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Statistical Modelling of Groundwater for Environmental Sustainbilty

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Abstract: ***In the worldwide calculations groundwater of urban areas has been depleting very rapidly by leaving its huge scarcity for the upcoming future generation due to uncontrolled and unpredictable census year by year along with migrations from rural to urban areas, at the other face the available groundwater is becoming polluted due to the unscientific handling like over lifting of water years together from one particular point which caused intrusion of pollutants in to the underground aquifers along with releasing of chemicals and other pollutant substances on the open ground as well as in to the nearby water bodies are the prime reasons for groundwater contamination. Modeling of groundwater with respect to its quality along with the quantity is an immediate need to be taken why because groundwater plays vital role and very important component to meet the total requirement of water lifting from the underground aquifers for both domestic and agricultural needs. By lifting water from the same point there is a possibility for deteriorating of water content in that aquifer and it may leads to permanent destruction of water quality in that respective aquifer, to overcome these consequences the modeling technique where withdraw of water will be regulated along with injection of water into the aquifer can be adopted. In the present study we have identified ten sampling localities from Guntur municipal corporation, Andhra Pradesh, India by considering severe problems associated with groundwater in both quality and quantity point of view, in all the locations five sub locations were identified for water sampling. Samples were collected for three times from the bore wells and hand pumps, average of three times analysis was considered as final values. Analysis was done by using standard analytical methods. The results were compared with IS 10500 -2012 drinking water quality standards to get the scenario of water quality.***

Keywords: ***Depleting, Groundwater, Modeling, Regulating, Scenario, Withdraw.***

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I. INTRODUCTION

Groundwater quantity and its quality in any urban areas is very important criteria to focus which is directly connected to the developmental activities and alsofor the living standards of the public,as the year are passing with tremendous increase and advancement in the field of science and technology for improving the quality of life at the other end protecting groundwater for the needs of present and future generation is the biggest problematic issue to concentrate as the source is limited and even the same is getting polluted due to the activities of people along with unimagined climatic situation that are changing very frequently.

In any area the groundwater modelling and management mainly depends on the volume of withdrawing water for the needs of the people in that area and rate of pumping along with groundwater recharging facilities in association with regulatory polices made by the local people to protect groundwater.

Majorly the groundwater is contaminating by the addition of hazardous substances to the ground and in to the water bodies, groundwater also getting polluted with high percentage of sprinkling pesticides and chemical fertilizers to raise the crop productivity.

Groundwater modelling is very much required to identify the response against to the stress on ground with respect to contamination of groundwater by conducting field studies for expecting to raise natural and artificial recharge capacity of the ground.

Groundwater modelling can helps to project accurate hydrological scenario and its association with various elements for predicting its possible changes in the behaviour of groundwater quality and its flow.

Groundwater management strategies are designed to enhance the quality and quantity of water without disturbing the existed environmental conditions, the target of sustainable development can be achieved with a set of proposed strategies, proper designing and perfect planning by optimum consumption of available resources.

II. OBJECTIVE

1. To analyze the groundwater quality in the selected zones of the study area
2. To correlate the results with IS 10500-2012 drinking water quality standards
3. To frame the guidelines and the strategies for environmental management plan (EMP)

III. METHODOLOGY

III.I Sampling locations:

1. Ten sampling locations were identified by considering the volume of people and the intensity of developmental activities taking place in the area.
2. All the samples were collected in bore wells and hand pumps, all the collected Sampling bottles were labelled with the names of locations

III.II Water quality Analysis:

1. Total seventeen parameters were examined namely P^H, Colour, Turbidity, Mg, Ca, Fe, Fluorides, Sodium, Total Alkalinity, Total hardness, BOD (Bio chemical Oxygen Demand), COD (Chemical Oxygen Demand) and DO (Dissolve Oxygen).
2. Standard analytical methods were adopted to conduct the tests
3. Three samples were collected from every location for three months
4. The results were correlated with IS(Indian standards)10500-2012 to find out the existed condition of groundwater

Table 1: Groundwater quality at study area

Area Code	P^H	C	T	Mg	Ca	Fe	Cl	So4	Na	F	T.A	T.H	BOD	COD	DO
1.1	7.1	6	4	17.1	70.2	0.17	210.7	117.1	53.9	0.6	105.5	151.2	4.3	7.7	3.2
1.2	6.9	5	3.7	21.2	42.6	0.2	207.9	120	97.9	0.7	126	126.6	3.7	5.6	3.5
1.3	7.3	8	2.9	12.7	53.6	0.09	220.7	147	99	0.5	109.2	102	2.5	9.2	2.6
1.4	7.7	7	4.6	25.7	66.1	0.23	204.2	136.3	124.4	0.4	170	190	4.7	8.9	3.7
1.5	7.9	9	3.9	19.2	71.6	0.19	242.4	170	77.8	0.6	191.1	181	2.9	5.7	1.8
2.1	6.9	4	1.9	17.2	74.6	0.24	235	121.9	61	0.6	110	122.7	3.4	5.9	1.6
2.2	8	10	2.6	15.7	62.9	0.11	220.9	147.9	59.2	0.7	137.4	141.4	4.6	7.6	3.2
2.3	7.6	5	4.7	29.2	67	0.18	229.2	131.9	141.2	0.4	157.6	133.4	2.2	8.2	1.5
2.4	7.4	7	3.8	16.7	51	0.27	241.2	179.9	136	0.2	188.9	189.7	3.9	9.1	3.5
2.5	7.3	4	4.2	9.8	59	0.17	257.4	190.2	52.1	0.2	166	191	4.7	5.2	3.7
3.1	6.9	11	1.5	17.2	67.7	0.06	239	187	71	0.7	170	141.4	4.9	7.1	2.6
3.2	7.4	5	4.6	24.4	72.2	0.27	210	155.9	64	0.5	112	205.6	4.4	7.6	1.7
3.3	7.7	12	3.6	27.2	70	0.13	202.1	152.9	107	0.5	183	109.1	3.9	7.8	2.8
3.4	7.6	9	4	8.8	68.3	0.29	249.2	161	69	0.6	141	177.7	4.1	8.9	1.6
3.5	7.1	7	4.9	21.9	71.2	0.12	237	160	183	0.5	167	155.6	4.56	5.3	3.9
4.1	8.4	13	5	28	59	0.06	262	179	100	0.7	102.6	160	4.6	9.2	2.4
4.2	7.1	6	3.9	35.4	62	0.25	207	102	155	0.7	107	130.4	4.2	9.7	3.4
4.3	6.9	9	4.4	19.1	69	0.21	232.8	171	167	0.7	197	107.4	3.8	8.8	3.6
4.4	6.7	7	3.9	21.9	61	0.14	240	235	130	0.5	205	112.6	4.6	7.4	3.7
4.5	7.9	4	2.6	27.4	52.1	0.02	224	122	59.9	0.4	161.6	149.5	4.4	9.7	2.1
5.1	8.2	8	3.4	11.1	57.1	0.19	239	147.6	71.9	0.4	147.7	114	4.7	8.1	3.2
5.2	7.7	5	2.9	17.1	55.5	0.27	245	152	67	0.6	177.8	170	4.9	6.4	2.8
5.3	6.8	9	4.5	20.2	71	0.37	231.9	142	140	0.7	131.4	197	5.02	6.2	3.3
5.4	7.4	7	1.9	21.7	72.2	0.16	209.8	187	133.2	0.7	101	195	4.1	7.1	3.8
5.5	7.1	5	4.5	25.7	69.9	0.05	237	140	109	0.4	67.1	156	4.7	6.2	2.9
6.1	8.1	8	4.7	20.1	66.2	0.07	239	190.1	51.1	0.4	51.17	147.7	4.8	7.8	3.1
6.2	7.6	5	4.7	27	51.6	0.21	230.2	141.1	57.1	0.5	140.1	191.9	4.8	8.7	5.4
6.3	7.6	6	3.7	11	70.2	0.09	202.6	111.1	100	0.2	76.02	157.7	3.7	9.1	1.6
6.4	7.1	5	4.2	17	59.6	0.19	245	147	146.4	0.4	146	164	4.6	8.8	3.2
6.5	6.9	7	2.6	22.1	96.2	0.22	236.6	133.4	133.9	0.7	71.04	171	3.2	5.6	2.4
7.1	7.9	11	1.7	18.2	55.6	0.17	209.1	167.2	121	0.1	46.64	177	2.1	7.7	4.4
7.2	7.6	8	2.5	26.2	60.2	0.14	217.2	188.9	67.6	0.8	155	131.7	1.9	6.4	2.1
7.3	7.4	9	3.2	21	72	0.04	246	176.9	92.1	0.4	193	179	4.1	7.1	3.5
7.4	7.6	6	4.2	14	58.5	0.07	237.1	197.7	87.9	1.2	55.06	119.2	2.6	8.2	3.7
7.5	8	7	3.4	19.1	69	0.11	209.9	177.1	111.9	0.3	88.24	187.4	4.7	8.4	2.5

Area Code	P^H	C	T	Mg	Ca	Fe	Cl	So4	Na	F	T.A	T.H	BOD	COD	DO
8.2	8.2	11	4.7	24.1	71.1	0.27	231.1	184.4	71	0.8	104	210	3.7	6.4	3.9
8.3	7.4	13	3.5	9.2	52	0.04	211.1	142.4	88.8	0.6	170.1	196.1	1.8	5.2	1.5
8.4	7.5	5	2.1	27	59.9	0.25	222.1	107.1	64.6	0.7	136	133.3	2.5	6.4	2.5
8.5	7.6	7	4.6	11.2	61.1	0.17	202.1	104.1	147.9	0.3	141.4	147.1	2.7	6.7	3.2
9.1	7.8	8	6.7	6	66.6	0.05	260.1	181.7	131	0.7	131.9	191	4.3	5.4	3.6
9.2	8.2	8	4.5	19	71.9	0.09	230	127.7	176.6	0.9	128.6	121.7	4.6	9.1	2.9

9.3	7.4	5	3.7	4	73	0.17	241.1	141.2	97.1	0.8	91.1	187.9	3.9	9.7	2.6
9.4	7.6	7	2.1	14.2	52	0.26	218.1	123.4	76.1	0.4	71	197.9	4.7	8.8	2.1
9.5	6.8	9	3.1	18	70.7	0.05	210	187.9	54	0.7	50	144.4	5.2	5.7	1.9
10.1	6.9	14	4.1	16	71.9	0.09	236.1	156.6	140.4	0.1	210	131.4	4.9	6.9	2.9
10.2	7	5	2.5	24	74.1	0.27	241.1	250.5	136.9	0.2	77.77	146.6	3.1	7.1	3.3
10.3	7.1	7	3.8	35.6	56	0.29	247.1	192.1	122.9	0.5	49.54	176.6	2.9	7.5	1.9
10.4	7.1	8	4.1	11	61	0.3	239.8	111.7	149.5	0.6	155.79	181	3.8	8.2	3.5
10.5	7.7	7	4.9	27.6	87	0.18	229.9	156.2	157	0.7	100	109.1	4.5	9.6	3.7

Where: C- Colour, T – Turbidity, Mg- Magnesium ,Ca- Calcium, Fe- Iron, Cl- chlorides, So4 –Sulphates, Na – Sodium F- Fluorides, TA – Total Alkalinity, TH Total hardness, BOD (Bio chemical Oxygen Demand), COD (Chemical Oxygen Demand) and DO (Dissolve Oxygen).

IV. RESULTSAND DISCUSSIONS

S.NO	PARAMETER	EXPLANATON
1	P^H	The P^H in the collected samples water correlated with IS 10500-2012 drinking water quality standards it was noticed that the P^H of the water in the study area is good
2	Turbidity	The Turbidity in the collected samples water correlated with IS 10500-2012 drinking water quality standards it was identified that the turbidity of the water in the study area is crossed its acceptable limit.
3	Magnesium as Mg	The Mg, concentration in the samples were correlated with IS 10500-2012 drinking water quality standards it was noticed that the Mg of the water in the study area is within the acceptable levels.
4	Calcium as Ca	The percentage of 'Ca 'in the collected samples correlated with IS 10500-2012 drinking water quality standards it was observed that the 'Ca 'of the water in the study area is acceptable
5	Fluorides as F	The 'F ' in the water samples were examined and correlated with IS 10500-2012 drinking water quality standards it was noticed that the ' F 'of the water in the study area is in the acceptable limits
6	Chlorides as Cl	The levels of 'Cl ' in samples of water correlated with IS 10500-2012 drinking water quality standards it was concluded that the ' Cl 'of the water in the study area is acceptable
7	Sulphates as so4	The 'so4 ' in the collected samples water correlated with IS 10500-2012 drinking water quality standards it was noticed that the ' so4 'of the water in the study area is good
8	1. The water quality in the study area is good and acceptable to consume with minimum treatment accept in the area which indicates high turbidity levels. The remaining all parameters were within the acceptable limits as per the IS 10500 -2012 drinking water quality standards. 2. Proper awareness must be created among the people on sustainable consumption of groundwater for promoting environmental sustainability.	

V. CONCLUSIONS

1. The water quality at any area depends on the climatic conditions and the activities of the surrounding people and it is always tend to change with respect to the concentration of various parameters.
2. There should be proper guidelines on practicing rainwater harvesting pits and must made it as mandatory requirement for approving plan for the proposed constructions.
3. There should be clear cut guidelines on releasing of chemicals and hazardous materials to avoid the risk of groundwater contamination.
4. Proper modelling techniques of groundwater must be adopted with respect to the quality of groundwater to raise the living conditions which in turn leads to sustainable development.
5. Risk assessment must be done periodically to overcome the consequences of environmental instability of freshwater aquifers.
6. Formulation of laws on judicial consumption of groundwater to promote environmental sustainability.

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