Assessment of Ground Water Quality in Different Villages Situated near Musi River Basin in Ghatkesar Mandal of Ranga Reddy District in Andhra Pradesh

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Assessment of Ground Water Quality in Different Villages Situated near Musi River Basin in Ghatkesar Mandal of Ranga Reddy District in Andhra Pradesh

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ABSTRACT: Water is a most precious resource which the nature has given to the mankind and other living beings. Its excessive and wrong use creates numerous problems. The quality of ground water plays a vital role in assessing the availability of safe water for miscellaneous uses such as drinking, irrigation and industrial use. City based effluents entering into the Musi river in Hyderabad region of Andhra Pradesh deteriorates water quality in several ways. The present study was conducted to assess the ground water quality of sixteen (16) villages of Ghatkesar mandal in Ranga Reddy district, Andhra Pradesh in the vicinity of Musi river. Water analysis was done for pH, electrical conductivity, carbonates, bicarbonates, calcium, magnesium, sodium, potassium, Residual Sodium Carbonate, (RSC) Sodium Adsorption Ratio (SAR) and fluoride. Almost all the water samples were found safe from the view point of pH, carbonates, bicarbonates, calcium, magnesium, sodium, potassium, RSC, SAR and fluoride. However, from the view point of electrical conductivity which is measure of soluble salts (salinity), water samples (25 %) collected from Sadataliguda, Jodimetla, Annojiguda and Narapally villages were found safe for irrigation purpose, whereas, the samples collected from Mathwaliguda, Maqta, Tenuguguda, and Venkatapur villages (25 %) were doubtful from the point of their suitability for irrigation. The samples collected from Peerjadiguda, Parvathapur, Kachavanisingaram, Pratapsingaram, Korremula, Chowdarguda, Medipally, and Boduppal (50 %) were unsuitable for irrigation purpose because of higher EC values. The salty water can be used for irrigation, if mixed with good quality water. Fluoride content was found within the safe limits (0.02-0.07 m.eq.L^{-1}).

Key words: Ground water quality, Irrigation, Musi river basin, Andhra Pradesh, water salinity.

Water is a precious resource and is very essential for life. Ground water is mostly distributed resource of the earth. It gets replenished from the annual precipitation (or) rainfall. The world's total water resources are estimated at 1.37*10^8million ha-m. Surprisingly, of these global water resources, about 97% is saline water, mainly in oceans, and only 2.8% is available as fresh water at any time on the planet earth. Of this total water available (2.8%), about 2.2% is reported as surface water and only 0.6% as ground water. Considering the contribution of glaciers and icecaps, very limited amount is available in lakes, reservoirs and streams as surface water. It means ground water is the predominant source of fresh water on the earth, excluding the polar icecaps and glaciers. It has been reported that about 1/5th of all the water used in the world is received from ground water resources. Of the total rainfall 370 M ha-m received in the entire country,1/3rd is lost as surface evaporation. Of the balance 247 M ha-m, 166 M ha-m flows as runoff and the remaining amount of 80 M ha-m percolates into the soil and contributes towards subsoil water. Of this percolated water into the subsoil, about 43 M ha-m gets absorbed in the top layer, thereby contributing to the soil moisture and the remaining amount of 37 M ha-m in real sense contributes to ground water from rainfall. Due to excessive pumping, there has been fall in the ground water table in the recent past. Further, the chemical quality of water is also deteriorating due to several reasons. The chemical composition of ground water is primarily related to the soluble products of rock weathering and decomposition and changes with respect to time and space (Raghunath, 2002)

Modern agricultural practices such as use of inorganic fertilizers, pesticides and herbicides pose a serious threat to the ground water pollution. Further, industrial effluents, which are unsafely disposed off, also contribute towards ground water pollution. Ground water, apart from being used for irrigation purpose, is also used as a source of drinking water for millions of rural and urban families. According to some estimates, it accounts for nearly 80% of the urban water needs in India. It has been understood that ground water is generally less susceptible to contamination and pollution when compared to surface water bodies. Even the rainwater enters the ground water after the natural infiltration through soil strata. However, in India where ground water is used intensively for irrigation and industrial purposes, a variety of land and water based human activities are causing pollution of this precious resource. The important parameters which determine the quality of water for irrigation as well as for other uses include pH, electrical conductivity, bicarbonates, calcium, magnesium, sulphates, chlorides, nitrates, sodium, potassium, Residual Sodium Carbonate, Sodium Adsorption Ratio and fluoride content (Kundu and Singh, 2004) and toxic trace elements and heavy metals (Kanwar and Sandha, 2000) and pesticides and herbicides (Singh, 2004). Soil and ground water salinization as a result of irrigation has been documented in Haryana, Rajasthan and Punjab states in particular (Kamra *et al.,* 2002; Khan, 2001). Surveillance of drinking water is essentially a health measure intended to protect the public from water borne diseases. (Sanjeeve *et al.,* 2004). Ground water quality is highly dependent on the nature of aquifers and on the ambient climatic conditions. Ground waters of calcium bicarbonate type with near neutral pH values typify the wetter regions of the north and north-east of the region where alluvial sediments constitute the most important aquifers. Both alluvial sediments and crystalline aquifers in the arid regions of Rajasthan often contain sodium-bicarbonate or sodium chloride type ground waters, reflecting increased salinity where rates of evapotranspiration are high and recharge is low. Salinity is a notable problem in the most arid and semi arid areas, exacerbated by salinization related to irrigation. In many arid areas, evaporite salts are observed as surface encrustations (Umar and Absar, 2003). Fluoride content has also long been recognized as one of the most significant natural ground water-quality problems affecting arid and semiarid regions of India. Some sustainable forms of appropriate-technology for water treatment has been developed for the removal of fluoride for the Nalgonda region of A.P. (Nawlakhe and Bulusu, 1989). Musi River, which passes through a metropolitan city of Hyderabad receives huge quantity of sewage and industrial effluents and poses a serious threat to agriculture lands and ground water sources. The present study was conducted to assess the quality of ground water in some of the villages situated near the vicinity of the Musi river basin.

Materials and Methods

The present water quality study was conducted in 16 villages of Ghatkesar mandal in Ranga Reddy District of Andhra Pradesh during 2006. Ground water samples were collected from 16 bore wells of different villages in Ghatkesar mandal of Ranga Reddy district in Andhra Pradesh .The tube wells were randomly selected covering 16 villages namely, 1. Peerjadiguda 2. Parvathapur 3. Kachavanisingaram 4. Mathwaliguda 5. Pratapsingaram 6. SadatAliguda 7. Maqta 8. Korremula 9. Tenuguguda 10. Venkatapur 11. Chowdarguda 12. Jodimetla 13. Annojiguda 14 Narapally 15. Medipally and 16. Boduppal. Boring depth of the bore well samples ranged from 80-200 ft.

Water samples freshly pumped out of each tube well were collected from 16 locations in two separate well-rinsed, polypropylene bottles of 500 ml and 1000 ml capacity. Water samples were brought to the laboratory. They were analyzed immediately for pH and EC (Electrical conductivity) using conductivity meters (ELICO make, model no: LI 612 pH analyzer, CM 183-EC analyzer). After that samples were stored in refrigerator for further analysis. The ground water samples were analyzed for different parameters such as Carbonates (CO_3) and Bicarbonates (HCO_3^-) by titration method, Calcium (Ca), Magnesium (Mg) were directly measured by using Inductively Coupled Plasma Spectrophotometer (ICP-OES, GBC Scientific equipment Pty Ltd.Australia.), Sodium (Na) and Potassium (K) were estimated using Flame photometer (Toshniwal make) Residual Sodium Carbonate (RSC) was computed by using the following relationship

$RSC=(HCO_3^{-})+(CO_3^{--})-(Ca^{2+}+Mg^{2+})$, where all concentrations were expressed as m.eq. L^{-1}. Sodium Adsorption Ratios (SAR) of the water samples were determined by the following relationship

$$SAR = Na/\sqrt{\frac{Ca + Mg}{2}}$$

Where the concentrations are in milli - equivalents per liter (meq L^{-1}). Magnesium and calcium ratio of the water samples were also worked out. The fluoride content was also estimated in the ground water samples. The data were subjected to statistical analysis to compute the mean values.

Results and Discussion

Data on various soil quality parameters have been presented in Table 1. Across the sampled bore wells, the pH of the water samples varied from 6.6 to 7.4 with a mean value of 6.97 whereas EC varied from 1.37 to 4.97 with a mean value of 2.94 dS m^{-1}. Considering EC values, about 25% of ground water samples were found permissible for irrigation (EC 0.75-2.0 dS m^{-1}) and 25% of analyzed samples were found doubtful (EC>2.0-3.0 dS m^{-1}) for irrigation ,whereas 50% of samples were found unsuitable for irrigation(EC> 3.0 dS m^{-1})Table-2

Interestingly, ground water samples contained no carbonate but bicarbonate contents varied from 2.12 to 20.0 meq L^{-1} with mean value 10.18 meq L^{-1}. In order to calculate the carbonate and bicarbonate contents in ground in excess of calcium and magnesium, Residual Sodium Carbonate (RSC) was calculated. The RSC values in the samples analyzed were marginally low (<1.25 meq L^{-1}) in all the samples. As suggested by Richards, (1954), water containing RSC <1.25 meq L^{-1} is considered to be safe, whereas, it becomes unsafe when RSC exceeds 2.50 meq L^{-1}. As per this criteria, all the water samples analyzed were found to be safe for irrigation purpose (Table 3).

There are confirmed reports that calcium and magnesium do not behave equally in soil system. Magnesium deteriorates soil structure particularly when irrigation water is rich in sodium and highly saline. Further, relatively high level of magnesium usually promotes higher amount of exchangeable sodium in irrigated soil. In the present study, calcium and magnesium contents ranged from 7.65 to 20.87 and 3.28 to13.49 meq L^{-1} with the corresponding mean values of 12.14 and 6.32 m.eq .L^{-1} respectively. The magnesium /calcium ratio of all the samples were <1.5. It has been understood that water having Mg/Ca ratio <1.5 is considered safe, between 1.5 and 3.0 is marginally safe and which exceeds 3.0 is unsafe for irrigation purpose (Table 3).

Sodium Adsorption Ratio (SAR) is another important indicator of water quality. Hazard caused by sodium in irrigation water can be expressed by computing. As has been reported by Richards (1954), water having SAR values <10 can be used for irrigation in variety of soil types, with little risk of development of harmful levels of exchangeable sodium. In the study area, the SAR values of ground water varied from 0.88 to 7.51 with mean value 2.96 meq L^{-1}.Considering the critical value of SAR, all the water samples analyzed (100%) were found to be in the permissible safe limit for irrigation purpose (Table 2). Water is a major source of fluoride intake. Throughout, many parts of the world, high concentration of fluoride occurring naturally in ground water and coal have caused wide spread fluorosis-a serious bone disease-among local populations. Fluoride exists fairly abundantly in the earth's crust and can enter ground water by natural processes. In the present study, fluoride content varied from 0.02 to 0.07 me L^{-1} with a mean value of 0.05 .The permissible upper limit (critical) of fluoride suggested by World Health organization (WHO) in drinking water is 0.08 meq L^{-1}. However, the same limit has been reduced to 0.05 meq L^{-1} for India. The water samples analyzed in the present study were found safe from the toxic effects of fluoride.

Conclusion

In general, the various parameters, which are considered important for irrigation water quality, are salinity hazard (total soluble salts), sodium hazard (a relative proportion of sodium (Na^+) to calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions), alkalinity (carbonate and bicarbonate), specific ions (chloride, sulphate, boron and nitrate –N) and pH. In the present study, the water samples were found almost safe from the viewpoint of pH, calcium, and magnesium content, sodium content, fluoride, SAR and RSC. However, when EC was considered, only 25% of the water samples were found suitable for irrigation, 25% of the samples analyzed were doubtful and 50% samples were found unsuitable for irrigation. The water samples collected from SadatAliguda, Jodimetla, Annojiguda, Narapally, were found safe for irrigation purpose. The samples collected from Mathwaliguda, Maqta, Tenuguguda and Venkatapur villages were found doubtful from the viewpoint of their suitability for irrigation. However, the samples collected from Peerjadiguda, Parvathapur, Kachavanisingaram Pratapsingaram, Korremula, Chowdarguda, Medipally

Table 1. Ground water quality parameters of some villages of Ghatkesar Mandal in Ranga Reddy District , Andhra Pradesh

Name of the village	PH	EC ($dS\,m^{-1}$)	CO_3	HCO_3	Ca	Mg	Na	K	RSC	Fluoride	SAR
						($m.eq.\ L^{-1}$)					
Peerjadiguda	7.4	3.32	Nil	7.8	12.86	9.65	5.83	0.08	Nil	0.04	1.74
Parvathapur6.9	4.97	Nil	10.8	16.09	13.49	15.83	0.36	Nil	0.07	4.12	
Kachavanisigram	7	3.42	Nil	8.4	12.29	9.0	9.43	0.38	Nil	0.07	2.89
Mathwaliguda	7	2.24	Nil	10.8	8.56	2.09	8.70	0.08	0.1	0.07	3.78
Pratapsingaram	6.8	3.78	Nil	20	17.82	5.58	12.39	0.05	Nil	0.02	3.62
SadatAliguda	6.8	1.59	Nil	7.2	7.67	3.42	17.65	0.72	Nil	0.05	7.51
Maqta	7	2.46	Nil	11	7.66	4.42	7.52	0.11	Nil	0.03	3.07
Korremula	6.9	4.8	Nil	11.2	17.47	10.73	17.61	1.79	Nil	0.04	4.70
Tenuguguda 7	2.94	Nil	12.6	8.23	5.43	11.0	1.23	Nil	0.04	4.21	
Venkatapur 7	2.84	Nil	8.4	10.86	5.47	9.57	0.31	Nil	0.04	3.35	
Chowdarguda	6.9	3.26	Nil	10.6	15.27	8.48	3.04	0.13	Nil	0.03	0.88
Jodimetla	6.9	1.61	Nil	9.2	8.81	4.49	3.48	0.05	Nil	0.05	1.35
Annojiguda 7	1.48	Nil	8.6	7.65	3.28	4.04	0.05	Nil	0.04	1.73	
Narapally	7.4	1.37	Nil	10	7.81	4.21	2.39	0.08	Nil	0.04	0.98
Medipally	6.96	3.83	Nil	9.8	14.34	8.05	6.91	2.92	Nil	0.08	2.06
Boduppal	6.6	3.05	Nil	6.4	20.87	3.39	4.91	0.08	Nil	0.02	1.41
Mean	6.97	2.94	-	10.18	12.14	6.32	8.77	0.53	0.0063	0.05	2.96
Range	6.6-7.4	1.37 4.97	-	2.12-20.0	7.65-20.87	3.28-13.49	2.39-17.65	0.05-2.92	0-0.1	0.02-0.07	0.88-7.54

Table 2. Frequency distribution of EC (d S m^{-1}) and SAR of the ground water samples of Ghatkesar Mandal in Ranga Reddy District of Andhra Pradesh.

EC(d S m^{-1})	Classes of water	No. of Tube wells	% of total samples
(0.250)	Excellent	0	-
(0.250-0.750)	Good 0	-	
(0.750-2.00)	Permissible	4	25%
(2.00-3.00)	Doubtful	4	25%
(3.00)	Unsuitable	8	50%
SAR			
<10	Permissible safe	16	100%
10-18	Modasately.safe	-	
18-26	Modasately.unsafe	-	
>26	Unsafe-		

Table 3. Frequency distribution of RSC(m.eq.L^{-1}) and Mg/Ca Ratio of the ground water samples of Ghatkesar Mandal in Ranga Reddy district of Andhra Pradesh.

RSC of water (meq.L^{-1})	No. of tube wells	% of total sample
< 1.25	16	100
1.25-2.50	-	
2.50-5.00	-	
>5.00	-	
Mg/Ca ratio		
< 1.5	16	100
1.5-3.0	-	
>3.0	-	

and Boduppal were not found suitable for irrigation purpose because of higher salt contents. Base on the findings, farmers of the targeted villages can be advised that that salty or saline water can be used for irrigation, after mixing with good quality water from alternative wells.

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