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Analytical Study of TDS and Sulphate Concentration in Ground Water: A Case Study of Vatva Region of Ahmedabad District, Gujarat

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Abstract: The most valuable natural resource for human life is groundwater. It is certainly required in all parts of life and well-being for energy generation, food production, industrial activities, maintenance of the environment and enhances sustainable development for future generations. Fresh groundwater has become a popular subject in recent years. Water is continuously contaminated in all nations. India is no special case to this marvel. In India, over 80% of the rural population depend on groundwater. People face a barrier in getting safe, portable drinking water since groundwater quality is impacted by public activity and utilities. The frequent monitoring of sources of groundwater and its quality helps to create and develop public awareness of groundwater resources. The area having high contamination of ground water is selected named as Vatva located in Ahmedabad district of Gujarat, due to urbanization and the presence of many chemical refineries and pharmaceutical firms in the vicinity. During the investigation, the most impacted pollutants, such as TDS, Nitrate, Chloride and Sulphate were valuated. QGIS is used to do a spatial distribution study of all of these parameters. Ground water quality index graphs are also generated using the IS 10500: 2012 drinking water quality standard as a reference.
***Keywords: Ground Water Contamination, Spatial Distribution, QGIS, TDS, Nitrate, Chloride, Sulphate*.**

I. INTRODUCTION

Groundwater is the most precious natural resource for human life. It is unquestionably necessary in all aspects of life and well-being for energy generation, food production industrial operations, environmental preservation, and]enhancing sustainable development for future generations [1], [10], [7]. In recent years, fresh groundwater has become a hot topic. Water is constantly poisoned in all countries. India is not an exception to this miracle. In India, groundwater is used by more than 80% of the rural population [2], [4], [12]. Because groundwater quality is altered by public activities and utilities, people confront a barrier to obtaining clean, portable drinking water, the regular monitoring of groundwater sources and quality aids in the creation and development of public awareness of groundwater resources [4], [5], [8], [12]. Due to urbanisation and the existence of several chemical refineries and pharmaceutical enterprises in the region, the area with high pollution of ground water is termed Vatva and is located in the Ahmedabad district of Gujarat [4], [7], [9]. The most affected contaminants, such as TDS, Nitrate, Chloride, and Sulphate, were analysed throughout the experiment. QGIS is used to investigate the geographical distribution of zall of these attributes [1], [3], [6], [11], [12]. The IS 10500: 2012 drinking water quality standard is also used to construct ground water quality index graphs [3], [10], [12].

II. STUDY AREA

In 1968, the Gujarat Industrial Development Corporation (GIDC) built the Vatva Industrial Estate. It is situated in the south-east of Ahmedabad, near the Ahmedabad – Mehmadabad state highway, with longitudes ranging from 22° 56'13" N to 22° 58'31" N and latitudes ranging from 72° 37'11" E to 72° 38'46" E. The Industrial Estate is divided into four phases from Phase I to Phase IV. The Vatva Industrial Estate, which spans 20 square kilometers, has been recognised as a 'Critically Polluted Area.' The Ahmedabad Municipal Corporation governs the Vatva Industrial Area, which is now part of AUDA. Around 30,000 people reside permanently in the Vatva industrial district, whereas more than 1.25 lakh people work on a daily basis, constituting the transit population. Many STPs (Sewage Treatment Plants) with a total capacity of 750 MLD have been provided by the Ahmedabad Municipal Corporation. The major source of water for industrial firms in Vatva is ground water supply managed by the Gujarat Industrial Development Corporation (GIDC) from a few deep tube wells located in the industrial estate zone of Vatva.

According to sources, the industry receives about 35 MLD of water via a piped water delivery system, while nearly 18.2 MLD of effluent created by the industries is discharged downstream of the Kharicut Canal and the Sabarmati River after treatment. Every year, over 1,26,250 MT of hazardous waste is generated, with almost 3,815 MT incinerated and the remainder 2,17,580 MT disposed of in government-approved landfill sites. For disposal of all sorts of effluent, there is a single outlet in the shape of a Mega pipeline through CETP, which is operated by Green Environment Co-operative Services Pvt. Ltd., in the southern area of the industrial park at Vatva.

III. METHODOLOGY AND DATA COLLECTION

Groundwater is also polluted by untreated septic waste, hazardous chemicals from underground storage tanks, and leaking landfills. As a result, determining the quality of groundwater is crucial. The Geographical Information System (GIS) is extensively used for spatial analysis. GIS is utilised in this work to analyse water quality for home and irrigation uses.

Hydrochemical data from 9 wells in the 2018-19 year were acquired from government agencies (such as the State Water Data Centre, Gujarat Water Resources Development Corporation Limited, Central Ground Water Board, and Gujarat Pollution Control Board) and other online sources (such as India WRIS, Bhuvan 3D and Google Earth). pH, Calcium, Magnesium, Electrical Conductivity, TDS, Total Hardness, Bicarbonate, Total Alkalinity, Sodium, Nitrate, Chloride, and Sulphate concentration were among the parameters measured and analysed in the samples. The findings are compared to those of the Bureau of Indian Standards (IS10500:2012) and the World Health Organization (WHO).

Data from recent years that exceeded acceptable limits set by IS 10500 were gathered after comparing this supplementary data with water quality criteria. Water samples were collected in one litre polyethylene water bottles for the missing data from recent years, and samples were collected using methods suggested by previous researchers. Immediately after collection, each sample container was carefully labelled with a marker, and the details for each sample were noted. The samples were kept out of direct sunlight while being transported to the laboratory for examination. The following table shows the location of the sampling points.

Table 1: Latitude and Longitude Location of Sampling Locations

Number	Station	LAT	LONG
1	Nilkanth Residency	22.983101	72.633472
2	Trikampura Patiya	22.98074	72.632008
3	Maruti Travels	22.971283	72.651338
4	Ratan Farm	22.965011	72.655319
5	Vinzol Gam	22.95035	72.644709
6	Phase 1	22.966163	72.634354
7	Phase 2	22.954201	72.63894
8	Phase 3	22.980138	72.623332
9	Phase 4	22.97721	72.641386

A. *Total Dissolved Solids*

Dissolved solids are any minerals, salts, metals, cations, or anions that are dissolved in water. Total dissolved solids (TDS) are inorganic salts dissolved in water, predominantly calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulphates, with some organic stuff thrown in the mix. Data on major TDS concentrations were previously accessible from government and private sources. In the absence of missing sample data, the Gravimetric Analysis Method was utilised to calculate Total Dissolved Solids. Before weighting, a 100mL sample was sifted and placed in a freshly dried and evaporated container. The formula was used to determine the total dissolved solids (TDS) in each sample.

The TDS concentration in mg/l of the sampling locations is shown in the table below for the 2018-19 year.

Table 2: TDS Concentration for Year 2018-19

Number	Station	TDS 2018-19
1	Nilkanth Residency	1704
2	Trikampura Patiya	2152
3	Maruti Travels	1388
4	Ratan Farm	1712
5	Vinzol Gam	2236
6	Phase 1	1839
7	Phase 2	1734
8	Phase 3	1787
9	Phase 4	1811

The TDS concentration in mg/l of the sampling locations is shown in the table below for the 2021-22 year.

Table 3: TDS Concentration for Year 2021-22

Number	Station	TDS 2021-22
1	Nilkanth Residency	1893.75
2	Trikampura Patiya	2624
3	Maruti Travels	2312.5
4	Ratan Farm	2555
5	Vinzol Gam	3193.75
6	Phase 1	2298.7
7	Phase 2	2040.33
8	Phase 3	1985
9	Phase 4	2351.5

B. Sulphate

Water contains sulphates as a result of sulphate mineral leaching and sulphide oxidation. Sulphates are frequently found in combination with the ion's calcium, magnesium, and sodium. Sulphate-containing water has a laxative effect. It also produces smell and corrosion problems in aerobic settings. Data on major sulphate concentrations were previously accessible from government and private sources. The missing Sulphate concentration data were determined using a visible spectrophotometer, also known as a colorimetric method.

The Sulphate concentration in mg/l of the sampling locations is shown in the table below for the 2018-19 year.

Table 4: Sulphate Concentration for Year 2018-19

Number	Station	2018-19-SO4
1	Nilkanth Residency	209
2	Trikampura Patiya	341
3	Maruti Travels	188
4	Ratan Farm	191
5	Vinzol Gam	226
6	Phase 1	285
7	Phase 2	263
8	Phase 3	230
9	Phase 4	210

The Sulphate concentration in mg/l of the sampling locations is shown in the table below for the 2021-22 year.

Table 5: Sulphate Concentration for Year 2021-22

Number	Station	2021-22-SO4
1	Nilkanth Residency	261
2	Trikampura Patiya	388
3	Maruti Travels	198
4	Ratan Farm	205
5	Vinzol Gam	235
6	Phase 1	324
7	Phase 2	286
8	Phase 3	302
9	Phase 4	256

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IV. RESULTS AND DISCUSSION

The following bar chart shows the comparison of change in TDS concentration of the sampling locations from year 2018-19 to year 2021-22.

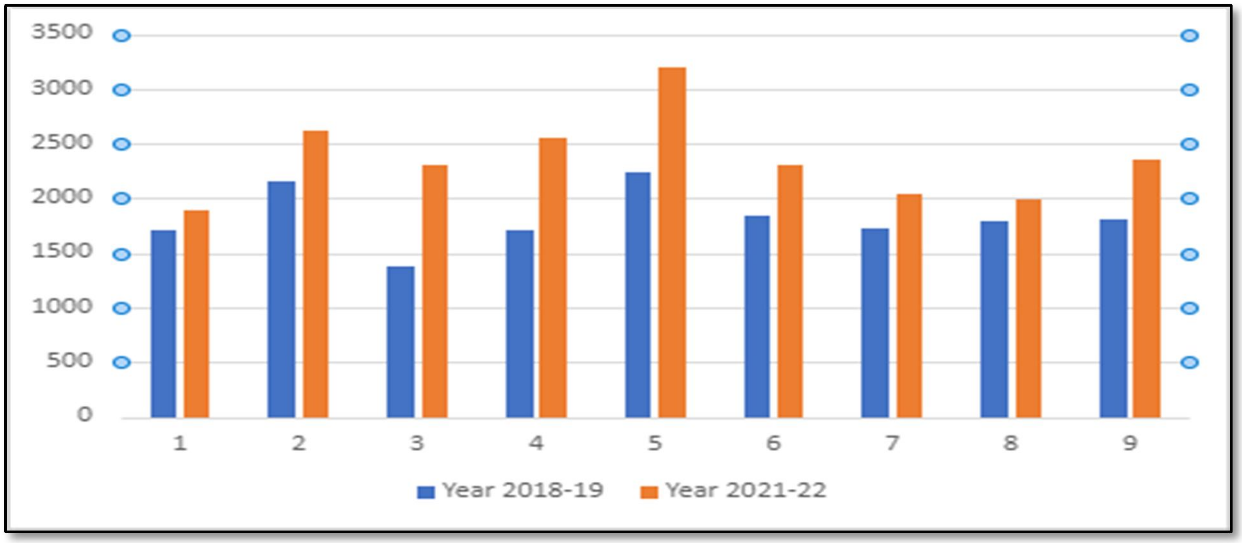


Figure 1: Comparison of TDS Concentration

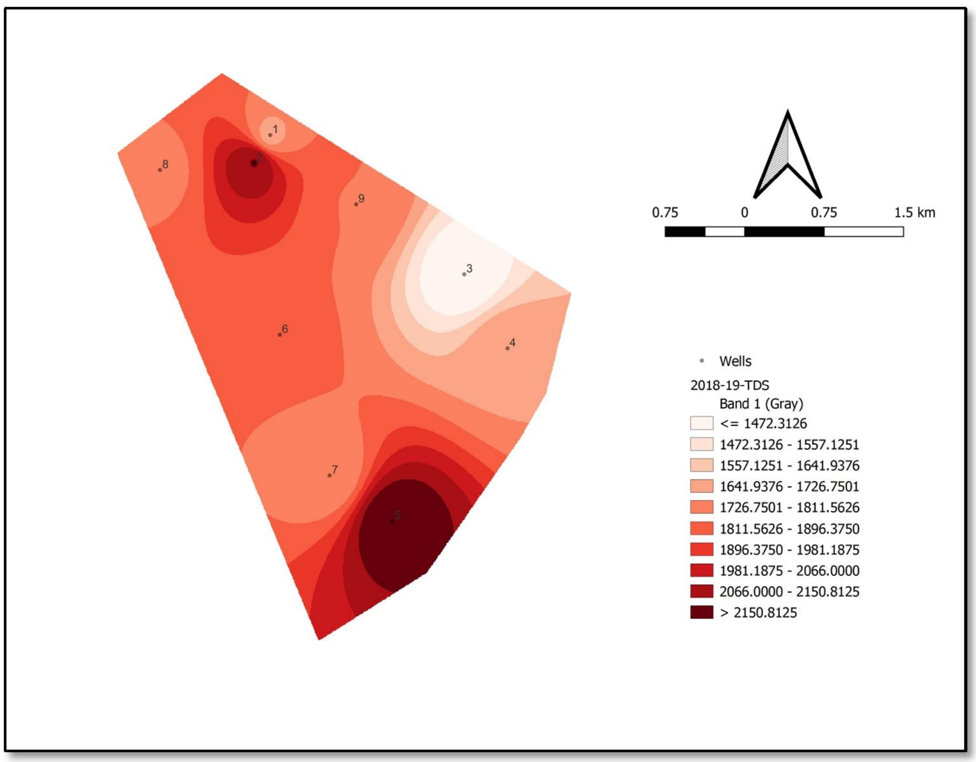


Figure 2: Spatial Distribution of TDS for Year 2018-19

The figure above depicts the spatial distribution of TDS concentration in the Vatva area in 2018-19. The data clearly reveals that TDS levels were extraordinarily high in the Vinjol Gam and Trikampura areas, ranging from more than 2000mg/l.

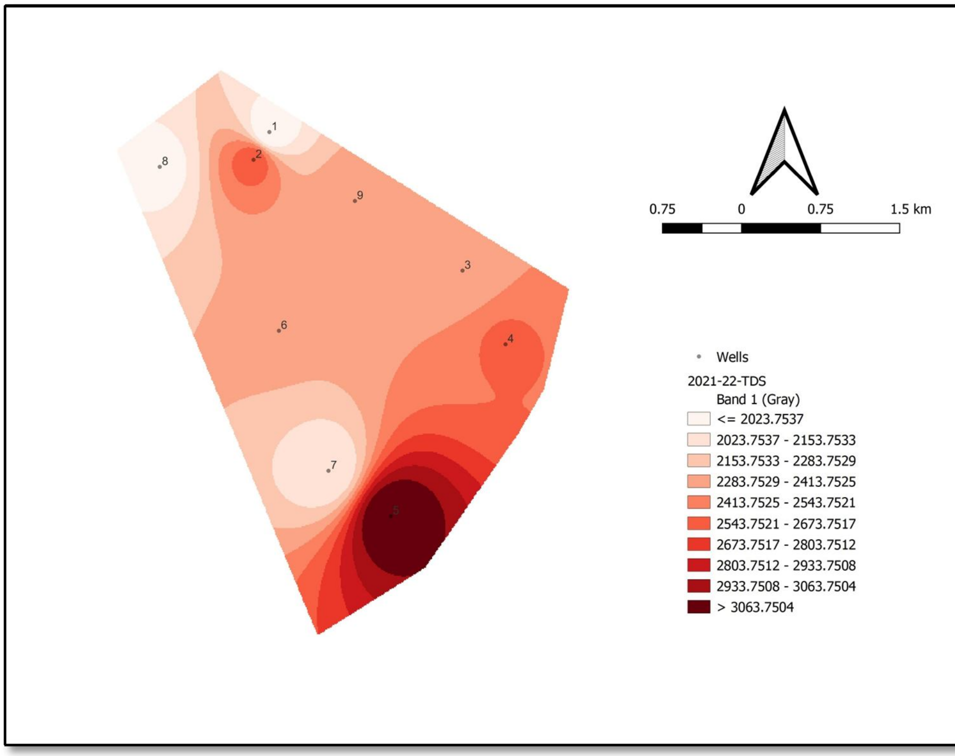


Figure 3: Spatial Distribution of TDS for Year 2021-22

The figure above illustrates the spatial distribution of TDS concentration in the Vatva area in 2021-22. The figure clearly shows that TDS levels around the Vinjol Gam region are still quite high, in the range of greater than 3000mg/l. The biggest issue, however, is that TDS concentrations near Trikampura have exploded and now exceed 2500mg/l.

The following bar chart shows the comparison of change in Sulphate concentration of the sampling locations from year 2018-19 to year 2021-22.

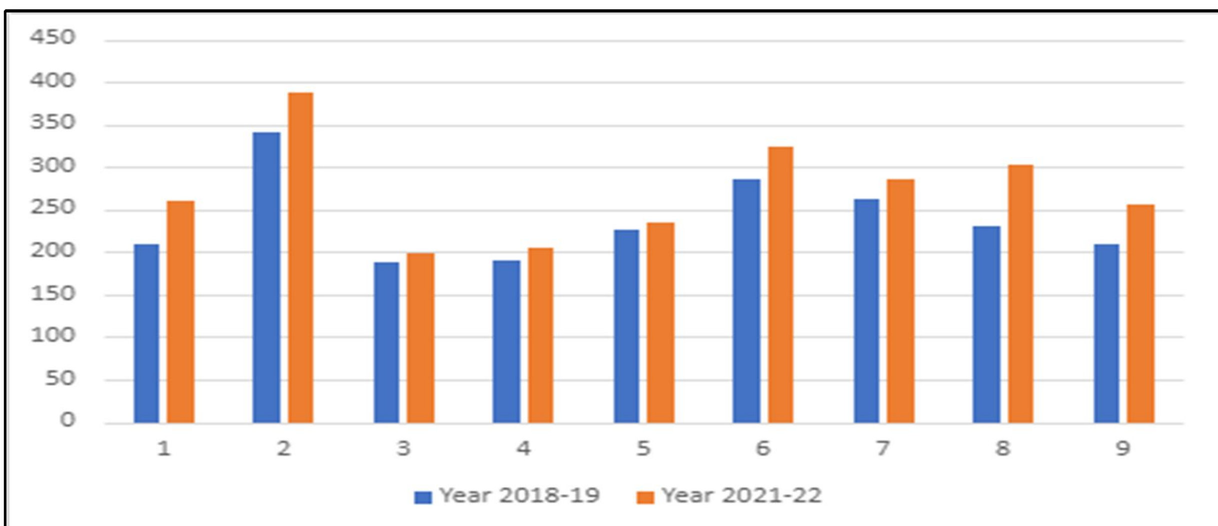


Figure 4: Comparison of Sulphate Concentratio

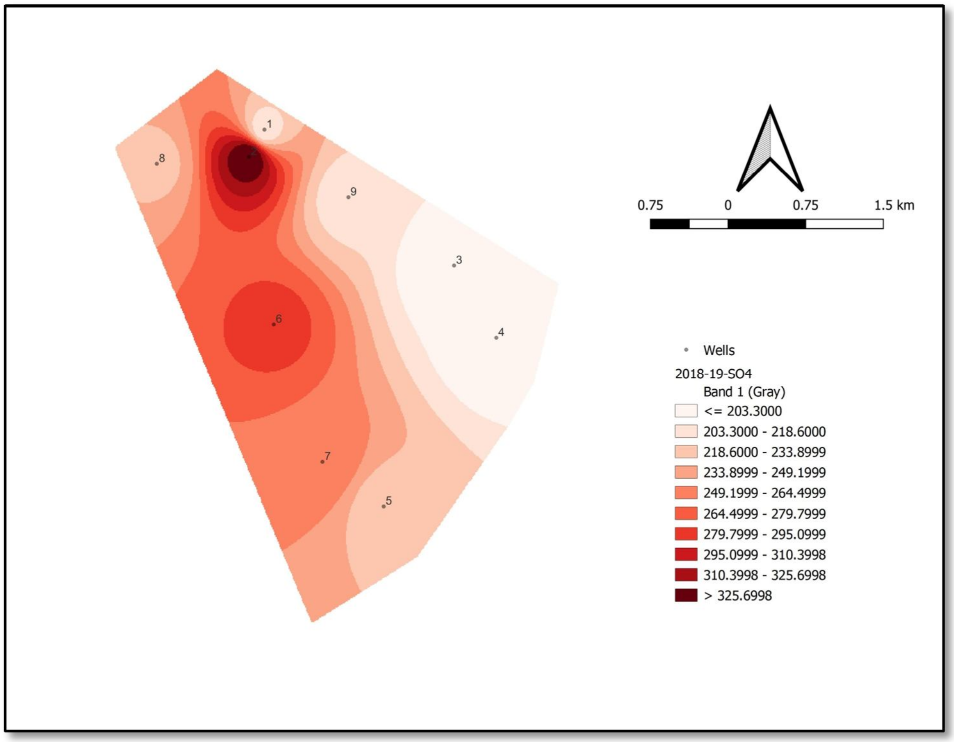


Figure 5: Spatial Distribution of Sulphate for Year 2018-19

The image above represents the spatial distribution of Sulphate concentration in the Vatva area in 2018-19. According to the map, Phase 3 had the greatest amount of Sulphate pollution. There were a few places where the value was somewhat higher than the permissible limit. The concentration was even lower than the allowable limit along the ring road.

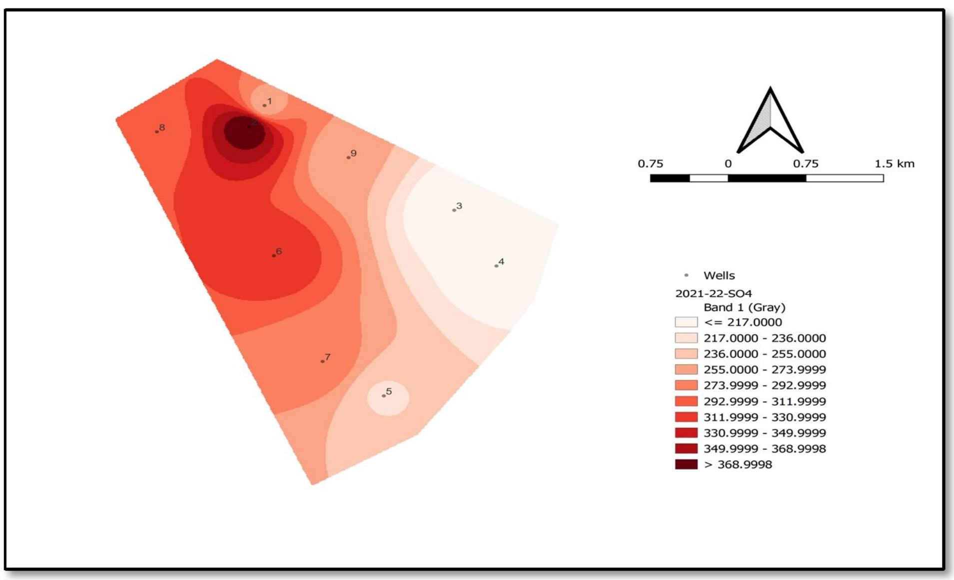


Figure 6: Spatial Distribution of Sulphate for Year 2021-22

The figure above displays the spatial distribution of Sulphate concentration in the Vatva area in 2021-22. The graph clearly shows that the rise in pollution is slow and nearly uniform across all areas. As a result, the location with the most Sulphate pollution is still in GIDC Phase 3, with a value nearing the 400mg/l threshold. And the area along the ring road still has a permissible level of contamination.

V. CONCLUSION

The spatial distribution of ground water pollutants was mapped using geo informatics in this work, giving for a better knowledge of ground water quality in Ahmedabad's Vatva area. Although there are operational 'Effluent Treatment Plants' and 'Common Effluent Treatment Plants' for treating effluent generated by each of the industrial units located in Vatva Industrial Area, and for treated effluent discharge Mega Pipe Line, constructed up to the sea coast in a 100 km downstream direction of the Sabarmati River, pollution issues are not fully controlled to this day. During the monsoon, it is stated that industrial effluent is frequently mixed with shallow ground water. Many companies on the Kharicut canal's bank in the Vatva district dump partly treated effluent into the canal.

The percolation of domestic sewage and waste water is the primary source of increased TDS. As a consequence, TDS levels in the Vinjol Gam area, where the Vinjol Lake is located, were discovered to be relatively high. Furthermore, as the population of this region grows, so does the volume of residential sewage produced. TDS levels above 500mg/l alter the taste of water, turning it salty, bitter, or metallic. TDS levels beyond a specific threshold indicate the presence of toxic minerals that are hazardous to one's health.

In previous years, almost half of the sites had sulphate concentration readings that were either below or slightly above the threshold. According to the findings of the study, sulphate content increases gradually and equally across all regions. Sulphate pollution has increased as a result, but not at an alarming pace.

During the current investigation, it was discovered that there is a large fluctuation in the quality and amount of waste water flow - discharge of a mixture of sewage and industrial effluent along different stretches of the Kharicut canal in the Vatva area. Furthermore, in its down flow direction, quality deteriorates significantly, and TDS of certain bore wells / tube wells samples are not recorded within the allowed level of drinking water standard. Given the large amount of effluent discharge generated by the Vatva area itself, as well as widespread pollution of shallow ground water in many industrial regions, rigorous monitoring of the ground water quality of the Vatva Industrial Zone's deep aquafer system is required.

REFERENCES

[1] Ajay K Bhanat, Mukesh A Modi, Dr. V M Patel. Analytical study of Nitrate and Fluoride concentration in ground water: A case study of a central region of Ahmedabad district, Gujarat. http://iwwaahmedabad.org/images/downloads/papers/2019/1912.pdf.

[2] GPCB Report. https://gpcb.gujarat.gov.in/webcontroller/page/annual-report Joshua N. Edokpayi, John O. Odiyo and Olatunde S. Durowoju. Impact of Wastewater on Surface Water Quality in Developing Countries: A Case Study of South Africa. https://www.intechopen.com/chapters/53194.

[3] Juliana Atmadja, Amvrossios C. Bagtzoglou. Pollution source identification in heterogeneous porous media. Water Resources Research, Vol. 37, NO. 8, Pages 2113-2125, August 2001. https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2001WR00 0223

[4] Matta Gagan, Chauhan Amit, Kumar Avinash and Kumar Ajendra. Impact of industrial effluent on ground water and surface water qualityA case study of Dhampur region (U.P.), India. Journal of Chemical and Pharmaceutical Sciences. https://www.researchgate.net/publication/302392914_Impact_of industrial_effluent_on_ground_water_and_surface_water_quali ty-_A_case_study_of_Dhampur_region_UP_India

[5] Mohanty, B., Das, A., Mandal, R., Banerji, U., & Acharyya, S. (2021). Heavy Metals in Soils and Vegetation from Wastewater Irrigated Croplands Near Ahmedabad, Gujarat: Risk to Human Health. Nature Environment and Pollution Technology, 20(1), 163–175. https://doi.org/10.46488/nept.2021.v20i01.017

[6] Mukesh A Modi, Hettal M. Tokle, Dr. N J Shrimali. Analytical study of ground water contamination in Ankleshwar Taluka of Gujarat. International Journal of Applied Engineering Research ISSN 0973-4562 Vol. 14, No.1, 2019 (Spl.) pp. 16-21 © Research India Publications. http://www.ripublication.com

[7] P R Gupte, Senior Hydrogeologist. Report on Groundwater Pollution Study of Vatva Industrial Area, Ahmedabad,

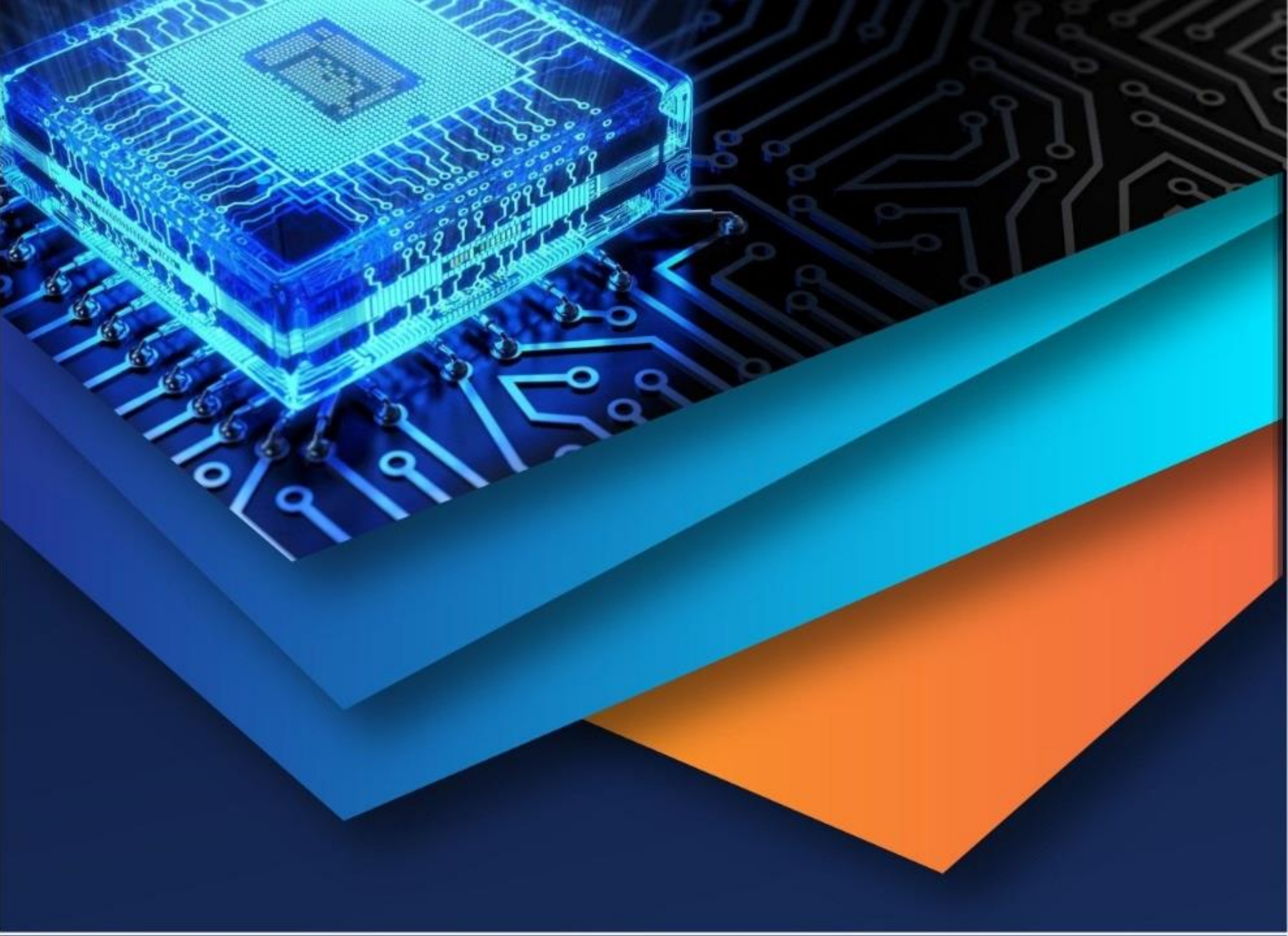
[8] Gujarat State. Government Of Indiaministry Of Water Resources Central Ground Water Board West Central Region Aahmedabad April, 2013. https://www.researchgate.net/publication/331917370_Report_on _Groundwater_Pollution_Study_of_Vatva_Industrial_Area_Ah medabad_Gujarat_State

[9] Petra Kuhr, Josef Haider, Peter Kreins, Ralf Kunkel, Björn Tetzlaff, Harry Vereecken, Frank Wendland. Model Based Assessment of Nitrate Pollution of Water Resources on a Federal State Level for the Dimensioning of Agroenvironmental Reduction Strategies. Water Resour Manage (2013) 27:885–909. DOI 10.1007/s11269-012-0221-z

[10] R Das, S N Das. Impact of Waste Water Discharge on Soil and Ground Water – A Case Study. Journal of Scientific and Industrial Research Vol 62 March 2003 pp 207-211. http://nopr.niscair.res.in/bitstream/123456789/17601/1/JSIR%2062%283%29%20207-211.pdf

[11] Richa Maheshwari. Impact of Industrial Estates on Water Resources. International Journal of Environmental Science and Development, Vol. 7, No. 12, December 2016. http://www.ijesd.org/show-88-1293-1.html

[12] VIA Report. http://www.vatvaassociation.org/pdf/ANNUALREPORT-2011-12.pdf



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