO, BIS
K	20 mg/L	2	WHO
Mg	30 mg/L	2	WHO, USPH, BIS

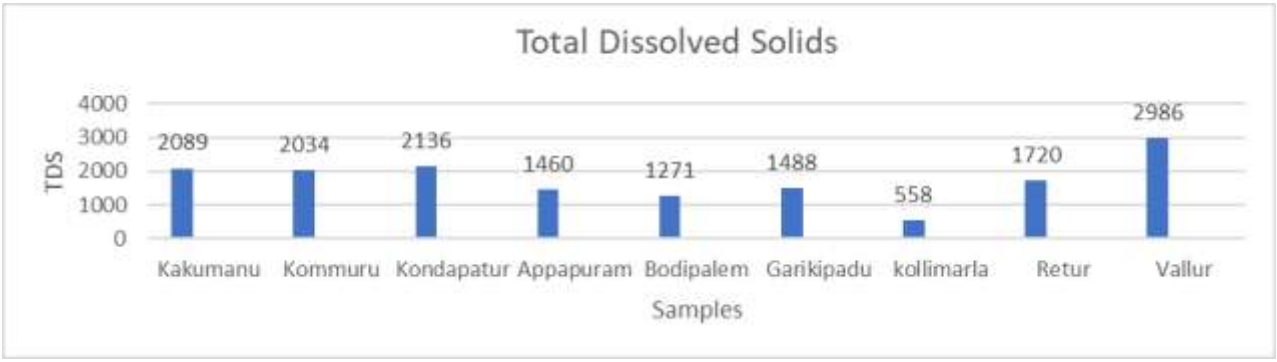
4. EXAMING PARAMETERS

Examining pH



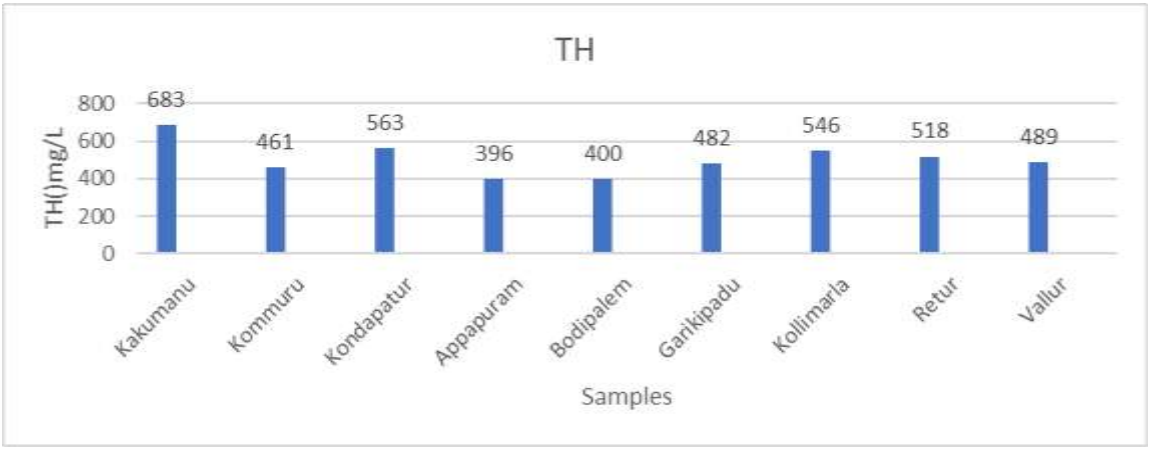
- pH value should lie between 6.5 to 7.5 as per is10500.
- Maximum value of pH is 7.95 and minimum value of pH is 7.28
- Mean average value is 7.53.
- Acceptable Range is 6.5-8.5.
- Not effected.

Examining Total Dissolved Solids (TDS)



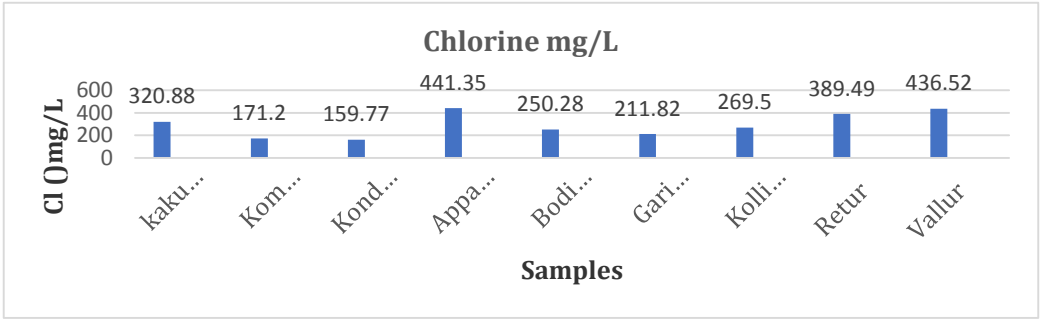
- Acceptable range is 500 mg/L and Permissible limit is 2000 mg/L.
- Maximum TDS value is 2986mg/L and Minimum value is 558 mg/L.
- Mean average value is 1749.11 mg/L.
- Hence not affected.

Examining TH



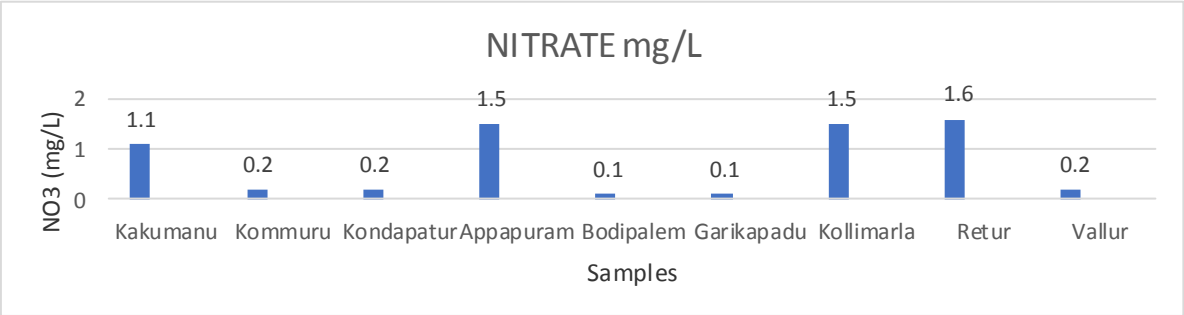
- Total Hardness Acceptable range is 200mg/L and Permissible limit is 600 mg/L.
- Maximum TH value is 746 mg/L and Minimum value is 396 mg/L.
- Mean average value is 526.44.

Examining Cl



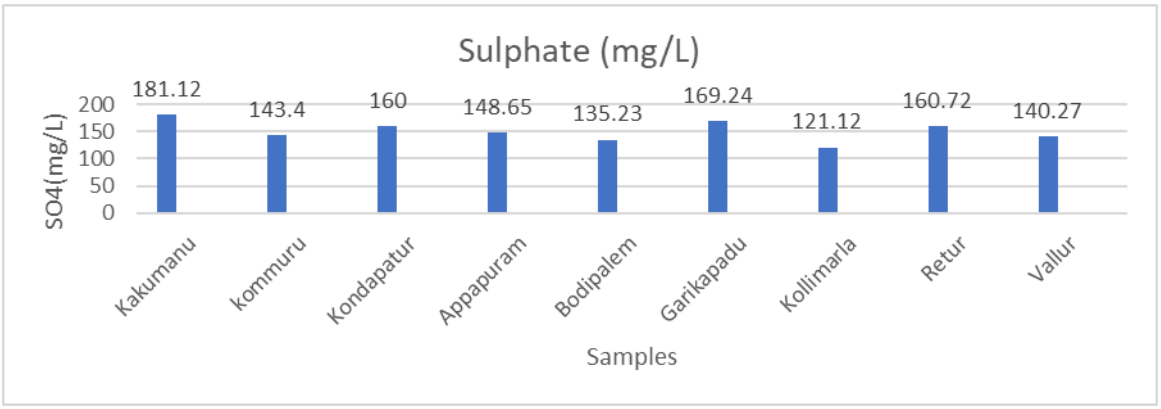
- Chlorine acceptable range value is 250 mg/L and Permissible limit is 1000 mg/L.
- Maximum alkalinity value is 441.35 and minimum value is 159.77.
- Mean average value is 294.53.

Examine NO3



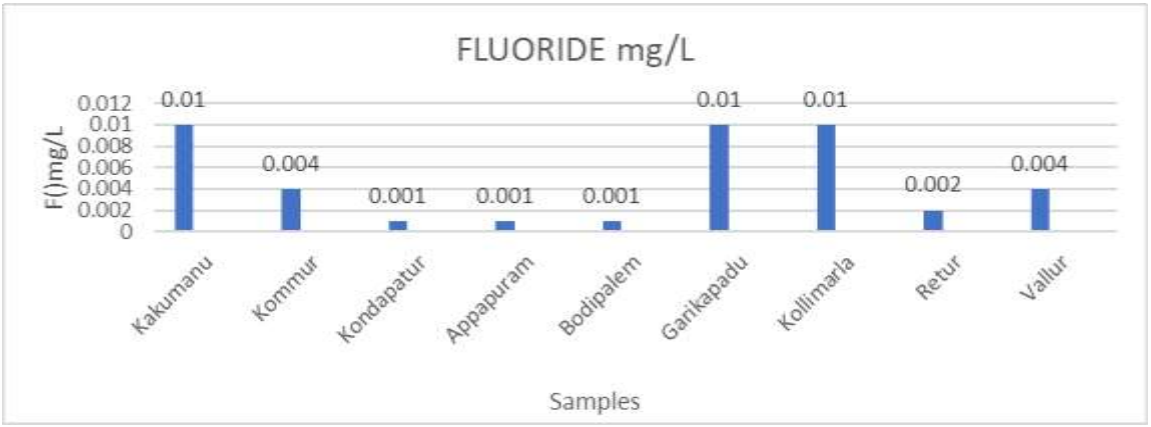
- Acceptable range of Nitrate is 45 mg/L and Permissible limit is 45 mg/L.
- Maximum alkalinity value is 1.6 mg/L and minimum value is 0.1 mg/L.
- Mean average value is 0.722.
- The concentration of nitrate should not be higher and hence the care should be taken for drinking.

Examining SO4



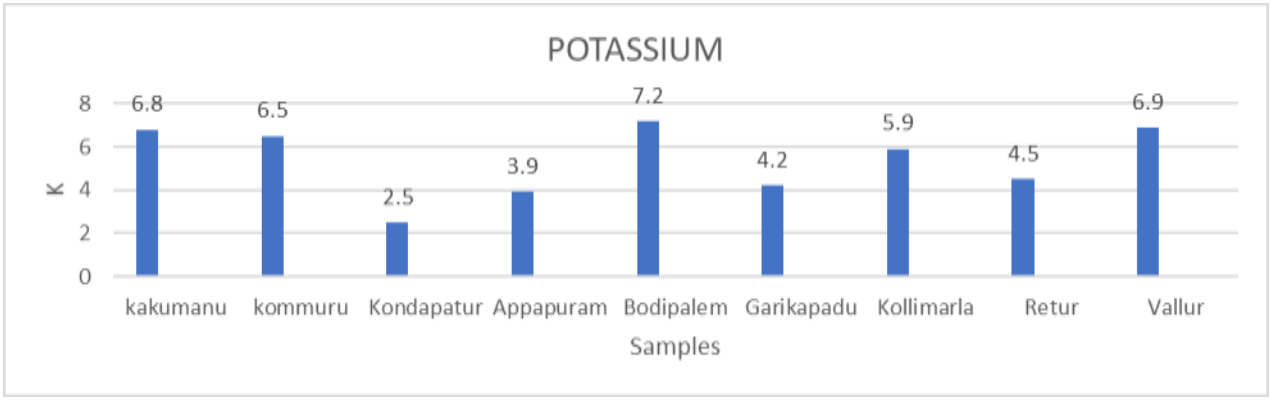
- Acceptable range of sulphate is 200 mg/L and Permissible limit is 400 mg/L.
- Maximum alkalinity value is 181.12 and minimum value of alkalinity is 121.12.
- Mean average value is 151. 083.

Examining F



- The Acceptable range of Fluoride is 1 mg/L and permissible limit is 1.5 mg/L.
- Maximum alkalinity value is 0.01 and minimum value is 0.001.
- Mean average value is 0.005.
- The concentration of Fluoride is within acceptable limits.

Examining K



- Acceptable range of Potassium is 20 mg/L.
- Maximum value of alkalinity is 7.5 and minimum value is 2.5.
- Mean average value is 5.37.

5. RELATIVE WEIGHT

The relative weight Wi is calculated as:

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

Where n is number of parameters.

The water quality parameters and the relative weights of parameters are shown in Table 3.

Table 3: Water quality parameters, its weight and Relative weights.

Parameters	Weight of each parameter wi	Relative Weight Wi
pH	4	0.1176
TDS	4	0.1176
TH	5	0.1471
T	3	0.0882
Cl	3	0.0882
NO_3	5	0.1471
SO_4	3	0.0882
Fe	3	0.0882
K	2	0.0588
Mg	2	0.0588
Total	**34**	**0.9998**

6. CALCULATION OF WATER QUALITY PARAMETERS

Table 4. shows the calculation of parameters with their standard values.

Table 4: Calculation of water quality parameters

Parameters	Si	Wi=K/Si	Qi	QiWi
pH	7.5	0.1333	100	13.33
TDS	500	0.002	140.02	0.28
TH	300	0.0033	256.2	0.8454
T	10	0.1	27.64	2.76
Cl	250	0.004	669.88	2.6795

NO_3	45	0.0222	1.6309	0.0362
SO_4	200	0.005	308.83	1.5441
Fe	1	1	0.401	0.401
K	20	0.05	36.75	1.831
Mg	30	0.0333	119.79	3.989
Total		**1.3531**		**27.7022**

According to standards of water quality index level, the status of water quality is shown in Table 5.

Table 5: Status of Water Quality Index in water quality index.

Water Quality Index Level (WQI)	Water Quality Status
0-25	Excellent
26-50	Good
51-75	Poor
76-100	Very poor
>100	Unsuitable for drinking

7. CONCLUSION

Ground water quality was known in selected areas of Kakumanu Mandal. The physio-chemical parameters are examined, and characteristic values are analysed for WQI. The quality of ground water is estimated by using different physio-chemical parameters such as pH, total hardness, total dissolved solids, chlorides, nitrate, sulphate, potassium, magnesium, iron and turbidity. After analysis of various physio-chemical parameters, water quality index (WQI) is observed as 27.7022. Water quality index at Kakumanu, Appapuram, Kollimarla and Vallur, the highest values are observed due to higher values of total dissolved solids, calcium, magnesium and total hardness. And it also indicates that these four stations are water contaminated. Hence, Kakumanu, Appapuram, Kollimarla and Vallur stations are to be treated before consumption and to protect the groundwater from contamination.

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