EVALUATION OF GROUND WATER QUALITY IN AND AROUND AREA OF BAPATLA USING GIS TECHNIQUE

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Abstract - *Groundwater resource forms a significant component of the urban water supply. Declining groundwater levels in Bapatla is generally due to continuous overexploitation during the last two decades. Physicochemical analysis data of the groundwater samples collected at predetermined locations form the attribute database for the study, based on which spatial distribution maps of major water quality parameters are prepared using MapInfo GIS software. Water quality index was then calculated by considering the following water quality parameters pH, total dissolved solids, total hardness, calcium hardness, magnesium hardness, alkalinity, chloride, nitrate and sulphate to find the suitability of water for drinking purpose. The high value of water quality index reveals that most of the study area is highly contaminated due to excessive concentration of one or more water quality parameters and that the groundwater needs pretreatment before consumption.*

Key Words: Physicochemical analysis, Water quality index, water quality parameters, MapInfo GIS software, Contaminated.

1. INTRODUCTION

Water is a unique natural resource since its total quantity available on a global basis remains constant compared to any other renewable resource. In India, more than 90% of rural and nearly 30% of urban population depend on groundwater for their drinking and domestic requirements. Groundwater is an invisible and endangered open or common access resource. Overexploitation of groundwater beyond the sustainable limit in several parts of the country has resulted in undesired and progressive depletion of its level in selected pockets of 370 out of 603 districts in the country. Rapid decline in groundwater levels could reduce India's harvest by 25% or more (Singh and Singh 2000). It is a well-known fact that pure water is absolutely essential for healthy living. Adequate supply of pure water is a basic need for all humans, yet it has been observed that millions of people worldwide are deprived of this. The consequence of urbanization and industrialization has caused the deterioration of water quality. Contamination of drinking water may occur by percolation of toxics through the soil into groundwater that is used as a source of drinking water. Groundwater quality is being threatened by disposal of urban and industrial wastes and agricultural chemicals. The rate of depletion of groundwater levels and deterioration of groundwater quality are of immediate concern in major cities and towns of the country. Geographic information system (GIS) are effective tools for water quality mapping and land cover mapping essential for monitoring, modeling and environmental change detection. GIS can be a powerful tool for developing solutions for problems related to water resources, for assessing water quality and managing water resources on a local or regional scale. Water quality if not adequately managed can serve as a serious limiting factor to the future economic development and to the public health and environment which will result in enormous long-term costs to society. Thus, the need for better management of the quality of water is greatly recognized. The use of maps is common practice in earth-related sciences in order to evaluate the evolution of physical phenomena and predict natural variables as well as assess the risk regarding surface and groundwater contamination in waste disposal industrial and other sites (Albanis et al. 1998; Warhate et al.,2006; Chopra et al. 1999; Dhillon et al. 2003). Namita et al.,(2017) have evaluation of Water quality index for drinking purpose in and around Tekanpur area M.P.(India).' They carried out experimental work on physic chemical parameters of groundwater samples taken from in and around Tekanpur, Gwalior (M.P.). Water samples were collected from five selected locations. After analysis results were compared with WHO and ISI standards. Most of the parameters satisfy the guidelines. WQI ranges from 58.66 to 93.75 are obtained for those samples. And they suggest that the pretreatment required before consumption. Jena, et al.,(2017) in their study on Physico chemical analysis of ground water of selected area of Raipur city.' In this study, during 2015-2016 assessment of physico chemical parameters is done for 20 groundwater samples of Raipur city. Standard methods and procedures were used for assessment. They conclude regular chemical analysis must be done. Osama Asanousilamma (2018) et.al, Ground water were found to be found be highly contaminated in the industrial area of Guntur. In essence, high TDS, Electric conductivity, Total hardness, Total alkality reflects addition to pollutants from industrial sources that further deteriorate its quality. Results are compared with BIS and revealed water quality parameters were failed to meet the drinking water quality standards and were graded as non-potable. Keeping this in view, observations of field study have been integrating in GIS for the evaluation of the impact of industrialization on the groundwater quality in Bapatla. Details of the study area Bapatla is located at latitude of 15° 54' 16"N and longitude of 80° 28′3"E at an altitude of 8 m from the coast of Bay of Bengal. Bapatla is renewed as a prominent educational research hub. Bapatla spread over an area of 17.92 km^2. Bapatla is heavily dependent on groundwater for its water requirements and the objectives of study area are to assessment of ground water quality by using water quality index method, to create spatial distribution maps of major water quality parameters by using MapInfo GIS software and to identify the water pollution in their local areas.

2. MATERIALS AND METHODS

2.1Study Area: Bapatla is a town in Guntur district of the Indian state of Andhra Pradesh. It is a municipality and the mandal headquarters of Bapatla mandal of Tenali revenue division Coordinates: 15°54′16″N 80°28′3″E , the location map of study area as shown in Fig.1

Fig -1:Location map of Study Area

2.2 Water quality index: Water quality index is a rating, reflecting the composite influence of different water quality parameters on the overall quality of water. The main objective of computing of water quality index (WQI) is to turn the complex water quality data into information which is easily understandable and usable. This index has been extensively field and applied all over the world to calculate the WQI for different water bodies. Study the Indian Standard (BIS 2004) for drinking water specification. The physicochemical parameters along with the desirable limits and related health effects are given. A parameter has to be selected based on its impact in the overall quality of water and health effects. The water quality Index computation the fallowing procedure.

2.2.1 Computation of WQI: The WQI is computed following the three steps.
First step – Assigning of weight (W_i) to the selected water parameters (e.g., pH, TDS, TH, HCO_3, Cl, SO_4, NO_3, Fe) according to their relative importance in the overall quality of water for drinking purposes.
Second step – Computation of a relative weight (W_i) of the chemical parameter using the following equation:
Where,
W_i is the relative weight, Wi is the weight of each parameter and 'n' is the number of parameters.

Third step - Assigning of a quality rating scale (q_i) using equation 1.

$$q_i = \left(\frac{C_i}{S_i}\right) \times 10 \quad (1)$$

where, q_i is the quality rating, Ci is the concentration of each chemical parameter in each water sample in mg/l, and Si is the guide line value/desirable limit as given in Indian drinking water standard (BIS 2004). For computation of WQI, the sub index (S_i) is first determined for each chemical parameter, as given equation 2. and equation 3.

$$S_i = W_i \times q_i \quad (2)$$

$$WQI = \left(\sum_{i=1}^{n} W_i \times q_i \Big/ \sum_{i=1}^{n} W_i \right) \quad (3)$$

Where, S_i is the sub index of the parameter; Wi is relative weight of the parameter; q_i is the rating based on concentration of the parameter and 'n' is the number of chemical parameters. Classification of water: The water may be classified into five types based on computed WQI as given below:
WQI range and water type:
<50 Excellent water; 50 - 100 Good water; 100- 200 Poor water; 200 – 300 Very poor water; > 300 Water unsuitable for drinking.
The samples are labeled as S1,S2, S3......S9 respectively.
The samples are collected in the month of January - March 2020. Few major physiochemical parameters values presented in table 1are identified based on literature prevailing BIS code.

2.3 Stands of Water Quality parameters

Stands of Water Quality parameters limits prescribed by IS 10500:2012 for drinking water quality are given table 1

Table -1: Standards Given By WHO/BIS/USPH Agency

S.No	Parameters	Standards	Recommended Agency
1	Ph	6.5-8.5	WHO/BIS/USPH
2	TDS	500-2000	WHO/BIS/USPH
3	Total Hardness	300	WHO/BIS/USPH
4	Chlorides	250	WHO/BIS/USPH
5	Nitrates	45	WHO/BIS/USPH
6	Sulphates	200	BIS
7	Potassium	20	WHO
8	Magnesium	30	WHO/BIS/USPH
9	Iron	0.1	BIS
10	Turbidity	10	WHO/BIS/USPH
11	Alkalinity	200	BIS

Table -2: Physiochemical parameters of drinking water from Bapatla, costal Andhra

Constituents	S1	S2	S3	S4	S5	S6	S7	S8	S9
Ph	8.00	8.23	8.30	7.8	8.32	8.27	7.89	7.5	8.7
TH	240	84	142	60	88	132	180	150	300
TDS	354	415	389	312	401	398	321	297	401
CL	45.8	56.7	70.9	42.45	56.7	141.8	176.19	150	200
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	160.72	121.12	135.3	140.27	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	340	138
Fe	0.001	0.001	0.004	0.001	0.002	0.004	0.001	0.001	0.001
Turbidity	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Alkalinity	64	40	46	30	74	120	74	46	150

Table-3: Water Quality Parametrs and Weightage factors of water quality Parametrs

S.No	Parameters	Mean	Unit Weight	Relative Weight	Q_i	S_i	W_i	$W_i Q_i$
1	pH	8.2	4	0.1	160	8.2	0.1	16
2	TH	152.8	5	0.125	146.06	300	0.125	18.257
3	TDS	356.3	4	0.1	481.82	500	0.1	48.182
4	CL	227.83	3	0.075	91.132	250	0.075	6.8349
5	NO3	1.29	5	0.125	2.866	45	0.125	0.3582
6	SO4	157.51	3	0.075	78.755	200	0.075	5.906
7	Tr	5.53	4	0.075	55.3	10	0.075	1.99
8	AK	131.2	3	0.075	65.6	200	0.075	4.92
9	Mg	148.1	4	0.1	68.6	221	0.1	11.05
10	Fe	0.002	5	0.1	0.0001	0.002	0.1	0.0004
			40	1	115.25			117.84

3. Results and conclusion

The present work reveals whether the water is suitable or unsuitable for drinking purpose in the area of Bapatla. In this study, the computed WQI value is 117.84 and therefore, can be categorized into five types "Excellent water" (<50) to "Good water (50-100)", Poor water quality (100-200), Very poor water quality (200-300). (Table-1) shows the percentage of water samples that falls under different quality. The high value of WQI at Sample 1, Sample 8 and Sample 9 has been found to be mainly from the higher values of Hardness, and Total Dissolved Solids in the groundwater (Table 2). Groundwater quality assessments for the development of rural drinking-water supply systems should give high priority to reducing pollution, total hardness, total dissolved solids, and chlorides in some sampling points because these health-related parameters significantly exceed WHO/BIS/USPH standards in the study areas (Table 1). It indicates that natural weathering and percolating as well as the anthropogenic sources are contaminating the groundwater in study area. The study reveals that the groundwater of a few locations needs some degree of treatment before consumption and it also needs to be protected from the perils of the prevailing contamination.

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