International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 05, 2020
ISSN: 1475-7192

Groundwater Pollution in Nanduru Region in Andhrapradesh

R. Venkata Ramana* and P. Nageswara Rao

Abstract--- *Groundwater is fresh and renewable resource having more advantages than surface water. Groundwater is more important for the development of any region. Management of its quality becomes necessary due to its limited availability in many regions. Hence Hydrogeochemistry of groundwater is determined to understand its quality for domestic and agricultural use in an unconfined aquifer in Nanduru region. Groundwater samples are collected and tested for determining the constituents present in it. Values of these constituents are greater than the prescribed limits. Water quality assessment parameters such as Percent Sodium, Residual Sodium Carbonate and Sodium Adsorption Ratio are also determined. Values of these parameters indicate that this water is more polluted. The salt water intrusion, ion exchange reactions, evapotranspiration and dissolution of carbonate minerals are the main processes responsible for regulating the chemistry of groundwater. As per the calculated parameters, high salinity and alkalinity of groundwater create problems for cultivation of crops. This groundwater pollution leads to decrease in soil quality and crop production. Proper management and maintenance of groundwater resources is advised to prevent its pollution and sustainability in this region.*

Keywords--- *Hydrogeochemistry, Groundwater Quality, Nanduru Region, Sodium Adsorption Ratio.*

I. INTRODUCTION

Demand of groundwater for various purposes is increasing day by day. Severe drought conditions prevailed sometimes in the past, insufficient availability of surface water, increasing demand of water for different uses such as irrigation etc., lead to depend on exploitation of groundwater. At the same time maintenance of groundwater quality also becomes necessary as it leads to ill- health of living beings in that area and decrease in agricultural production. Chemical composition of groundwater depends on geological structures, deterioration of lithological formations and evapotranspiration within aquifers [1]. More over the increase of population, agricultural and industrial activities and decrease in water table level due to over exploitation leads groundwater resources under constrains throughout the world [2]. Natural and anthropogenic factors affect the groundwater hydrochemistry [2]. Increasing cultivation practices, insufficient surface waters, low precipitation and high evaporation have constrained to drinking water supply. Earlier studies carried out in this area are groundwater contamination by backwaters of Tungabhadra drain, assessment of pollution in groundwater in Krishna delta, saline water intrusion in Appikatla and Gudipudi villages in Guntur district in Andhra Pradesh [3,4,5]. These studies reveal some of the factors responsible for pollution in the surrounding areas. Hence, a study is carried out in this region to assess aquifer vulnerability, groundwater suitability for drinking and agriculture purposes.

R. Venkata Ramana, Vignan's Foundation for Science, Technology and Research Deemed to be University, Vadlamudi, Andhra Pradesh. E-mail: rvramana_62@yahoo.com*
P. Nageswara Rao, Acharya Nagarjuna University, Andhra Pradesh.

DOI: 10.37200/IJPR/V24I5/PR201998
Received: 25 Feb 2020 | Revised: 20 Mar 2020 | Accepted: 30 Mar 2020

II. STUDY AREA

Nanduru region lies at 10 kilometers distance to Ponnur town in southern direction and occurs from 16.0239°N latitude to 80.5090^{0}E longitude as shown in map enclosed (fig1). It is located in Ponnur tehsil of Andhrapradesh state in India. Nanduru region is situated in western direction to Tungabhadra canal flows in N-S direction. This region makes 10^0 slope with the Bay of Bengal and extends over an area of 1187 hectares. It lies 9 meters above mean sea level. The study area contains 93% cultivated land, 5% domestic land and 2% waste land. It has mean rainfall of 230 millimeters per annum. This region contains black cotton formation as superficial soil zone. Clay, clayey sand and silt occurred as subsurface formations. Permeable coarse to medium sands occur around the Nanduru region. These sand formations lie at 11 to 28 m depth from the ground level. These sandy formations have a thickness of 9 to 13 m and yields fresh groundwater. Thick clay formation lies above these sandy formations and yields saline water. Fresh groundwater available in sands of paleo channels in this region as per report of Central Groundwater Board [6]. Groundwater in this region is exploited through shallow tube wells for cultivating agriculture lands. Water table in this region occurs at a depth of 3.9 meters to 6.2 meters from surface.

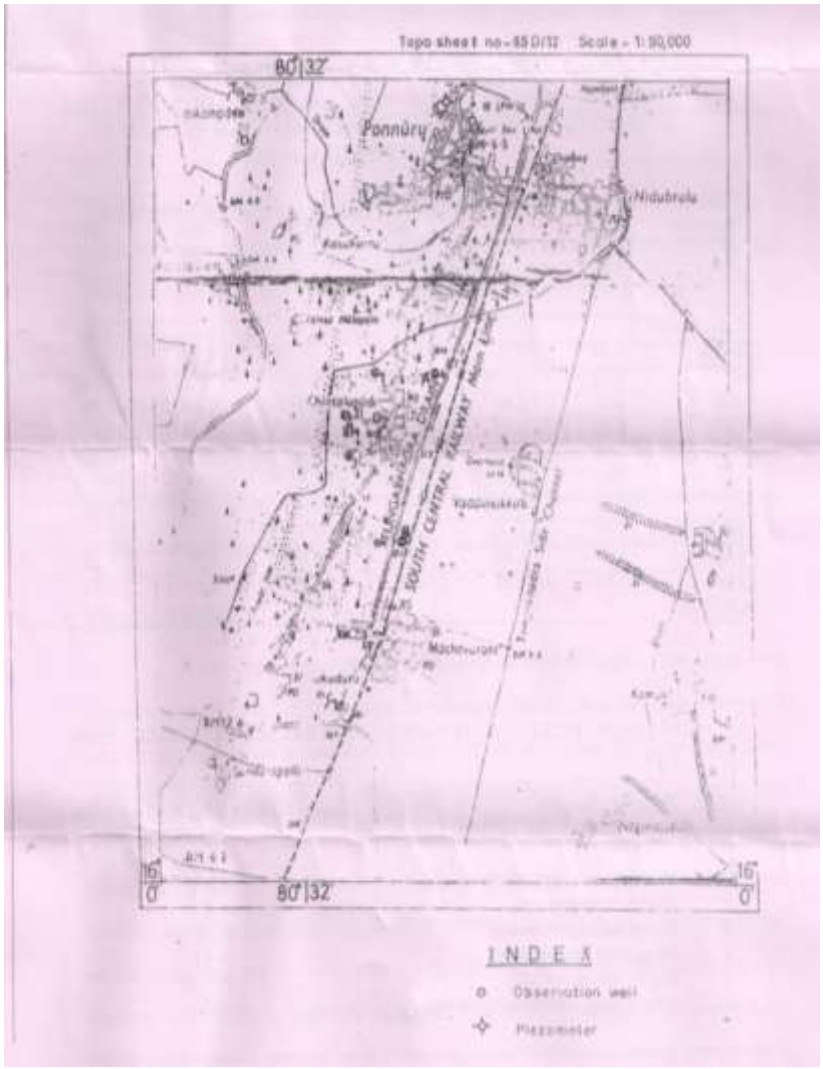

Fig. 1: Location map of Nanduruu

DOI: 10.37200/IJPR/V24I5/PR201998
Received: 25 Feb 2020 | Revised: 20 Mar 2020 | Accepted: 30 Mar 2020

III. METHODS

It is found during preliminary hydro geological investigations conducted in Nanduru region that quality of ground water has decreased remarkably at present. Hence considering groundwater contamination in Nanduru region, groundwater data of this region in 1976 year available from Andhra Pradesh State Groundwater Board, and the average values of five ground water samples collected in various directions from Nanduru village during Decemberber-2019 and May-2019 are considered and compared [7]. Analysis details of groundwater samples is as shown in Table 1.

Table 1: Groundwater data in Nanduru region

Constituents	Nanduru region		
	1976	May, 2019	December, 2019
P^H	7.64	8.62	8.85
EC (micro siemons/cm)	1940	2760	2890
CO_3 (meq/l)	0.52	2.53	2.78
HCO_3 ,'	3.58	6.56	6.84
Cl ,'	7.66	16.43	15.78
SO_4 "	3.84	7.16	7.49
Ca^{+2} ,'	1.54	2.39	2.16
Mg ,'	1.73	3.14	3.31
Na^+ ,'	1.62	34.45	35.78
K^+ ,'	0.15	0.28	0.46
RSC .'	0.83	3.56	4.15
SAR ,'	1.27	20.72	21.63
Na%	51.75	597.59	611.13

Table 2: Wilcox (1967) permissible values of Electrical Conductivity, Sodium Adsorption Ratio, Residual Sodium Carbonate and Percent Sodium for Agriculture purpose

Parameters	Range	Category
Electrical Conductivity	<2000 µs/cm	Unpolluted
	>2000 µs/cm	More polluted
Sodium Absorption Ratio	<18	Unpolluted
	18-26	Moderately polluted
	>26	More polluted
Residual Sodium Content	< 2.5	Unpolluted
	>2.5	More polluted
Percent Sodium	<60	Unpolluted
	>60	More polluted

DOI: 10.37200/IJPR/V24I5/PR201998
Received: 25 Feb 2020 | Revised: 20 Mar 2020 | Accepted: 30 Mar 2020

Electrical Conductivity: Electrical conductivity value is 1940 µs/cm in 1976 year and that of ranges from 2760 to 2890 µs/cm in 2019 year in Nanduru region as per Table 1. Electrical conductivity value 1940 µs/cm in 1976 year in Nanduru region indicates the uncontamination of groundwater in that year whereas its value ranges from 2760 to 2890 µs/cm in 2019 year suggests that more pollution of groundwater and unsuitable for agriculture purpose as per Table 2.

Residual Sodium Content: According to Raghunath [8],

$$\text{Residual Sodium Content} = (CO_3 + HCO_3) - (Ca + Mg)$$

As per Table 1, Residual Sodium Content value of groundwater in Nanduru region is 0.83 in 1976 year and ranges from 3.56 to 4.15 in 2019 year. Residual Sodium Content value of groundwater greater than 2.5 implies its more pollution as per Table 2. Residual Sodium Content value of groundwater 0.83 in Nanduru in 1976 year implies that the groundwater is not polluted in that year where as its value ranges from 3.56 to 4.15 in 2019 year suggests that more pollution of groundwater and its unsuitability for agriculture purpose as per Table 2.

Sodium Absorption Ratio: As per USSLS [9]

$$\text{Sodium Adsorption Ratio} = Na/\{(Ca+Mg)/2\}^{1/2}$$

Sodium Adsorption Ratio of groundwater in Nanduru region is 1.27 in 1976 as per Table 1 and ranges from 20.72 to 21.63 in the year 2019. Sodium Adsorption Ratio of groundwater more than 26 indicates the more polluted groundwater as per Table 2. Sodium Adsorption Ratio of groundwater 1.27 in Nanduru region in 1976 year imply that the groundwater is not polluted in that year whereas its value ranges from 20.72 to 21.63 in 2019 year suggests that more pollution of groundwater and its unsuitability for agriculture purpose as per Table 2.

Percent Sodium

$$\text{Percent Sodium} = \{(Na+K)/(Ca+Mg+K)\}100$$

Percent Sodium content of groundwater in Nanduru region is 51.75 in 1976 year and ranges from 597.59 to 611.13 in 2019 year as per Table 1. Percent Sodium content more than 60 indicates the more polluted groundwater as per Table 2. Accordingly the Percent Sodium content 51.75 in Nanduru region in 1976 year implies that the groundwater is not polluted in that year. Percent Sodium content in Nanduru region ranges from 597.59 to 611.13 in 2019 year suggests that more pollution of groundwater and its unsuitability for agriculture purpose as per Table 2.

Higher values of Electrical Conductivity, Sodium Adsorption Ratio, Residual Sodium Carbonate and Percent Sodium in 2019 year in Nanduru region indicate that increase in sodium content implies more pollution of groundwater and unsuitable for agriculture purpose as per Wilcox [10]. It may be due to increase in number of tube wells and over exploitation of groundwater, excessive use of fertilizers and pesticides and proximity of sea water to this region. Tube wells raised in number from 38 in 1976 year to 850 in 2019 year implies proper regulation and monitoring of tube wells construction needed in this region.

IV. CONCLUSIONS

It is concluded that in the Nanduruu region, increase in number of tube wells, over exploitation of groundwater

DOI: 10.37200/IJPR/V24I5/PR201998
Received: 25 Feb 2020 | Revised: 20 Mar 2020 | Accepted: 30 Mar 2020

through these tube wells for irrigation and excessive use of Pesticides leads to contamination of groundwater. The following precautions should be followed to prevent pollution of groundwater in this region. Overexploitation of groundwater should be controlled and regulated in proper way. Artificial recharge tanks should be dug nearer to the contaminated area. Water harvesting areas should be constructed in this region. Artificial recharge should be done by storing the water in agriculture fields also. Excessive use of pesticides and fertilizers should be avoided. The groundwater department should construct observation wells and monitor quality of groundwater in the study area. Regular leaching and special management for salinity control should be applied. More use of pesticides and chemicals should be avoided in this region.

REFERENCES

[1] Nematollahi, M.J. Ebrahimi P. Razmara M. Ghasemi A. Hydrogeochemical investigations and groundwater quality assessment of Torbat Zaveh plain, Iran. *Environ Monit Assess.* 188 (1) (2016) 1-21.

[2] Singh K.P. Gupta S. Mohan D. Evaluating influences of seasonal variations and anthropogenic activities on alluvial groundwater hydrochemistry using ensemble learning approaches. *J. Hydrol.* 511 (2014) 254-266.

[3] Ramana, R.V. Saline water intrusion in Appikatla and Gudipudi villages in Guntur district in Andhra Pradesh. *International journal of Civil Engineering and Technology*. 9 (4) (2018) 1495-1500.

[4] Venkata Ramana, R. Groundwater contamination by backwaters of Tungabhadra drain. *Journal of Advanced Research in Dynamical and Control Systems*. 11 (8) (2019) 74-77.

[5] Venkata Ramana, R. Assessment of pollution in groundwater in Krishna delta. *International Journal of Innovative Technology and Exploring Engineering.* 8 (9) (2019) 236-240.

[6] Central Groundwater Board (CGWB) Ground water information guntur district, Andhra Pradesh; cgwb.gov.in/ district profile/ ap/ guntur.pdf

[7] Andhra Pradesh State Groundwater Board (APSGWB). *Note on Groundwater quality of Ponnur mandal in 1972* by Andhra Pradesh State Groundwater Board, (1972).

[8] Raghunath, H.M. Groundwater, *Wiley Eastern Ltd., Delhi, India,* (1967) 563.

[9] U.S.Salinity Laboratory Staff (USSLS). *Diagnosis and improvement of saline and alkali soils.* U.S. Department of Agriculture Handbook 60 (1954) 160.

[10] Wilcox, L.V. *Classification and Use of Irrigation Water*, USDA Circ. 969, Washington D.C., USA, (1967) 19.

DOI: 10.37200/IJPR/V24I5/PR201998
Received: 25 Feb 2020 | Revised: 20 Mar 2020 | Accepted: 30 Mar 2020