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A STUDY ON OPPIDAN COURSE OF BUGGAVANKA ENVIRONS, KADAPA, ANDHRA PRADESH, INDIA USING GEOSPATIAL TECHNOLOGIES

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ABSTRACT

The environment always plays a key role on the well being of the organisms inhabiting within the influential zone / Buffer Zone. In the present study, Physico-Chemical characteristics in the Buffer Zone of 1.5Km along the Oppidan course of Buggavanka environs at kadapa are studied. Geographically it lies between the latitudes of 14.23°N & 14.31°N and the longitudes of 78.46°E & 78.54°E and covered in the open series maps of Survey of India (SOI) Toposheet numbering D44G15NW. The average elevation of the urban parts of Kadapa is 138 metres. The environmental parameters evaluated include pH, Total Dissolved Solids, Electrical Conductivity, Carbonates, BiCarbonates, Calcium, Chloride, Potassium and Sodium. The estimations of the above parameters reveal a considerable deviation from the standards prescribed by World Health Organisation (WHO). A brief attempt has been made to study the extent of change in the quality of water in comparison to water quality standards of World Health Organisation (WHO).

Geospatial Technologies provide an ambient and quick renaissance of the analysis and spatial distribution studies on the results obtained. From the distribution and correlation studies in the study area, it can be concluded that the water parameters taken are beyond the imagination for consumption either for irrigation or domestic purposes. The pollution levels for both surface water and bore wells/underground are discussed at length including their spatial distribution and correlations studies. The results of the present study throw light on the level of pollution stretching its tentacles on the inhabitants all along the study area.

KEYWORDS: Opppidan Course, Buggavanka, Pollution, Geospatial Technologies

INTRODUCTION

The surroundings of an organism or human being are commonly referred to as Environment. It includes both living and nonliving organisms, and also called as Biotic and Abiotic components. According to P. Gisbert “Environment is anything immediately surrounding an object and exerting a direct influence on it.” The etymology of the term environment is from a French word “Environia” meaning “surround”. It refers to both a biotic (physical or non-living) and biotic (living) things. Therefore the word environment means surroundings, in which organisms live. Environment controls the activities of all the organisms, where human beings occupy summits of its interaction. Any modification in the components of environment affects the dynamism and balance of the energy flow at a given place and time. The undesirable change in composition of the Environment is called as pollution. The environmental pollution may affect any of the Abiotic and Biotic components like Air, Water, Land, Forests, living organisms, etc.

Geospatial Technologies are computer based integrated database management system in which large volumes of geo referenced spatial data derived from variety of sources are efficiently stored, organized, manipulated, retrieved, analysed and displayed according to the user defined specifications. Spatial analyst module in ArcGIS software has been used for the present study. Spatial analysis of drinking water quality was carried out by interpolation of sampling points by the algorithmic method 'Inverse Distance Weighted' (IDW). The coordinates of the sampling stations were imported into GIS environment as point layer. Each sample point was assigned by a number and stored in the point attribute table. The attribute data file contains values of all physico-chemical parameters in separate columns for each sampling station. The geodatabase was used to generate the spatial distribution maps of the analyzed water quality parameters such pH, Total Dissolved Solids, Electrical Conductivity, Carbonates, Bicarbonates, Calcium, Chloride, Potassium and Sodium.

STUDY AREA

Geographically it lies between the latitudes of 14.23°N & 14.31°N and the longitudes of 78.46°E & 78.54°E falling in the open series maps of Survey of India (SOI) Toposheet numbering D44G15NW. The average elevation of the urban parts of Kadapa is 138 metres. The city is traversed by a stream called Buggavanka or RallaVanka which is originated in the Palakondas to the south. It is surrounded by Palakondas in the south and to the east by a patch of the same hills and by the Lankamalas and Penneru in the north. The exposures in the study area are the rocks belonging to Peninsular Gneissic complex unconformably overlie by a thick sequence of Proterozoic sediments belonging to Kurnool group which unconformably overlie the Cuddapah Super group of rocks comprising Banganapalle quartzite, Koilkuntla limestone, and Nandyala shale. The present study area constitutes Oppidan Course of Buggavanka / Rallavanka that is traversing across from south to north. It was and presently is a part of it is source of irrigation and drinking water but gradually losing its identity and became a destiny of coprolite thereby influencing the quality of water and soil directly and the inhabitants indirectly.

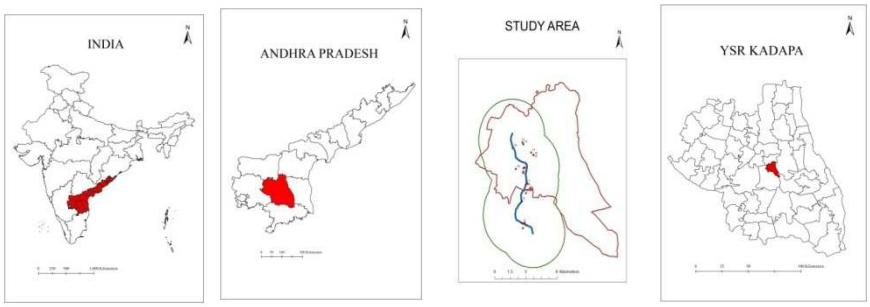


Figure 1: Location Map of the Study Area

A total of twenty water samples were collected from study area with geotagged coordinates using global positioning system, an important input for spatial distribution analysis. These water samples are estimated in the wet lab for detailed correlation studies and distribution maps. The following photographs illustrate sample collection in the field.

Figure 2: Sample Collections (Surface and Underground) in the Study Area

RESULTS AND DISCUSSIONS

The results data obtained from the present samples are tabulated in Table.1 and the comparative analysis with WHO are tabulated in Table.2.

pH: The pH of water is very important indication of its quality and provides important piece of information in many types of solubility calculations (Hem, 1985). The pH of the groundwater in the study area is varying between 7.13 to 8.66mg/l. The limit of pH value for drinking water is specified as 6.5 to 8.5 (ISI, 1983).

Total Dissolved Solids: Total dissolved solids of the groundwater is varying from 57 mg/l to 6980 mg/l. the desirable limit of TDS in drinking water is 500 mg/l. Palatability of the water decreases when the concentrations exceeds this limit and may cause gastro-intestinal irritation (ISI, 1983). It is observed that 100% of the groundwater from the area exceeds the desirable limit.

Electrical Conductivity: Electrical conductivity is a measure of water capacity to convey electric current. The levels of EC under study ranged between 310 to 2580µs/cm. The average level of EC for the study area is 732µs/cm. The conductivity measurement provides an indication of ionic concentrations. It depends upon temperature, concentration and types of ions present (Hem, 1985). The maximum limit of EC in drinking water is prescribed as 1500µs/cm (WHO, 1996). Maximum value of EC 6280µs/cm is observed in the groundwater of Masapeta and minimum value of EC is observed (198µs/cm) is observed in the groundwater of Devunikadapa.

Total Hardness: The concentration of total hardness in Buggavanka surrounding areas is varying from 40 mg/l to 280 mg/l. The limit of total hardness for drinking water is specified as 360 mg/l (ISI, 1983). Water sample of the entire study area exceeds the desirable limits. The hardness of water is due to the presence of alkaline earths such as calcium and magnesium.

Bicarbonate and Carbonate: The HCO_3 Concentration in the water sample of the study area 60-878.4 mg/l. In the study area samples fall in the ‘normal carbonate water’ and samples fall in the ‘under carbonate water’. Hence the water sample of the study area is generally “normal carbonate water”.

Calcium: The concentration of in the water samples were between 24 mg/l to 152 mg/l which is derived from calcium rich minerals like feldspars, pyroxenes and amphiboles. The upper limit of calcium concentration for drinking water is specified as 75 mg/l (ISI, 1983). It observed that nearly 94 percent of the groundwater exceeds the permissible limit.

Chloride: The Chloride concentration of the water sample is 49.7 mg/l to 5786.6 mg/l. The upper limit of chloride concentration for drinking water is specified as 250 mg/l (ISI, 1983). Nearly 30 percent of the water sample exceeds the permissible limit. The source of chloride in the water sample is due to the weathering of phosphate minerals and domestic sewage (Karanth, 1987).

Potassium: Potassium concentration is varying from 30 mg/l to 180 mg/l. The limit of chloride concentration for drinking water is specified as 250 mg/l (ISI, 1983).

Sodium: Sodium concentration is varying from 280 mg/l to 850 mg/l. The sodium concentration in the water sample is due to weathering of plagioclase feldspar, the use of sodium compounds for corrosion control and water-softening processes have contributed to sodium concentration in water sample of the study area.

Table 1: Results of the Chemical Analyses of Samples

S. NO	PH mg/l	TDS mg/l	EC µs/cm	TH mg/l	CO_3 mg/l	Hco_3 mg/l	Ca^{+2} mg/l	Cl^- mg/l	K^{+2} mg/l	Na^+ mg/l
1	8.45	105	198	40	132	0	120	49.7	62	101.8
2	8.21	412	796	100	60	0	56	127.8	232	140.8
3	8.27	3170	6120	280	84	268.4	80	5786.6	159	276.3
4	8.30	1040	1960	200	60	341.6	72	376.3	449	185.5
5	8.38	830	1560	180	156	0	120	298.2	536	176.6
6	8.11	1550	2900	220	36	219.6	136	560.9	466	211.8
7	8.38	310	585	60	180	0	152	170.4	222	137.4
8	8.18	306	579	180	72	195.2	112	42.6	137	117.3
9	8.66	620	1160	40	72	0	96	198.8	328	159.1
10	8.58	1560	2900	200	60	268.4	88	440.2	607	1654
11	8.33	1810	3360	240	72	0	88	596.4	232.6	1741
12	8.50	3230	6240	200	72	366	96	901.7	300.6	2610
13	8.12	1090	2060	280	288	0	88	191.7	486	1304
14	7.76	6980	1830	200	204	0	48	284	453	1222
15	8.30	113	215	120	0	146.4	104	63.9	64	116.7
16	8.34	385	722	120	144	0	80	134.9	99.33	728.9
17	8.85	1720	3150	260	72	268.4	64	518.3	262	1926
18	8.10	940	1740	180	384	0	72	362.1	166	1205
19	7.13	100	186	200	180	0	88	156.2	28	104.4
20	8.04	930	1730	240	204	878.4	96	390.5	187.6	1191

To assess the suitability of water for drinking and public utilitu viz, domestic and irrigation purposes, the results of the samples collected are made in comparison with the prescribed standards recommended by World Health Organization (WHO, 2004) as shown in the Table.2.

Table 2: Comparison of the Chemical Parameters of Samples with Who Standards

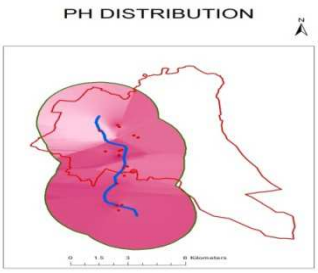
Parameters	Who Standards		Study Area Values	
	Max. Accept Limit	Max. Allow Limit	Minimum	Maximum
PH	6.5	8.5	7.13	8.66
EC	500	1500	198	6240
Calcium	75	200	48	144
Magnesium	50	150	30	180
Sodium		200	101.4	2610
Potassium			8.64	536
HCO_3			219.6	878.4
Chloride	200	600	49	5786.6

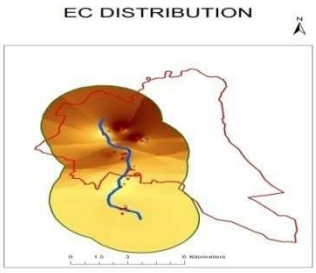
CORRELATION ANALYSIS

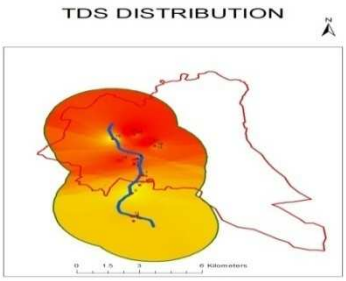
Hydro geochemical relationships can be illustrated in different ways. In water quality, it is used for the measurement of the strength and statistical significance of the relation between two or more parameters. The correlation coefficient is helpful to illustrate the hydro geochemical relationships in this study. In Table 3 correlation analysis of different groundwater quality variables reveals that highly positive correlation is observed between EC & TDS (0.99961) i.e. EC increases as the concentration of all constituents/ions increases. EC (µS/cm) is correlated with Na^+& K^+, Cl^- (ranges from 0.046585 to 0.328935) & EC is poorly correlated with Ca^+, CO_3^-, HCO_3^- (ranges from -0.1843 to 0.31312). PH is correlated with Na^+& K^+ (ranges from 0.1183346 to 0.328935). Cl^- correlated with Na^+& K^+ (ranges from -0.0635 to 0.01492). Ca^+ is correlated with Na^+& K^+.

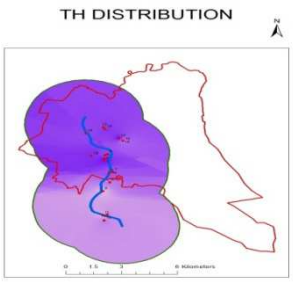
Table 3: Correlation Coefficient between Different Hydro Geochemical Parameters

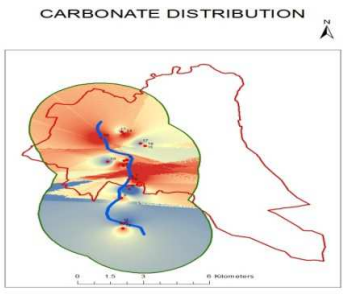
	PH	TDS	EC	TH	CO_3	HCo_3	Ca	Cl	K	Na
PH	1									
TDS	0.308788	1								
EC	0.301501	0.999617	1							
TH	-0.19166	0.619954	0.611589	1						
CO_3	-0.34914	-0.1843	-0.18541	0.116449	1					
Hco_3	-0.01037	0.31312	0.313524	0.415222	-0.10827	1				
Ca	0.096813	-0.10266	-0.10346	-0.26659	-0.11554	-0.12704	1			
Cl	0.046585	0.675268	0.683854	0.420478	-0.12651	0.196654	-0.15585	1		
K	0.183346	0.200088	0.197828	0.247457	0.038452	0.084778	-0.04286	-0.0635	1	
Na	0.328935	0.633518	0.622801	0.489369	0.124985	0.226803	0.15306	0.001492	0.00471	1

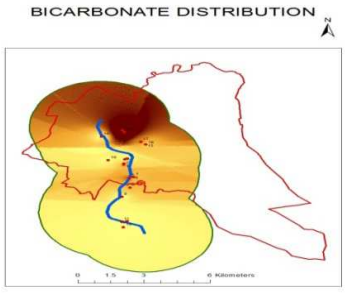












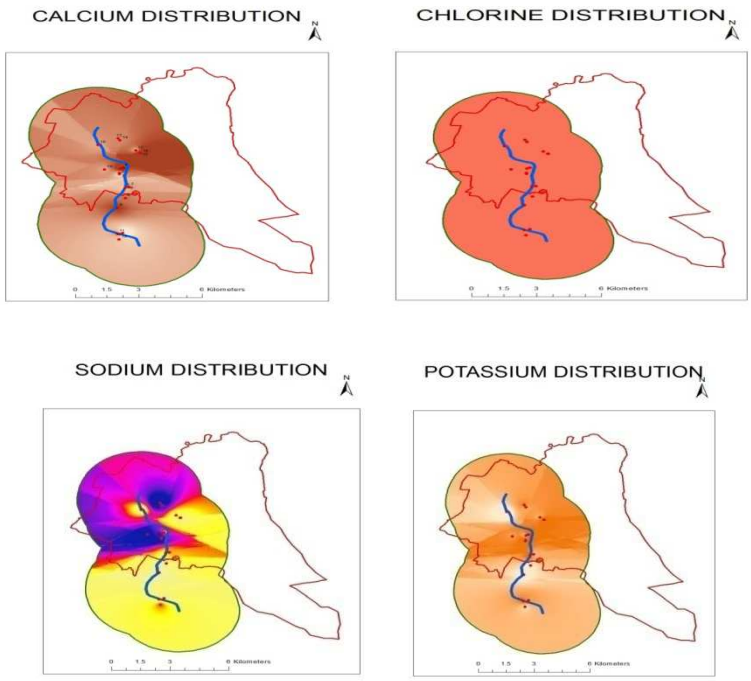


Figure 3: Spatial Distribution Maps of Various Physicochemical Parameters

CONCLUSIONS

The study reveals that the water of the Buggavanka stream is deteriorated very badly as a result of addition of coprolite like urban waste, domestic sewage, which enters the river from both the banks during its course through the heart of Kadapa city. Direct discharge of human and animal waste not only imparts the quality of water but also affects the health of the people down stream of Kadapa city where the same water is used for washing, bathing and sometimes for drinking purposes. The urban runoff and continuous dumping of waste materials especially sanitary waste are affecting the water quality of opppidan course of Buggavanka. There is considerable need for better understanding of this small stream so that they can be managed effectively. The study illustrates the use of geostatistical technique for investigating spatial variation of water quality which is more effective effort toward groundwater management system. The thematic maps of groundwater quality parameters will be beneficial to the city authority for effective management and monitoring of groundwater. The correlation coefficient and spatial distribution maps are helpful to illustrate the hydro geochemical relationships among the parameters and their distribution in the study area.

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