IJRSET AUGUST 2017 Volume 4, Issue 7 Pages: 72-78
ISSN 2394-739X
International Journal for Research in Science Engineering and Technology

GROUNDWATER QUALITY MAPPING USING REMOTE SENSING AND GIS – A CASE STUDY FOR NAGONDAPALLI PANCHAYAT, HOSUR BLOCK, KRISHNAGIRI (DT), TAMILNADU, INDIA.

[1] Dr. L. YESHODHA, [2] Mr. B. M. Purshothaman, [3] Er. V. KARTHICK
[1] Professor, [2] Assistant Professor, [3] Research Scholar
Department of Civil Engineering,
Adhiyamaan College of Engineering,
Hosur, Tamilnadu-635109, India.

ABSTRACT: Water is an elixir of life. It is an indispensable natural resource of this planet.Water availability and its quality has a profound impact on the overall well-being of people in a country and its development. Ground water is the major source in India not only for domestic use, but also for agricultural and industrial sector. The present investigations orient towards assessing the groundwater quality in Nagondapalli Panchayat of Hosur block and to map the groundwater quality using GIS. Groundwater samples were collected from different location in and around the study area. The physico-chemical parameter such as pH, EC, TH, TDS, TA, Ca, Mg, Na, K, Cl, F, SO_4, NO_3, HCO_3were analyzed and results were compared with WHO standards. ArcGIS software tools were used for analyzing and displaying the spatial data for investigations ground water quality. The results showed that most of the parameters were within permissible limits,except in some areas theEC, TH, TDS, TA, Ca, Mg, HCO_3 wasslightly high.Using overlay and thematic map interpretation for the selected critical parameters spatial distribution of drinking water is mapped through GIS software.

KEY WORDS: [Groundwater, Physico-chemical parameter, GIS, WHO,Spatial Analysis]

1. INTRODUCTION

Many consequences of unsustainable groundwater use are increasingly evident in several parts of the world due to ever-increasing population, urbanization and intensified human activities. The main concern is how to maintain sustainable groundwater supply on a long-term basis. Ground water has an important role in meeting the water requirement of agriculture, industrial and domestic sector in India.Groundwater, being a hidden natural resource, is not amenable to direct observations and hence, exploration or assessment of this resource plays a pivotal role in determining locations of water supply, monitoring wells, and in controlling groundwater pollution. As greater development and use of ground water continues, combined with the reuse of water, quality suffers unless consideration is given to protecting it (Adhikary et al.,).Ground water contains a wide variety of dissolved inorganic chemical constituents in various concentrations resulting from chemical and biochemical interactions between water and geological materials. Inorganic contaminants include Salinity, Chloride, Fluoride and Arsenic are important in determining the suitability of ground water for drinking purposes (Ground water quality in shallow aquifers of India, 2010).Chemical composition of ground water is influenced not only by geographical factors like type of soil, rocks through which the water percolates but also by anthropogenic factors like use of fertilizers, pesticides, uncontrolled disposal of industrial wastes etc (Praveen Kumar.G et al.,2014).The Remote Sensing technology and GIS hasenabled data collection and subsequent assessment possible evenin the most inaccessible areas thus helping in effective study ofground water. GIS helps in creating geographical databases andthematic models of ground water depth, quality etc.

Corresponding author: yesocivil123@yahoo.co.in

2. STUDY AREA

Nagondapalli one of the Panchayat of Hosur block, Krishnagiri district of TamilNadu. It is located about 57kms towards west from headquarters, Krishnagiri. Nagondapalli panchayat has two villages with a total population of 3000, covering an area of 8.96 sq.km, it lies b/w 12°39'to 12°41'30" N latitude and77°46'30" to 77°49' E longitude. It has a tropical climate and receives an average rainfall of 850 mm. People in this panchayat are dependent on ground water for various purposes, since there is no perennial source. Fig 1 shows the study area map

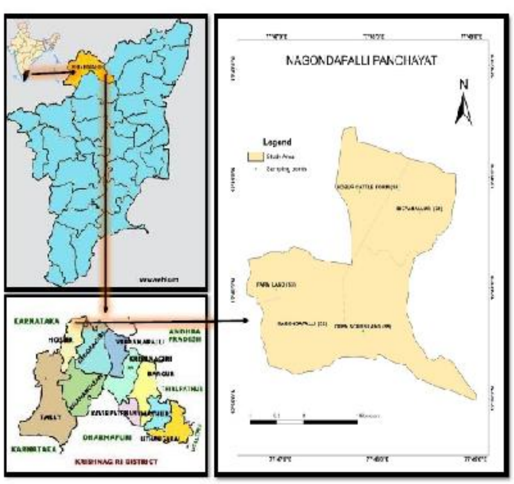

Figure 1- Study Area map

3. METHODOLOGY AND MATERIALS

The present study aims in assessing the ground water quality and to map the parameters based on spatial analysis technique using ArcGIS software. Fig 2 depicts the detailed methodology of the analysis

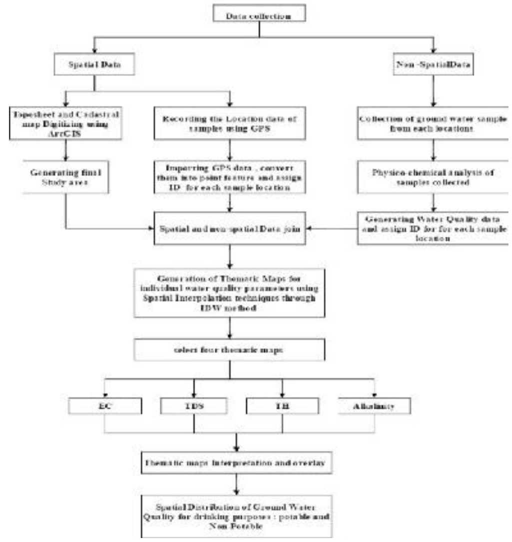

Figure 2 - Flowchart of methodology

3.1 Data source:

Hosur Block map and Cadastral map of the panchayat was collected from the Taluk office, Hosur for the preparation base map of the study area.

Toposheet D43X14 with scale 1:50,000 of Krishnagiri district was collected from the survey of India, Chennai.Fig 3 shows the Toposheet clipped for the study area.

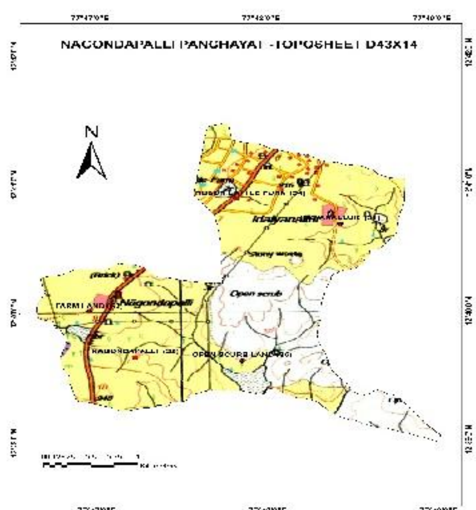

Figure 3 - Toposheet -D43X14

3.2 Analysis of Water Samples:

Groundwater samples from various locations of the panchayat were collected which are extensively used for drinking and irrigation purposes. Sample location points and their co-ordinates are recorded using the Garmin e-trex GPS.Assign ID for each sample location pointswhich were shown table 1. Samples were analysed as per standard procedure for variousphysio-chemical parameters and the results compared with values recommended by World Health Organization (WHO).

Location ID	Name	LATITUDE	LONGITUDE	ALTITUDE (m)
S1	IDEYANALLUR	12.67804207	77.80736230	902.68
S2	NAGONDAPALLI	12.66099225	77.78719137	904.30
S3	FARM LAND	12.66689736	77.78276056	914.67
S4	HOSUR CATTLE FORM	12.68135847	77.79728402	908.46
S5	OPEN SCURB LAND	12.66043053	77.79762341	901.22

Table 1 : Sample points with GPS data

GIS is a powerful tool for the integration of the spatial data with the attribute data of samples result. Maps collectedwere scanned, georeferenced and digitization of boundaries was done using ARCGIS 10.4 software. Using cadastral maps, boundary of study area is traced out to create the spatial database.

3.3 Inverse Distance Weighting (IDW) Interpolation:

In the Inverse Distance Weighting (IDW)technique, a weight is attributedto the point to be measured. The amount of this weight is dependent on the distance of the point to another unknown point. These weights are controlled on thebases of power of ten. With increase of power of ten, the effect of the points that are farther diminishes.Lesser power distributes the weights more uniformlybetween neighbouring points. In this method, the distancebetween the points count, so the points of equal distancehave equal weights. The weight factor is calculatedwith the use of the following formula:

$$\lambda_i = \frac{D_i^{-\alpha}}{\sum_{i=1}^{n} D_i^{-\alpha}}$$

λ_i= the weight of unknown point

D_i = the distance between point i and the unknown point,

α = the power ten of weight.

4. RESULTS AND DISCUSSIONS

The Physico-chemical parametersof the sampleswere analysed and the results compared with WHO standards. Table 2 shows the results of samples analysed.

4.1. pH

Water is classified as acidic or alkaline based on the pH value. pH is an important indicator of the ability of water to dissolve. If the samples have pH value below 6.5, it is said to be acidic and if it exceeds the permissible limit, it is said to be in alkaline nature. The pH values of the samples ranged between 7.56 - 7.81 and itsaverage value was 7.7 which was within permissible limit as per WHO.

4.2 EC

EC of water is its ability to conduct electrical current due to the presence of dissolved material,more the dissolved material higher is the EC. It generally affects the taste and acceptance of water as potable.The permissible limit of Electrical conductivity is 300 µS/cm. The electrical conductivity of the samples ranges from 486 - 814 µS/cm. All the values are higher than the permissible limits and the peak Value is found in Nagondapalli area (814 µS/cm). Fig 4 shows the spatial variation of Electrical conductivity (EC).

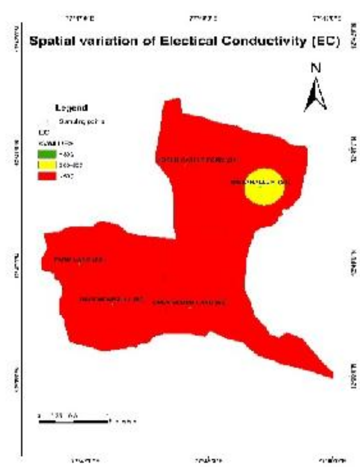

Figure 4 - Spatial variation of EC

PARAMETERS LOCATION ID	PH	EC µS/cm	TH mg/L	TDS mg/L	TA mg/L	Ca^{2+} mg/L	Mg^{2+} mg/L	Na^+ mg/L	K^- mg/L	Cl^- mg/L	F^- mg/L	SO_4^{2-} mg/L	NO_3^- mg/L	HCO_3^- mg/L
S1	7.65	486	234	374	228	67	16.4	30.5	6.4	34	0.19	76.5	0.29	230
S2	7.56	814	482	552	244	128.3	39.1	97.4	25.1	55	0.25	54.6	0.35	248
S3	7.74	569	278	424	236	70	25.11	48.1	11.2	64	0.2	100.1	0.31	240
S4	7.72	650	360	510	286	101	26	93.1	31	114	0.26	32.5	0.34	290
S5	7.81	544	208	388	160	38.5	27.2	66.4	16.6	200	0.24	96.6	0.3	162
Min	7.56	486.00	208.00	374.00	160.00	38.50	16.40	30.50	6.40	34.00	0.19	32.50	0.29	162.00
Max	7.81	814.00	432.00	552.00	285.00	128.30	39.10	97.40	31.00	200.00	0.26	100.10	0.35	290.00
Mean	7.70	612.60	312.40	449.60	230.80	80.96	26.76	67.10	18.06	93.40	0.23	72.06	0.32	234.00
SD	0.10	127.08	110.97	77.94	45.47	34.50	8.11	28.70	10.03	66.44	0.03	28.63	0.03	46.28

Table 2 - Test result and statistical data of each location

4.3 Total Hardness

Water hardness represents the total concentration of calcium andmagnesium ions that is responsible for scaling of boilers. It is a measure capacity of water to react with soap. Values for the samples of total hardness ranges from 208 - 482 mg/l and the higher value is observed in Nagondapalli area about 482 mg/l. Fig 5 shows the spatial variation of total hardness (TH).

4.4 Total Dissolved Solids

Total Dissolved Solids is a measure of the combined content of all inorganic substance and organic substances contained in a liquid in molecular, ionized or micro-granular suspended form. The permissible limit of TDS is 500 mg/l as per WHO. The values of TDSin samples range from 374 -552 mg/l, which were above the permissible limits.Fig 6 shows the spatial variation of Total Dissolved Solids (TDS).

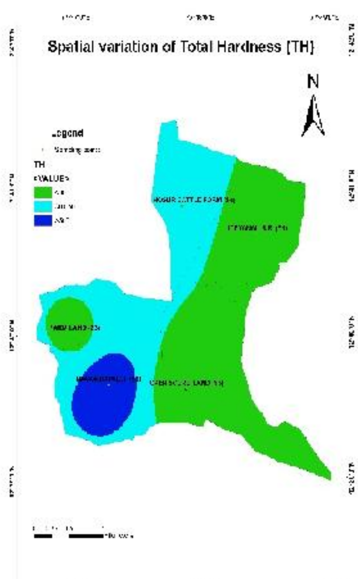

Figure 5-Spatial variation of TH

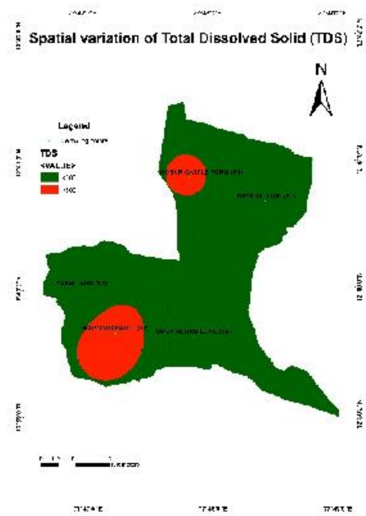

Figure *6*- Spatial variation of TDS

4.5 Nitrate

Nitrate is a naturally occurring oxide of nitrogen and is an essential living things. The permissible limit of nitrate is 45 mg/l as per WHO. The nitrate content in water samples ranges from 0.29 - 0.35 mg/l. So, all sampling points has a negligible value when comparing to the permissible limits.

4.6 Sulphate

Sulphates seep into ground water through effluents from industries like tanning, paper mills or through usage of chemical fertilizersin agriculture. The permissible limit of sulphate is 200 mg/l as per WHO. The sulphate content in the water samples ranges from 54.6 – 100.1 mg/l.

4.7 Fluoride

Fluoride have significant effects on teeth at lower concentrations in drinking water, but excessive to fluoride in drinking water or in combination with exposure to fluoride with other sources, can give rise to several adverse effects. The permissible limit of fluoride is 0.5 mg/l according to WHO. The samples have the fluoride content ranging from 0.19 – 0.26 mg/l. Comparatively, Edeyanallurvillage have less fluoride content 0.19 mg/l and all the values were within the permissible limit.

4.8 Chloride

Chloride is present in water due to agricultural activities, industries and chloride rich rocks. The permissible limit of chloride is 200 mg/l as per WHO. The chloride values of our samples were varying from 34 – 200 mg/l. All the values of samples fall within the permissible limit.

4.10 Sodium

Our body needs sodium for many basic processes essential to life. If the amount of sodium is high, the kidneys may not be able to do their functions properly. The permissible limit of sodium is 200 mg/l according to WHO. The sodium content in the samples Varies from 30.5 – 93.1 mg/l and all the values were below detectable limit.

4.11 Iron

Iron is one of the most abundant elements on earth. Iron is necessary for our health. Aeration of iron-containing layers in the soil can affect the quality of both groundwater and surface water if the groundwater table is lowered. The permissible limit of iron is 0.3 mg/l as per WHO. Allsamples values were below the detectable limit.

4.12 Calcium

Calcium is unique among nutrients, in that the body's reserve is also functional increasing bone mass is linearly related to reduction in fracture risk. The permissible limit of calcium in drinking water is 75 mg/l by WHO. The values are found to be varies from 67 – 128.3 mg/l. Excess calcium intake is directed the simultaneous presence of hypocalcaemia, metabolic alkalosis and renal insufficiency.Fig 7 shows the spatial variation of Calcium (Ca).

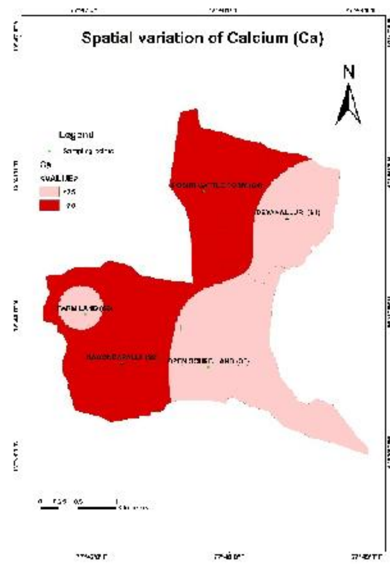

Figure 7-Spatial variation of Ca

4.13 Magnesium

Magnesium content in water plays a critical role due to higher bio-availability. The permissible limit of magnesium is 30 mg/l and the we obtained are varies from 16.4 – 39.1 mg/l. The highest value recorded at Nagondapalli area of 39.1 mg/l. Fig 8 shows the spatial variation of Magnesium(Mg).

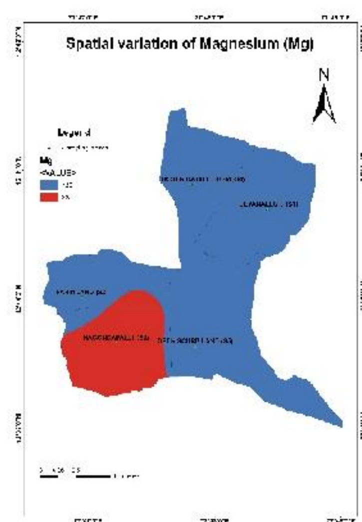

Figure 8-Spatial variation of Mg

4.14 Potassium

Potassium is an essential element in humans and is seldom. It occurs widely in the environment, including all natural waters. It can also occur in drinking-water because of the use of potassium permanganate as an oxidant in water treatment. The desirable limit of potassium ion in the drinking water is 8 mg/l. The value of potassium ion concentration in the sampling varies between 6.4 – 31 mg/l.

4.15 Total Alkalinity (TA)

Total Alkalinity is the measure of the capacity of unfiltered water to neutralize acid. In almost all natural waters alkalinity is produced by the dissolved carbon dioxide species, bicarbonate, and carbonate. The desirable limits for alkalinity was found to be 200mg/l as per WHO standards. The value ranges from 160 to 286 mg/l.Total Alkalinity was higher in almost all samples. Fig 9 shows the spatial variation of total alkalinity.

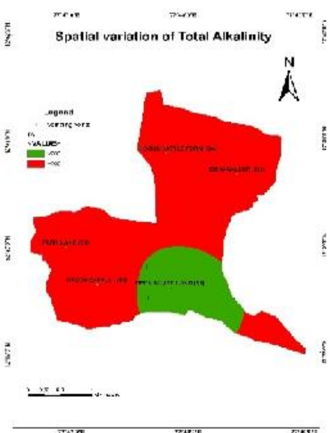

Figure 9 - Spatial variation of TA

4.16 Bicarbonate

Bicarbonate is a major element in the human body, which is necessary for digestion. If it exceeds 300 mg/l in the drinking water, as it may lead to kidney stones in the presence of higher concentration of Ca. Their value ranges between 162 mg/l to 290 mg/l. The highest value recorded was at Government cattle farm which were within the permissible limits only.Fig 10 show the Spatial variation of Bicarbonate (HCO_3).

4.17 Spatial distribution of drinking water Quality

Thematic maps of critical physico-chemical parameters like EC,TH,TDS and alkalinity were interpreted using ArcGIS overlay technique to delinate the spatial distribution of the drinking water quality potable and non potable regions.Fig 11 shows the spatial distibution of drinking water quality.

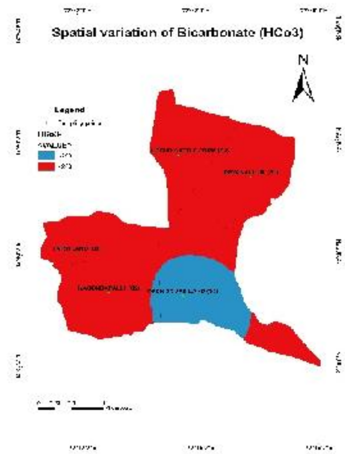

Figure 10- Spatial variation of HCO3

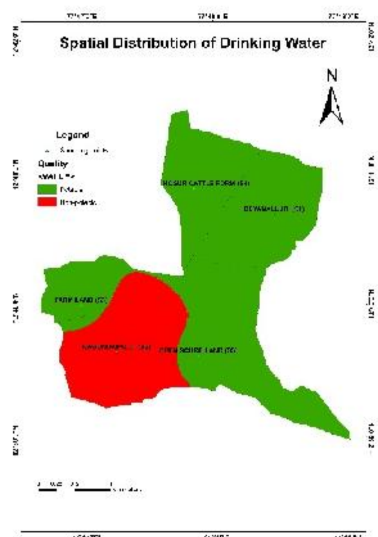

Figure 11- Spatial distribution of drinking water Quality

CONCLUSION

From the above results and maps, it is concluded that most of the parameters are within permissible limit and potable. Except some regions of south western part was non-potable. The spatial analysis and interpretations of thegroundwater quality of the study area successfullydemonstrate the GIS is apowerful tool in evaluation and describing the spatial analysis and mapping of the groundwater characteristics. The spatial maps give clear visualization of the ground water quality. This analysis made on ground water quality can be used as a reference for the further study and ground water modelling.

ACKNOWLEDGMENT

The Authors are very thankful to Natural Resources Data Management System (NRDMS) for providing financialassistance to carry out this investigation.

REFERENCES

[1]. P.Balakrishnan, Abdul Saleem and N.D., Mallikarjun. “Groundwater Quality Mapping using Geographic Information System (GIS): A Case Study of Gulbarga City, Karnataka, India” African Journal of Environmental Science and Technology. 2011. 5 (12) 1069-1084.

[2]. G.Praveen Kumar, M.Kaviarasan ,G.Rashmi ,P.Geetha“No.342/ISRS Proceedings 2014/ISPRSTCVIII Mid-Symposium 2014, Hyderabad, India”.

[3]. T., Subramani, S. Krishnan, and P.K., Kumaresan. “Study of Groundwater Quality with GIS Application for Coonoor Taluk in Nilgiri District”. International Journal of Modern Engineering Research. 2012. 2 (3) 586-592.

[4]. N., Karthikeyan, A., Saranya, and M.C., Sashikkumar. “Spatial Analysis of Groundwater Quality for Virudhunagar District, Tamil Nadu Using GIS”. International Journal of Remote Sensing & Geoscience. 2013. 2 (4). 23-30.

[5]. Thangavelu, A.. “Mapping the groundwater quality incoimbatore city, india based on physico-chemical parameters”.IOSR Journal Of Environmental Science, Toxicology AndFood Technology 3,2013, pp. 32–40.

[6]. WHO (World Health Organization). Guidelines for Drinking-Water Quality: Recommendations, 2nd Ed., 1993 pp: 174-180.

[7]. N.S. Elangovan, M. Dharmendiumar (2013), “Assessment of groundwater quality along the cooum river Chennai, Tamilnadu, India,”. Journal of Chemistry, id-672372.

[8]. T. Subramani, “Ground Water quality and the suitability for drinking and Agricultural use in Chithar River Basin, Tamil Nadu, India”, April 2005.

[9]. Shankar.K, Aravindan.S, Rajendran.S. (2010), “GIS based Groundwater Quality Mapping in Paravanar River Sub- Basin, Tamil Nadu, India”, International Journal of Geomatics and Geosciences, 1.1(3), pp. 282-296.