Spatial Variation of Groundwater Quality Parameters in Different Areas of GHMC, Hyderabad - Case Study

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Abstract *- The present study aims to assess the spatial and temporal variations of the hydro chemical characteristics of North Zone of GHMC ground water. 80% of the study area occupy with dense residential area. The depth to water level in the area majorly in between 5 to 20m. The hydro chemical data used in the study is collected from bore well and dug wells in December 2022 by the authors. total of 72 sample collected from various location to cover the study area. pH, TDS, Hardness, Alkalinity, Chloride, Sulphate, Sodium And Potassium, Nitrate and flouride were analysed in BVRIT environmental engineering laboratory, Hyderabad. from the result it is observed that the ground water is quality is poor and not suitable for drinking. the contamination of groundwater is due to the lack of maintenance of waste disposal in the study area.*

Keywords — *North zone GHMC, Groundwater, physico-chemical parameters, spatial variation,*

I. INTRODUCTION

India is the world's largest user of groundwater. The country uses about 230 cubic kilometers of groundwater each year. This equates to more than a third of the entire world. More than 60% of irrigated agriculture and 85% of drinking water resources depend on groundwater alone [1]. Sewage and industrial waste pollute surface and ground water in Indian cities.

The current level of groundwater use in the city includes many problems, issues and issues for the management of groundwater sustainability at the bottom [2]. If the trend continues, there are serious situations in many areas, both in the short and long term [3]. The current level of use, protection and protection measures and practices cannot control all situations. In this context, the first thing to do is to develop conservation effectiveness, conservation strategies and action plans, and to ensure stability in the region. For this purpose, it is very important to examine the problems, problems and problems faced by groundwater quantity and quality at the regional level.

Considering the above points, this study attempts to evaluate changes in groundwater physicochemical parameters in a part of Hyderabad city using GIS software. Some researchers have studied changes in the temporal and spatial distribution of groundwater quality, as well as metaphysical and chemical parameters related to the impact of human activities polluting groundwater in the form of waste [4]–[25]. Besma [26] studied the impact of recovery and release areas on groundwater quality of the Mathur aquifer (Northeast Tunisia) with the help of a groundwater quality map.

The investigating area falls under *North Zone of GHMC (Greater Hyderabad Muncipal Corporation) and lies between* 78° 26.49' W latitude and 17° 24.5' N longitude with a total area of 18.309 Sq. Km (fig.1). It comes under Musi Basin, which is part of the Krishna River that crosses the city of Hyderabad and divides the city into north and south. The elevation of the area fluctuates between 460 and 560 meters above sea level. The main geomorphic units are the residual hills, mountain plains and valleys. The slope of the Musi River is 2 meters per kilometer and flows from west to east, and most of its streams are ephemeral streams.

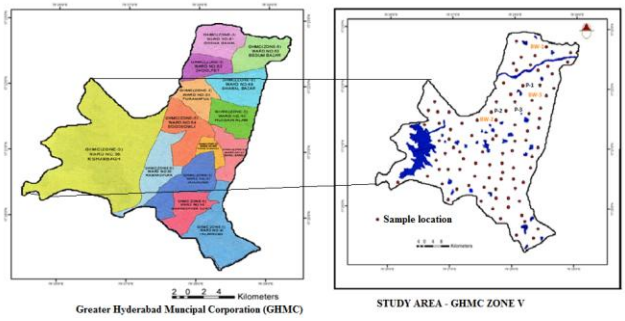

Fig. 1 Location Map

II. METHODOLOGY

The hydrochemical data used in the study is collected from bore well and dug wells in December 2022 by the authors. total of 72 sample collected from various location to cover the study area. pH, TDS, Hardness, Alkalinity, Chloride, Sulphate, Sodium and Potassium, Nitrate and flouride were analysed in BVRIT environmental engineering laboratory,

Hyderabad. the base map was digitised using arc GIS software. the latitude and longitude of location points are noted using GPS and imported on base map with the help of ARC GIS software. spatial maps are generated using ARC GIS spatial analyst tool.

II. RESULTS AND DISCUSSION

Land Use / Land Cover categories are classified in the study area from IRS-RS2 LISS4 FMX Resolution 5.8mts and IRS-1C PAN and IRS-1D LISS III Imagery satellite data. 80 percent of the land covered with dense residential area. it is observed that there is poor waste disposal system. The solid and liquid waste join the groundwater in the form of leachate and destroying the water quality of the aquifer.

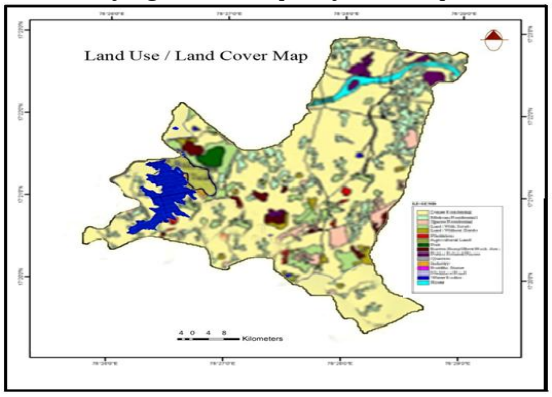

Fig. 2 Landuse/Landcover Map

Over the years, water levels has fallen in many areas such as Kothapet, Moulali, Kukatpalli, Boinpalli, Aghapura, Erragadda, Bashherbagh, Langar house, Jubilee hill, Begumpet, Koti, West Maredpalli, Gudimalkapur, Mushherabad, Sanath nagar, Picket and Madhapur. The depth of the water usually ranges from 5 to 20 m, with an average of 12 m. The water depth varies between 5 m and 20 m barrels in the pre-monsoon period and between 2 m and 15 m barrels in the post-monsoon period.

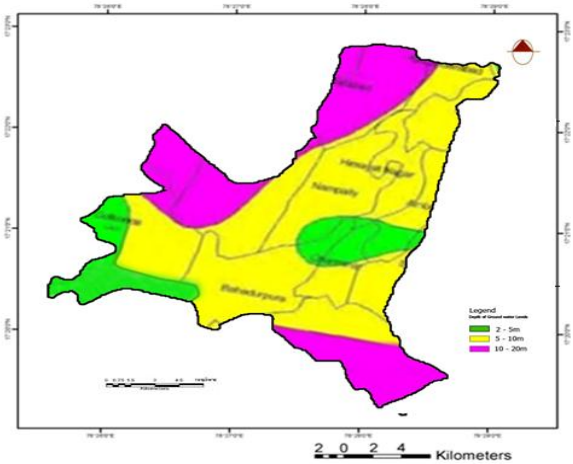

Fig.3 Depth to water level map

a) pH

he recommended pH tolerance for public water supplies is between 6.5 and 8.5. The pH of water samples in the area currently ranges from 7.01 (Bahadurpur Nala S-W) to 28 Mahabob Gunj. The pH of most samples collected in the study area is neutral to slightly alkaline.

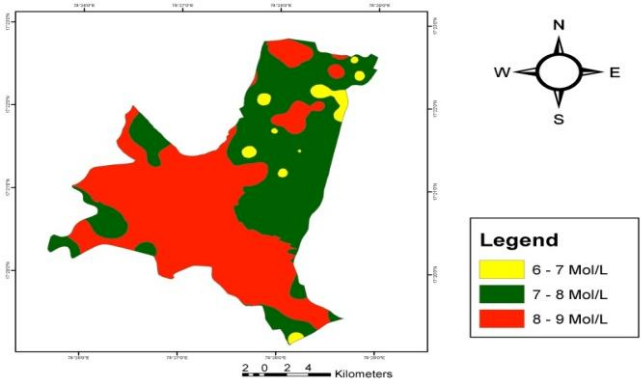

Fig.4 pH distribution in the study area

b) Total Dissolved Solids(TDS):

The recommended Indian standard value for TDS in drinking water is 500 mg/1. TDS concentrations in the study ranged from 285 to 1180 mg/l. Kishanbagh, Afzal Gunj, Ramanjpura, Gulab Singh Bowli, Hussaini Alam, Asad Baba Nagar, in Amberpet , Kamalanagar, Bazarghat, Bathkamakunta, Chikkadpally, Imlibun, Ghansi Bazar and NawabSaheb Kunta, showed above 500mg/l TDS concentration. Samples taken near the Musi river and near the Hussain Sagar outlet at Chikkadpally were found to have high TDS. It has been observed that the waste and liquid wastes in the study area are not in good condition. At present, the quality of groundwater has been greatly affected.

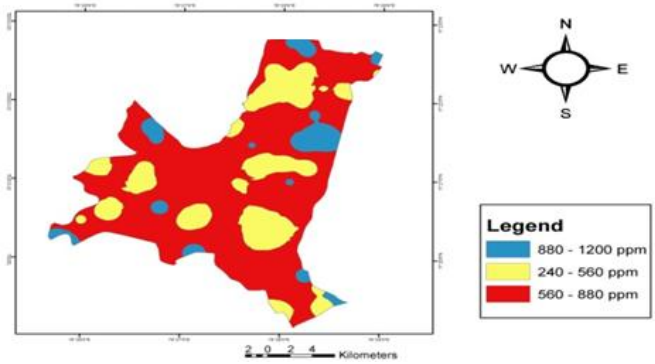

Fig.5 TDS distribution in the study area

***c) Hardness*:**

Figure 6 shows that a higher hardness of 360 - 700 ppm was reported in the center of the study area. Hardness values as low as 100 - 220 ppm have been reported in the north, east, west and south of the study area.

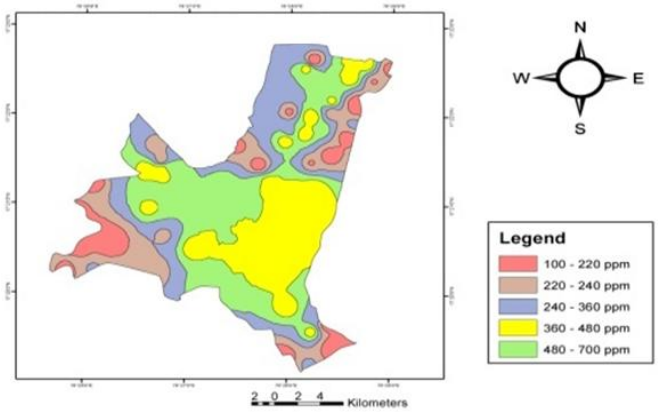

Fig.6 Hardness distribution in the study area

***d) Alkalinity*:**

Figure 7 shows that the size of the study area presents alkalin ity values of 20-145 ppm. Higher alkalinity values (560 - 695 ppm) were reported in the southern part of the study are a. The reason for this is the osmansagar lake located in the so uth of the study area. Osmansagar lake supplies drinking water

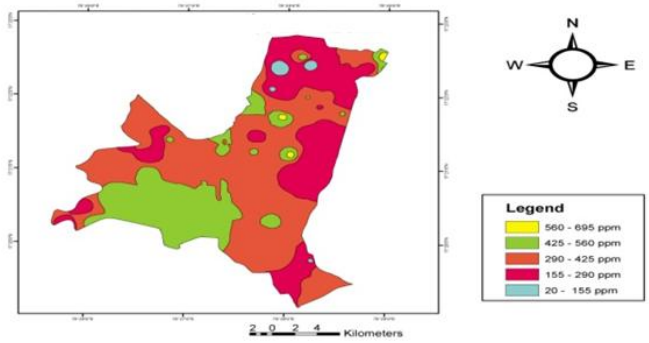

Fig.7 Alkalinity distribution in the study area

e) Chloride (Cl):

Fig.8 portrays that the larger extent of area in North, West, Southern portions are reported relatively lower values of chloride in the ground water resources. The remaining categories of moderate chloride values 145 – 270 ppm, 270 – 395 ppm and 395 – 520 ppm are reported in relatively lower patches in the edges of north, west and east portion. The area come under these categories are in and around Miralam tank, Tadbun and Semshanglai. Similarly, the imaginary also shows similar pattern.

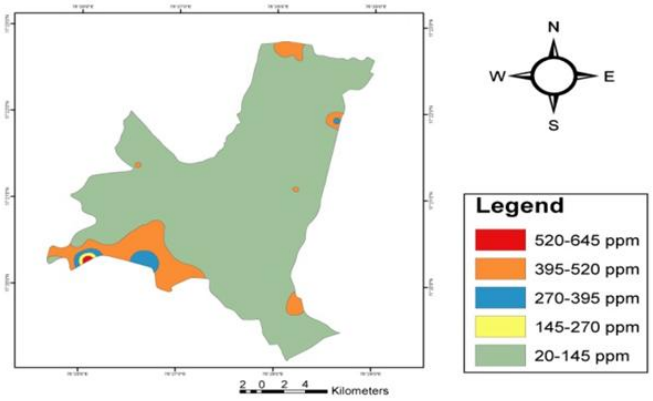

Fig.8 Chloride distribution in the study area

f) Sulphate(S):

Figure 9 shows that very high levels of sulfate (342 - 509 ppm) have been reported in groundwater for most of the North, Southwest and East of the area. Similarly, very small area reported values of 175 - 342 ppm.

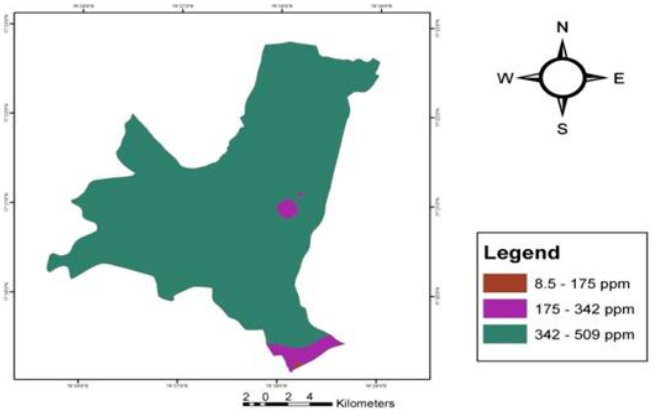

Fig.9 Sulphate distribution in the study area

g) Sodium and Potassium (Na+K):

Fig.10 portrays that relatively higher extent of region in North, West, East and South are reported relatively lower values of sodium and potassium (17 – 125 ppm and 125 – 243 ppm) in the area. However, relatively higher value of sodium and potassium (361 – 479 ppm and 479 – 597 ppm) are reported in the isolated small patches in the almost all the directions. The areas such as Falaknama Palace, Zoological park, Kishnabagh, Gosha mahal and Gowliguda chaman are reported relatively higher values of sodium in the ground water

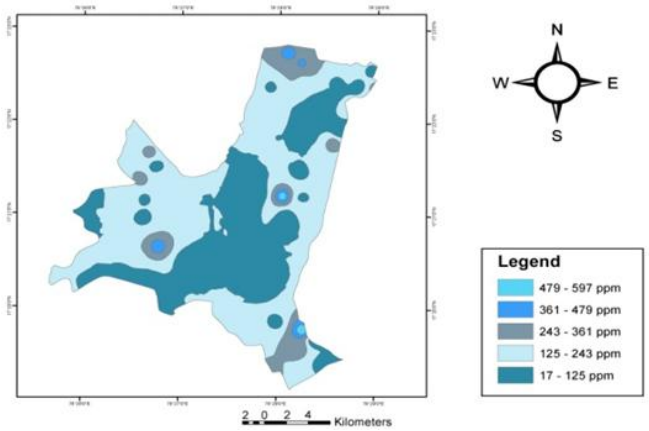

Fig.10 Sodium and Potassium distribution in the study area

h) Nitrate(N):

It may be observed from fig.11 that large extent of the region in almost all directions reported higher value of nitrate (163 – 217 ppm and 109 -163 ppm) in the study area when compared to the figures of WHO standards (45 – 100 ppm). Further, almost all the areas in the study area are reported relatively higher values of Nitrate.

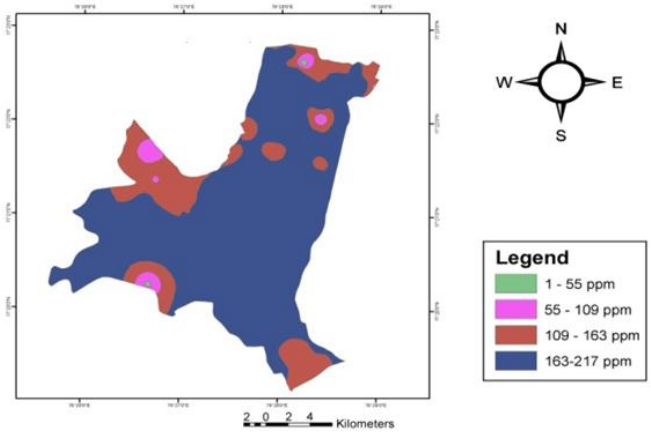

Fig.11 Nitrate distribution in the study area

i) Fluoride (F):

Fig.12 shows that relatively higher values of fluoride 1.5 – 2.66 ppm and 2.6 – 3.7 ppm are reported in larger extent of the areas in East, South, Western regions of the area. Almost all the areas of the study area is found in this categories. However, a considerable proportion of the area which has lower value of fluoride is also reported in the scattered and lower extent patches. The areas in and around such as Nudimusaiguda, Miralam tank, Kishanbagh, Zoological Park, Gosha Mahal, Feelkhana, Gouliguda, Gulzar Harz and Ghansi Bazar are reported relatively higher values of fluoride in ground water resources while relatively lower values of fluoride (0.4 – 1.5 ppm) is reported in the areas of Bandarpur, West Devibagh, Bahadpura, Samsheer, Kabutar Khana, Gosh Mahal, Mangalhat east respectively.

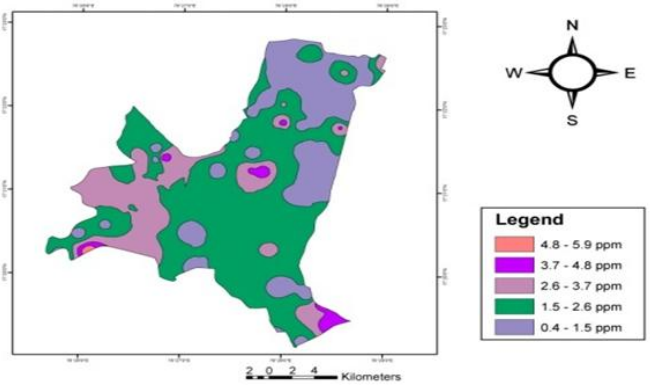

Fig.12 Flouride distribution in the study area

IV. CONCLUSIONS

It is evident from the above results that the large extent of dense residential area come under in the study area (GHMC: Zone–V). Further, the river and other water bodies are also occupied by unauthorized constructions and slums. As a result the quantity of surface water as well as ground water is decline quality at an alarming rate. All these conditions significantly responsible for contamination and pollution of groundwater at greater extent. The hydrological, geological and geo-morphological conditions are also significantly affected by the rapid urbanization and industrialization. As a result, the quantum of groundwater resources are significantly depleted over the period.

To improve the groundwater quality it need to identify the sources of contamination and water pollution as per zone-wise in and outskirts of the study area. To develop safe disposal system for solid and liquid wastes and industrial effluents as per zone-wise in and outskirts of the study area. improve the recycling facilities for plastic and medical disposal waste at storage points alone. To create better hygienic conditions in and around bore-wells as per zone wise in and around outskirts of the study area.

The finding of the study envisages that the extent of recharge conditions of water resources is not upto the mark. Hence, the study has recommended to develop recharge pits in and around bore well not only to collect roof top water of the every house but also connected into bore well. As a result, the rain water is entered into the earth and within quantum of ground water resources in and around bore wells improved a lot. Further, the water table as well as acquifer system are improved substantially.

R

EFERENCES

1) Gumma, R., K., Rao, P., N., Varadaraj, N., and Kumar, G., P., 2011. Groundwater Scenario in Major cities of India- Hyderabad City, Andhra Pradesh, Central Ground Water Board report, pp.90-98.

2) Prakash, G., R. Vasudevan, R. Sundaram, J. Bagchi, M. Narula, G. Lovink, & S. Sengupta, 2002. The Cities of Everyday Life, sarai READER: 02,pp.1-345.

3) Mishra V, J Cullmann, NS Raghuwanshi, GH Schmitz, Peakflow analysis with WaSiM-ETH-model parameter sensitvity and input data quality, European Geosciences union (EGU), Vienna, Austria.

4) K. Ilayaraja and A. Ambica, 2015. Spatial Distribution of Groundwater Quality Between InjambakkamThiruvanmyiur Areas, South East Coast of India , Nature Environment and Pollution Technology, 14(4), pp.771-776.

5) B.Abraham Ponsingh and K.Maharani, 2015. A Study on Groundwater Quality and Spatial Distribution of Gandarvakottai Taluk by Using GIS, The Asian Review of Civil Engineering, 4(1), pp.36-41.

6) Chacha, Nyamboge ;Njau, Karoli N. ;Lugomela, George V. ;Muzuka, Alfred N. N., 2018. Hydrogeochemical characteristics and spatial distribution of groundwater quality in Arusha well fields, Northern Tanzania, Applied Water Science, 8 (4), pp.3-23.

7) Thanga Gurusamy.B, Ilango.T, Soundarya.M.K, Ram Kumar.R, Janagar.N, Paul Abbinesh.L.S., 2018. Spatial Distribution Analysis And Mapping Of Ground Water Quality Across Chennai, International Journal of Civil Engineering and Technology 9 (4), pp.620–630.

8) Bjerg, P.L. and Christensen, T.H., Spatial and Temporal 1992. Small-Scale Variation in Groundwater Quality of a Shallow Sandy Aquifer, Journal of Hydrology, 131(1-4), pp.133-149.

9) M. C. Sashikkumar, S. Selvam , V. Lenin Kalyanasundaram and J. Colins Johnny, 2017. GIS Based Groundwater Modeling Study to Assess the Effect of Artificial Recharge: A Case Study from Kodaganar River Basin, Dindigul District, Tamil Nadu, Journal Geological Society Of India, 89, pp.57-64.

10) Balakrishnan. P, Abdul Saleem, N. D. Mallikarjun, 2011. Groundwater quality mapping using geographic information system (GIS): A case study of Gulbarga City, Karnataka, India Afr. J. Environ. Sci. Technol., 5(12), pp.1069-1084.

11) M. Venkateshwarlu, M. Narsi Reddy and. A. Kiran Kumar, 2017. A Case Study on Assessment of Ground Water Quality Parameters In and Around Lambapur Area, Nalgonda District, Telangana State, International Journal of Civil Engineering and Technology, 8(7), pp. 563–566 .

12) Joan Nyika, Ednah Onyari, 2019. Hydrogeochemical Analysis and Spatial Distribution of Groundwater Quality in Roundhill Landfill Vicinity of South Africa, Air, Soil and Water Research, 12(1-8), pp.1-8.

13) Babanezhad E, Qaderi F, Salehi Ziri M., 2018. Spatial modeling of groundwater quality based on using Schoeller diagram in GIS base: a case study of Khorramabad, Iran., Environ Earth Sci. pp.77,1-16.

14) Babiker IS, Mohamed MAA, Hiyama T, 2007. Assessing groundwater quality using GIS. Water Resour Manag., 21, pp.699–715.

15) Ishaku JM, Ahmed AS, Abubakar MA, 2012. Assessment of groundwater quality using water quality index and GIS in Jada , northeastern Nigeria., J Earth Sci Geotech Eng, 1,pp. 35–60.

16) Nura Umar Kura, Mohammad Firuz Ramli, Wan Nor Azmin Sulaiman S, Ibrahim, Ahmad Zaharin Arisa TSN, 2015. Spatiotemporal variations in groundwater chemistry of a small tropical island using graphical and geochemical models, International Conference on Environmental Forensics 30, pp.358-363.

17) Yammani S, 2007. Groundwater quality suitable zones identification: Application of GIS, Chittoor area, Andhra Pradesh, India, Environ Geol., 53, pp.201–210.

18) B.Nas, 2009. Geostatistical Approach to Assessment of Spatial Distribution of Groundwater Quality, journal of environmental studies, 18(6), pp.1073-2082.

19) Lin, C. Y., Abdullah, M. H., Praveena, S. M. & Yahaya, A. H. B. 2012. Delineation of temporal variability and governing factors influencing the spatial variability of shallow groundwater chemistry in a tropical sedimentary island, Journal of Hydrology, 432–433, pp. 26–42.

20) Reddy, A., Saibaba, B. and Sudarshan, G., 2012. Hydrogeochemical characterization of contaminated groundwater in Patancheru industrial area, southern India, Environ Monit Assess, 184, pp.3557–3576.

21) Akshay Kumar Chaudhry; Kamal Kumar; Mohammad Afaq Alam, 2019. Spatial distribution of physico-chemical parameters for groundwater quality evaluation in a part of Satluj River Basin, India, Water Supply 19 (5), pp.1480–1490.

22) Gharbia S., Gharbia S. S., Abushbak T., Wafi H., Aish A., Zelenakova M., Pilla F., 2016. Groundwater Quality Evaluation Using GIS Based Geostatistical Logarithms, Journal of Geoscience and Environment Protection, 4, pp.89-103.

23) Sharma P. K., Vijay R., MP P., 2015. Geostatistical Evaluation of Groundwater Quality Distribution of Tonk District, Rajasthan, International Journal of Geomatics and Geosciences, 6 (2), pp.1474-1485.

24) Eslami H., Dastorani J., Javadi M. R., Chamheidar H., 2013. Geostatistical Evaluation of Ground Water Quality Distribution with GIS (Case Study: Mianab-Shoushtar Plain), Bulletin of n Environment, Pharmacology and Life Sciences, 3(1), pp.78-82.

25) Susanto , Syafrudin and T T Putranto, 2021. Spatial distribution change of groundwater quality in deep aquifer of Semarang alluvial plains area in past five years, IOP Conf. Series: Earth and Environmental Science,896, pp.1-10.

26) Besma Tlili-zrelli, Moncef Gueddari rachida Bouhlila, 2018. spatial and temporal variations of water quality of Mateur aquifer (Northeastern Tunisia):suitability for irrigation and drinking purposes, Journal of chemistry, 1(4), pp.1-15.