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Evaluating the Hydrogeochemical Properties of Groundwater for Irrigational Purposes: A Case Study

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Abstract

Groundwater is a vital life component in earth for sustaining every species of life. Groundwater is incredible source through water cycle and it is extremely beneficial for the living body. But, the not potable water release from geogenic sources and some place anthropogenic source may significantly levels of pollution in groundwater, making it vital to assess the quality of the groundwater for current use and to develop its potential as a sustainable water source for human use. Groundwater is a major source of irrigation and drinking water in India's rural areas. The condition of ground water is very important in this part of Harur Taluka since it is a vital source for agriculture and drinking water, and the local population faces numerous problems with water quality. The goal of the irrigational purposes of current study project is to look into the geographical distribution and quality of groundwater. approaches as well as hydro chemical dynamics. pH of groundwater samples are fall in potable condition their limiting Values of 6.5 - 8.5 in this study area. In this research work, twelve water quality parameters were tested at 34 different selected locations, including E.C. micS/cm, TDS, pH, Na+, K+, Ca2+, Mg2+, HCO3, CO3, SO4, Cl, and F. The purpose of the analysis was to evaluate the quality of the water. Every region within the study area is classified as Acceptable, Allowable, and Not Potable based on the spatial distribution map. The hydro chemical mechanism of water quality was principally due to the leaching from soil to groundwater. Groundwater in the studied area has a geochemical pattern that indicates sodium as the predominant cation (NaCa Mg>K) and chloride as the predominant anion. ($Cl>HCO_3>SO_4>H_4SiO_4>NO_3>F>PO_4$) respectively.

Key words: Drinking water, Gibbs plot, Spatial distribution of water, USSL, WHO standards

For many domestic, agricultural, and drinking water uses, groundwater is a typical source. For human consumption and habitat support, groundwater is nearly universally significant [1]. A sustainable and safe use of the resources for residential, agricultural, and drinking uses depends on the quality assessment of the resource [2-3]. But because of excessive evapotranspiration and little rainfall, its quality is declining. Water mobility is declining as a result of natural and human-caused pollution in the majority of significant freshwater bodies [4]. Numerous variables, such as the type of recharge, the hydrologic gradient, the amount of time groundwater spends in the aquifer, pollution from human activity, and the interactions between rock and water below the surface, affect the chemistry of groundwater. The need for groundwater is rising as a result of this. In the lack of groundwater legislation, such needs are satisfied with unrestricted groundwater mining. The excess usage of groundwater leads to the deterioration of water quality and a decrease in groundwater potential. The situation becomes more critical in the hard rock terrain with lesser recharge. The study area is chiefly recharged by a few ephemeral rivers, which are monsoon dependent. The frequent failure of monsoon and increased dependency on rainfall associated with booming industrial sector demands has made it essential to understand the hydrogeochemical nature of the present study area. According to [5], there are a number of problems with the quality of ground water.

Furthermore, the excessive levels of metals and nutrients in groundwater have resulted in non-potable water quality. In the hard rock region, groundwater quality ratings are increasingly important in determining which wells are best suited for irrigation and drinking. For baseline quality with an appropriate level of assurance, the pollutants and the monitoring procedures of groundwater quality are essential parameters are effective management. In order to create spatial analysis and their decision support systems using ArcGIS 10.3 software, groundwater quality for irrigational and drinking assessment models are integrated with spatial data. These studies are used for site suitability analyses, managing site inventory data, estimating groundwater contamination, and groundwater flow and leaching for water resource management. When evaluating the quality of groundwater in any place where it is utilized for both drinking water and irrigation, hydrochemistry expertise is crucial [6]. The physical, chemical, and biological characteristics of groundwater influence its quality [7]. The natural geochemical features of climate, lithology, weathering of minerals, the nature of geochemical reactions, and salt solubility all have an impact on the concentration of dissolved ions. The purpose of this study is to determine how underground water quality distributed across the

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Tamil Nadu district of Dharmapuri's harur taluka. The study's goals are to identify the primary ions that make up groundwater quality and use geographic information systems (GIS) to map the groundwater quality's geographical distribution throughout the study area. GIS Based Geospatial distribution and function characterized by groundwater quality dynamics. Since there has been a noticeable decline in the area's water quality over some part of area, it was vital to determine whether groundwater was suitable for the various proposed purposes in the current study. Thus, in this study, global norms were taken into account. The quality of groundwater plays a crucial role in determining whether or not water is suitable for a certain use.

MATERIALS AND METHODS

The Harur Taluka is located in the Tamil Nadu State of India's Dharmapuri district. The study region lies between latitudes 11°51'0"N and 12°12'0"N and longitudes 78°18'0"N and 78°39'0"N. The whole geographical area is 963 km^2 with an average elevation of 350 m. Following the monsoon season, the research area and sampling sites are given. In the winter, the temperature decreases significantly to between 10 and 25 °C. The average yearly precipitation in Harur Taluka is 760 mm. It was found that the region's rainfall totals were largely constant. Since agriculture occupies a large portion of the study region, this has been investigated. The northern part has significantly less forest cover. Everywhere there are developments, the build-up area is replicated. In the current research region, groundwater is crucial for drinking and irrigation. Groundwater is essential for both rural and urban regions in Taluka. Because groundwater is so vital to the state's economy, it must be regularly monitored for both quantity and quality in order to promote sustainable development and management. For the purpose of management and accurate source identification of drinking water in this research area, it is imperative that a thorough investigation of ground water quality be carried out.

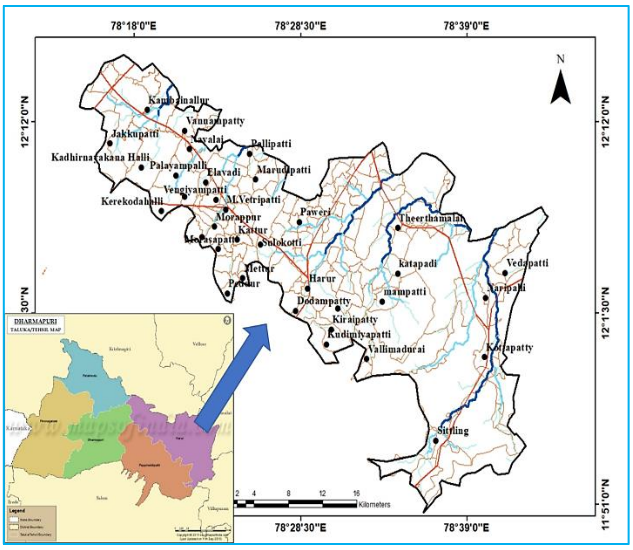

Fig 1 Geography of location of study area

The interplay of groundwater quality with geological, environmental, climatic, biological, and other anthropogenic systems causes the quality of the groundwater to change in numerous ways. The research area's groundwater samples were taken in 2023 during the North East Monsoon (NEM) season. Using the normal protocols, the gathered samples were examined for major and minor dissolved ions. By calculating the cation-anion balance (Eq. i), which requires that the total concentrations of anions (TCA) expressed in milliequivalents per liter and the total concentrations of cations (TCC) expressed in milliequivalents per liter, the accuracy of the complete chemical analysis of a groundwater sample was verified [8-9].

$$\text{cation-anion balance} = (TCC-TCA)\ (TCC + TCA)] \times 100 \quad \ldots\ldots\ldots i$$

With few exceptions, all of the groundwater samples' reaction (cationic and anionic balancing) error percentages (Er%) were within the acknowledged limit of ±10%, providing additional evidence of the data's accuracy. However, several ions exhibit unusually high concentrations that occur over different seasons.

The presence of pollutants in distilled water, limitations in the procedures and instruments utilized, and the reagents used can all contribute to inaccuracies in the chemical analysis of groundwater. There is around a 0.6 to 0.9 correlation relationship between TZ and IZ. In the range of 0.5 to 0.9 was the TDS/EC ratio. Other than those examined here, ions have a less significant impact on the charge balance between cations and anions. (Table 1) shows the mg values for the maximum, minimum, and average during the various seasons.

Table 1 Maximum, minimum, and average of the chemical constituent in groundwater representing all four seasons

Chemical parameters	Min	Max	Average
E.C. micS/cm	650	4750	1652.94
TDS	324	3128	987
pH	6.9	8.2	7.60
Na^+	7	644	163.68
K^+	2	293	21.12
Ca^{2+}	13	184	73.82
Mg^{2+}	12	124	66.21
HCO_3	104	702	397.91
CO_3	0	6.3	0.41
SO_4	17	768	122.32
Cl	25	794	234.35
F	0	1.6	0.74
NO_2	2	77	24.12

Note: (All values in mgl except EC in µS/cm and pH)

RESULTS AND DISCUSSION

Groundwater chemistry

The majority of the samples had pH values between 6.9 and 8.2, with an average of 7.60, indicating that they were generally acidic to alkaline (Table 2). The total dissolved ions (TDS) in the water have an average of 987 mg/l and range from 324 mg/l to 3128 mg/l. The amount of charged ions in groundwater is measured by electrical conductivity, which ranges from 650 to 4750 µS/cm on average. The average content of Ca is 115.2 mg/l, with a range of 81.6 mg/L to 148.8 mg/L. The average content of Na is 224 mg/L, with a range of 98 mg/l to 350 mg/l. Because potash feldspars are more resistant to chemical weathering and are fixed on clay products, the concentration of K is lower in groundwater, ranging from 2 mg/l to 293 mg/l with an average of 21.12 mg/l, than the concentrations of Ca, Mg, and Na ions among the cations.

Cl has an average of 234.35 mg/l and ranges from 25 mg/1 to 794 mg/l. A range of 104 mg/l to 702 mg/l is recorded for HCO_3, with an average of 397.91 mg/l, respectively. The range of SO_4 levels is 17–768 mg/l. The average concentration of NO in the groundwater is 24.12 mg/l, with a range of 2 to 77 mg/l. Poisson's ratio reveals that lower values are observed in both seasons. When compared to other locations, Kadhirnayakana Halli's groundwater has a higher concentration of F (1.6 mg/l).

Comparison with water standard parameter using spatial distribution

The most essential element on Earth is water, which is also most likely what keeps life on Earth alive. Water quality varies from the point of intake to the exit due to a variety of factors, including weathering, geology, soil, industrial presence, pollution emissions, sewage disposal, and other environmental circumstances. The groundwater's chemical composition is altered by all of the aforementioned factors, and this has an impact on the water quality for different applications. Combining the chemistry of all the ions yields better results than using only one or a pair of ions [10-11]. Because of its wide development, the suitability of water for various uses, such as drinking, industrial, and irrigation, is evaluated. The criterion for drinking water is determined by the existence of compounds that have detrimental physiological consequences in addition to an unfavorable taste, odor, or color. The allowable limit of a few criteria mostly determines how portable drinking water can be. Water that is over the allowable limit is not fit for human consumption. Name of the groundwater collected locations as following Kambainallur (1), Jakkupatti (2), Vannampatty(3), Palayampalli (4), Kadhirnayakana Halli (5), Obilinayakkanpatti (6), Kerekodahalli (7), Navalai (8), Elavadi (9), Vengiyampatti (10), M.Vetripatti (11), Morappur (12), Bodinaickenhalli (13), Morasapatti (14), Kattur (15), Marudipatti (16), Pallipatti (17), Peddur (18), Mettur (19), Paweri (20), Sulokotti (21), Harur (22), Dodampatty (23), Kiraipatty (24), Ellepudayampatti (25), Kudimiyapatti (26), Vallimadurai (27), Theerthamalai (28), Katapadi (29), Mampatti (30), Sittling (31), Kottapatty (32), Naripalli (33) and Vedapatti (34).

Table 2 Groundwater quality parameter comparison with "WHO AND BIS standard" value during post monsoon-2023

Quality parameters	WHO international standards [12]		Bureau of Indian standards [13]		During post monsoon 2023	
	Max acceptable limit	Max allowable limit	Max acceptable limit	Max allowable limit	Min	Max
pH	7.0-8.5	6.5-9.2	7.0-8.5	6.5-9.2	6.9	8.2
EC	<1500	1500	-	-	650	4750
TDS	500	1500	500	1500	324	3128
Calcium	75	200	75	200	13	184
Magnesium	50	150	50	150	12	124
Sodium	<200	200	<200	200	7	644
Potassium	<10	10	<10	10	2	293
Chloride	200	600	200	600	25	794
Sulphate	200	400	200	400	17	768
Nitrate	<45	45	<45	45	2	77
Bicarbonate	<300	600	<300	600	104	702
Iron	<1.5	1.5	<1.5	1.5	0	1.6

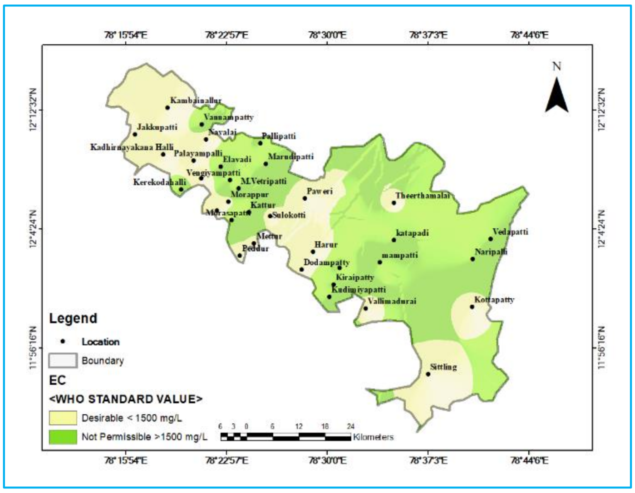

Fig 2 Spatial distribution map of EC

Total dissolved solids (TDS)

The term "total dissolved solids" (TDS) refers to the total dissolved content of all organic and inorganic materials floating in a liquid that can be molecular, ionized, or micro-granular (colloid sol). The whole concentration of dissolved salts or minerals in the water is referred to as total dissolved solids. Typically, rainwater has fewer than 10 parts per million of TDS. Increases in total dissolved concentrations and principal ions typically occur when groundwater flows and remains fixed for an extended period of time [14]. Longer water residence times are correlated with higher TDS [15]. TDS range into four categories of water. Groundwater samples are included of TDS values of less than 500 acceptable (1, 4, 6, 13, 22), 500-2000 allowable (1, 2, 3, 5, 7, 8, 9, 10, 11, 12), 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 27, 28, 29, 30, 31, 32, 33, 34, with the exception of the >2000 Not Potable 26 category.'

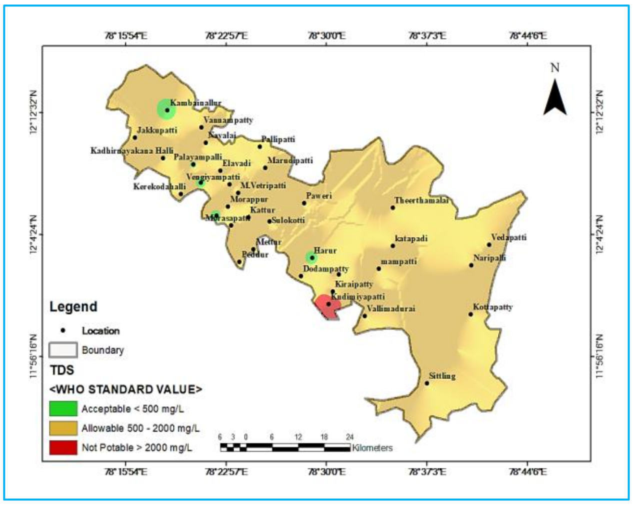

Fig 3 Spatial distribution map of TDS

Spatial distribution of calcium

In crystalline terrain, minerals such as apatite, wollastonite, fluorite, and those belonging to the feldspar, amphibole, and pyroxene groups weather and release calcium. Rocks like marble, limestone, calcite, dolomite, gypsum, etc. may dissolve it. Because calcium is present in water as Ca^{+} ions, it is a factor in determining the hardness of the water. The system's carbon dioxide content raises the calcium concentration in water. The Study Area's Calcium Value falls below 75. Acceptable 44.23%, in this area's sq. km. range of 75-200.

Spatial distribution of magnesium

Magnesium shares geochemistry with calcium, whose solubility is regulated by carbon dioxide. Despite the fact that most of its compounds are more soluble, magnesium is commonly found in higher concentrations than calcium. Common sources of magnesium include olivine and other materials. The majority of the hardness and scale-forming characteristics of water are caused by magnesium and calcium. The study area's magnesium value is less than 50, which is acceptable (sample numbers 1, 4, 5, 6, 8, 12, 13, 21, 23, 25, 31, 32) and permissible (sample numbers 1, 2, 3, 7, 9, 10, 11, 14, 15, 16, 17, 18, 19, 20, 22, 24, 26, 27, 28, 29, 30, 33, 34).

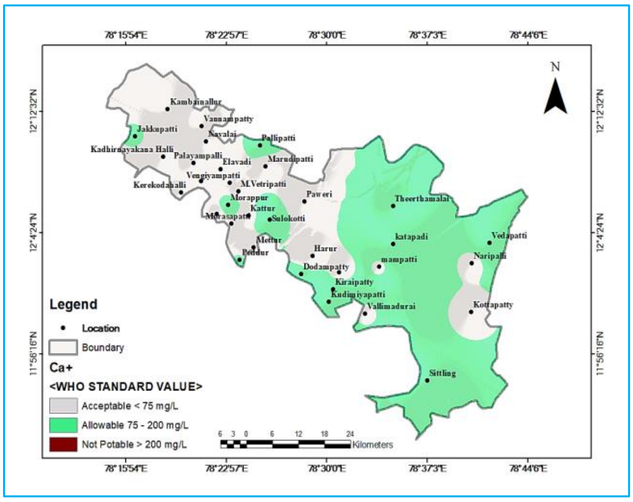

Fig 4 Spatial distribution map of Ca^+

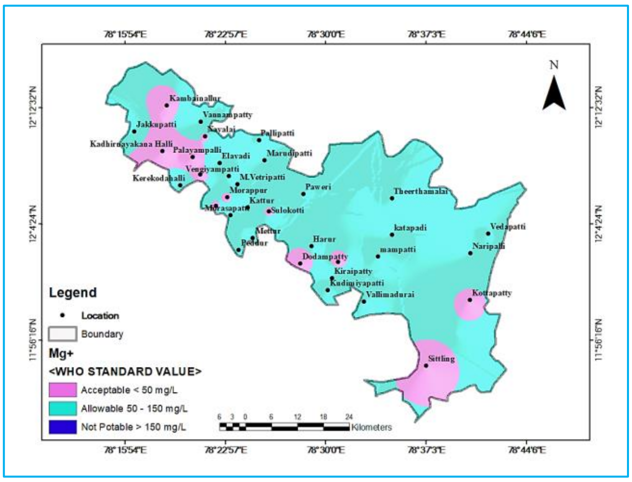

Fig 5 Spatial distribution map of Mg^+

Spatial distribution of sodium

Weathering of feldspar is the main source of sodium in natural water. Exchangeable sodium in significant amounts can be released by clay minerals. The most significant and prevalent alkali metal that is soluble and highly mobile in groundwater is sodium. Value of Na^+ in the Research Area <50 Alright 1, 4, 5, 18, 22, 50–200 Permissible 1, 2, 6, 8, 12, 13, 17, 19, 20, 21, 23, 28, 29, 30, 31, 32 >200 Not Drinkable 9, 10, 11, 14, 15, 16, 24, 25, 26, 33, 34. Na^+'s spatial distribution result. Tolerable less than fifty 19.3, 2.18%, 50-200, 617.1, 69.8% permissible unfit for drinking > 200 < 247.6 ~ 28.02%.

Spatial distribution of potassium

Rocks are the source of potassium, which is typically found in lower concentrations than sodium in natural waterways. This is because many potassium minerals have a stronger resistance to weathering and because potassium enters the structure of several clay minerals. Potassium is present in detectable amounts in all-natural water. The weathering of rocks is the primary source of potassium in naturally occurring freshwater, however the discharge of waste water is causing an increase in its quantity in contaminated water. Compared to sodium, potassium is far less common in groundwater in most freshwater aquifers. Potassium Content in the Research Area K^+'s spatial distribution outcome. Area in square kilometers Desirable << 12~357 40.38% and Not Permissible <> 12~526.4 ~59.54% as a percentage of the area.

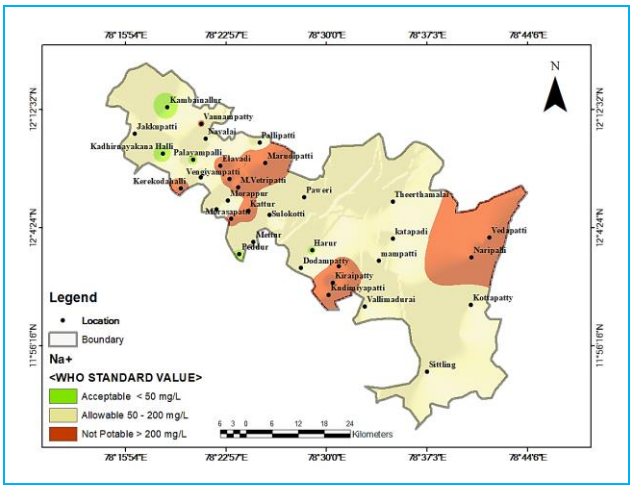

Fig 6 Spatial distribution map of Na^+

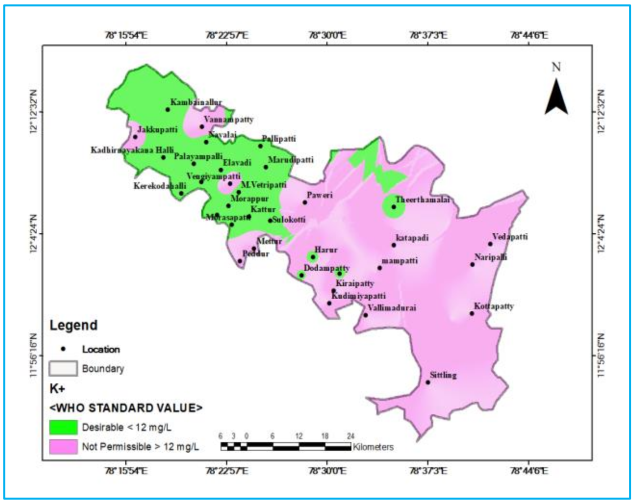

Fig 7 Spatial distribution map of K^+

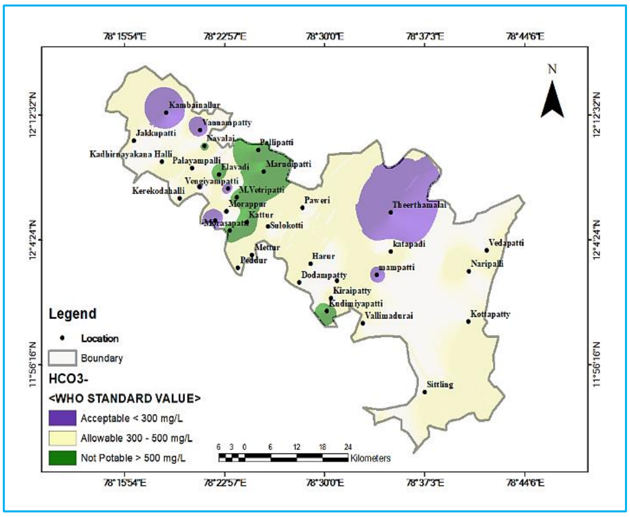

Fig 8 Spatial distribution map of HCO_3

Spatial distribution of bicarbonate

HCO_3, or bicarbonate, is a byproduct of your body's metabolism. Bicarbonate is carried to your lungs by your blood and exhaled as carbon dioxide. After entering your lungs, carbon dioxide is expelled. Bicarbonate is regulated in part by your kidneys. The kidneys both eliminate and reabsorb bicarbonate. The body's acid-base balance is regulated by this. The atmospheric carbon dioxide, soil carbon dioxide, and a carbonate rock solution are the sources of bicarbonate ions in groundwater. HCO_3: Acceptable Value of Study Area <300 (1, 3, 10, 13, 28, 30); Allowable Value of Study Area <300 – 500 (2, 4, 5, 6, 7, 8, 12, 18, 19, 20, 21, 22, 23, 24, 25, 27, 29, 31, 32, 33, 34). >500 Unfit for drinking 11, 12, 13, 14, 15, 16, 17, and 26 Geographical dispersal. The area covered by each of the following percentages: Not Potable (13.46%), Acceptable (15.29%), and Allowable (71.16%) is the result of HCO_3.

Spatial distribution of chloride

While it makes up a small portion of the earth's crust, chloride is a key dissolved component of the majority of natural fluids. Chlorides are frequently present in water and include those of calcium, magnesium, and iron. These chlorides significantly intensify the corrosive properties of water. Chloride results for the spatial distribution are displayed as percentages of the region, with acceptable being 69.61%, allowable being 13.45%, and not potable being 16.93%.

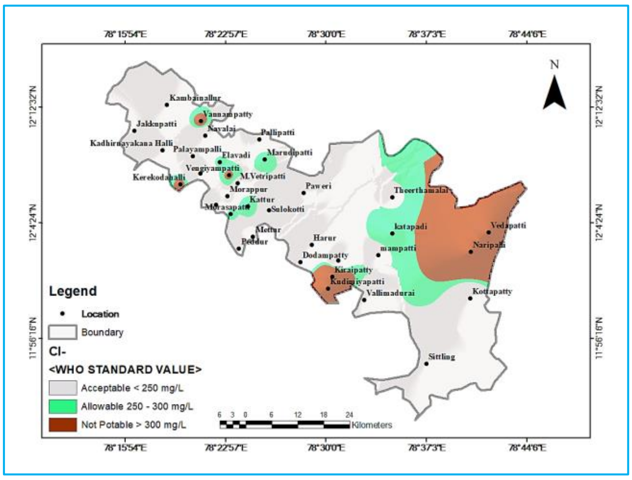

Fig 9 Spatial distribution map of Cl^-

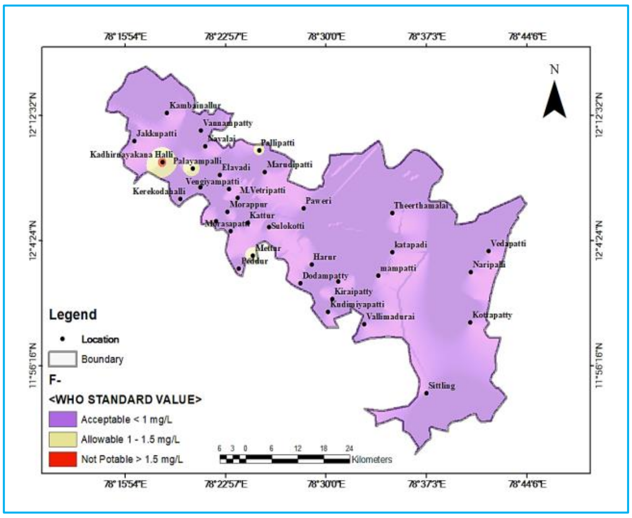

Fig 10 Spatial distribution map of F^-

Spatial distribution of fluoride

Biotite and hornblende are the main sources of fluoride minerals in the research area. Because most fluorides have low solubility, there is a limited quantity of fluoride in regular waters. An overabundance of fluoride can lead to fluorosis, tooth abnormalities, and altered bone structure. The Study Area's Value Geographical Dispersion Outcome of Fluoride. Area in sq. km The area's percentage. Allowable <1~851.4 ± 96.31%, Acceptable1- 1.5~27.9~3.15%. >1.5~4.7 0.53% is not potable.

Spatial distribution of sulphate

Sulfate is mostly found in oxidized form in water, though it can also exist as sulfides. It tastes better when combined with other ions. Water is made hard by the sulfate of magnesium and calcium. Both home sewage and industrial water discharges are to blame for the rise in sulfate concentration. SO_4 of Study Area Value of Less Than 200 alright 200–400. 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 27, 28, 29, 30, 31, 32, 33, 34. Permitted 24. >400~. Not Drinkable 26. Results of SO4's Spatial Distribution: Area in sq.km as a percentage of the total area. Acceptable 97.38% <200 860.9. Permitted 200–400 13.4 1.51%. Unfit for Drinking >4009.7 and 1.09%.

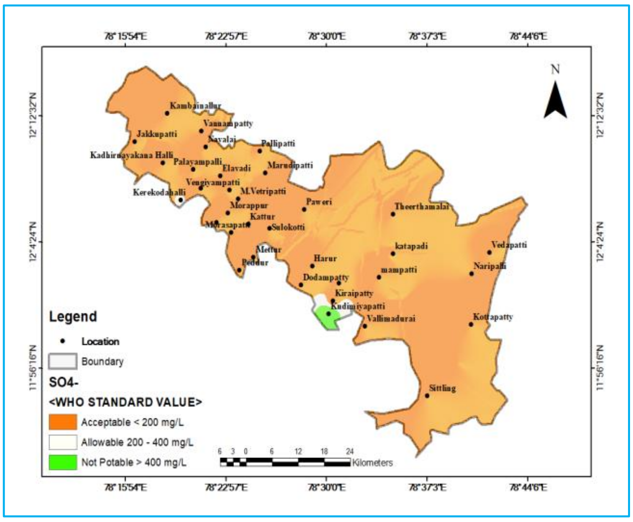

Fig 11 Spatial distribution map of SO_4

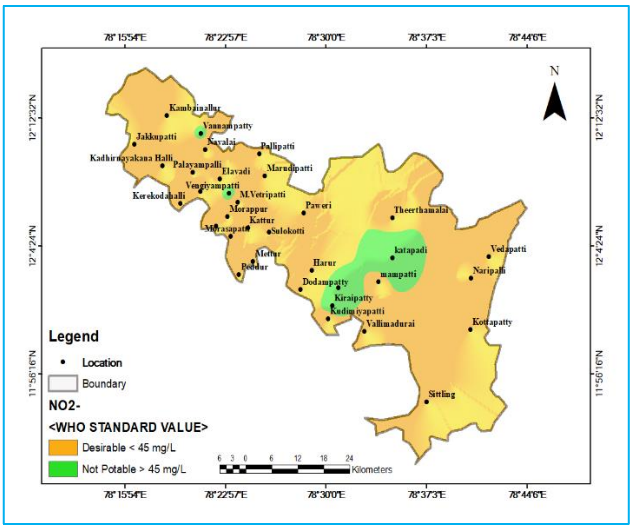

Fig 12 Spatial distribution map of SNO_2

Spatial distribution of nitrate

Natural nitrogen-based substances can be found in water, soil, plants, and food as nitrate and nitrite. Two of the most frequently observed contaminants in well water are nitrate and nitrite, which are more prevalent in groundwater than in surface water. Fertilizers release nitrates into runoff, sewage, and mineral deposits. Since nitrite prevents bacteria from growing, it is utilized in the food industry to cure meat products. Regretfully, when added in large enough quantities to a body of water, it can also encourage the growth of bacteria. NO_2- Study Area Value < 45, Desirable > 45. 1, 2, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 26, 27, 28, 30, 31, 32, 33, 34. Not Allowed 3, 10, 24, 25, and 29. Results of NO_2's spatial distribution: Area in sq.km as a percentage of the whole. Optimal 45, 756.2, 85.54% is desired. Not Allowed > 45, 128.3, 14.4%.

Groundwater analyses for irrigation purposes

When river and drainage systems are insufficient, groundwater has emerged as the primary source of water used in agriculture in many nations. Because of this, low-quality groundwater for irrigation has become a concern in recent years. Depending on the type of replenishing water, precipitation, subsurface and surface water, and hydro-processes in aquifers, the degree of chemical fertilization—whether excessive or insufficient—affects the quality of groundwater.

The first way that groundwater quality deteriorates is through geochemical reactions in aquifers and soils; the second way is when water is delivered for irrigation through inappropriate canals or drainage systems. As such, it is imperative to conduct routine evaluations of irrigation and potable water quality. An adequate supply of useable quality is necessary for irrigation. When assessing a water's suitability for use in agriculture, the index based on the make-up and concentration of dissolved components in the water can be helpful. The type of minerals presents in the water and how they affect the plants and soil determine whether groundwater is suitable for irrigation. A surplus of salts alters the absorption capacity of plants as a result of intricate modifications resulting from osmotic processes, which in turn impacts plant growth. Thirty-four groundwater samples that were taken from dug and bore wells were examined in the current study to determine changes in the water quality index over time as well as temporal variance. The majority of bore wells are found in agricultural regions.

USSL diagram for irrigation purposes

For the purpose of assessing irrigation water, the U.S. Salinity Laboratory also proposed the diagram depicted in the picture, in which the SAR is plotted against a certain conductance (EC). The figure shows sixteen classes. Salinity dangers such as low (C_1), medium (C_2), high (C_3), and very high (C_4) can be impacted by water in the soil. Similarly, location of samples falling into different categories can affect salinity hazards such as low (S_1), medium (S_2), high (S_3), and very high (S_4).

One sample is classified as C_1-S_1, three as C_2-S_1, twenty-eight as C_3-S_1, and two as C_4-S_1 field. These USSL classifications show that the high salinity and alkali danger of the soil make it unsuitable for irrigation, especially in regions with poor drainage. Within the study area 2023, the C_1-S_1 field comprises 3% of the samples, the C_2-S_1 field comprises 9% of the samples, the C_3-S_1 field comprises 82% of the samples, and the C_4-S_1 field contains 6% of the samples. The water quality is high according to the USSL classification. Low Salinity Hazard and Low Sodium (Alkali) Hazard (C_1-S_1) 3 Sodium (Alkali) and the Salinity Hazard Medium Low Risk (C_2-S_1) 4, 5, 11 High Salinity Hazard and Low Sodium (Alkali) Hazard (C_3-S_1) 1, 2, 6, 7, 8, 9, 10, 11, 12, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34. Sodium (Alkali) Hazard Low and Salinity Hazard Very High (C4-S1) 13, 14.

Gibbs plot for irrigation purposes

Numerous experts have talked about the processes governing the chemical compositions of water. It is commonly known that aquifer lithology and water chemistry are closely related [16]. Understanding the variables influencing the chemistry of groundwater is aided by the Gibbs plot, which separates the interactions of groundwater caused by evaporation, rock, and precipitation from the following ratios: 1) Cl/Cl+HCO3 and TDS; 2) Na+K/Na+Ca+K and TDS. It is discovered that the vast majority of the samples point to interactions between the subsurface water seeping through the rock. All water samples in the research area 2023, Cations - Gibb's plot, fell within the rock dominance category. Gibbs Plot with Cation Rock Dominance 1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34. 16–24 evaporation. GIBBS PLOT: Anion. Rock Dominance 1, 2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, and Evaporation 16-24.

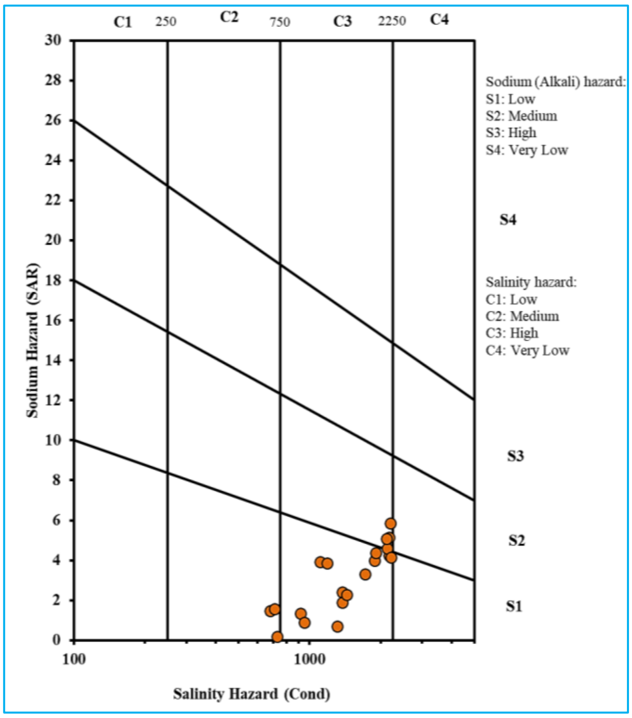

Fig 14 USSL diagram for irrigational purposes

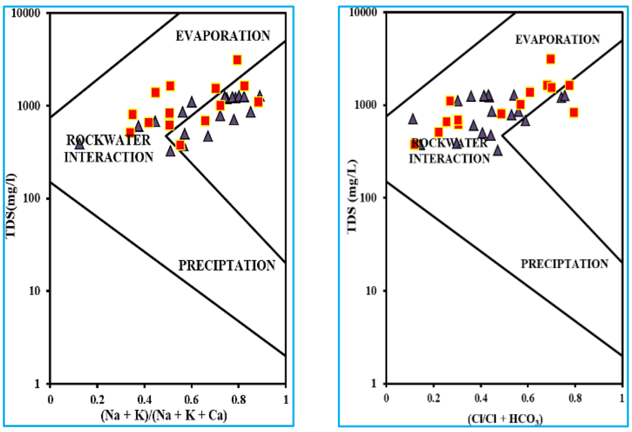

Fig 15 Gibbs plot (Cation) and Gibbs plot (Anion)

WILCOX diagram for irrigation purposes

Step to determine whether groundwater is appropriate for irrigation, Wilcox created a categorization system in which the percentage of sodium is connected against electrical conductivity or the total concentration of salts. The Wilcox diagram's percentage of sodium vs. specific conductance was used to analyze the chemical quality of the water samples.

Sodium content (SC)

The concentration of sodium ions is important because it partially fills the vacant space in the soil, reducing its permeability. Compared to saline soils, which have chloride and sulfate as the main anions, alkali soils have sodium and carbonate. Sodium content (SC) is formulated as follows and is expressed as a percentage.

Sodium content:

$$SC\ (\%) = \frac{100\ (Na^{+} + K^{+})}{Ca^{2+} + Mg^{2+} + Na^{+} + K^{+}}$$

Electrical conductivity (EC)

It measures the amount of dissolved material in an aqueous solution and is related to the material's electrical conductivity. Seimens per unit area, or miliSeimens per centimeter, are what EC stands for. The more dissolved material there is in a sample of water or soil, the higher the EC will be in that substance. Eight samples in the research region fell under the Excellent to Good category (1, 2, 3, 5, 8, 9, 10, 11), whereas seventeen samples fall under the Good to Permissible category (4, 6, 7, 12, 15-27). From dubious to inappropriate (27-34).

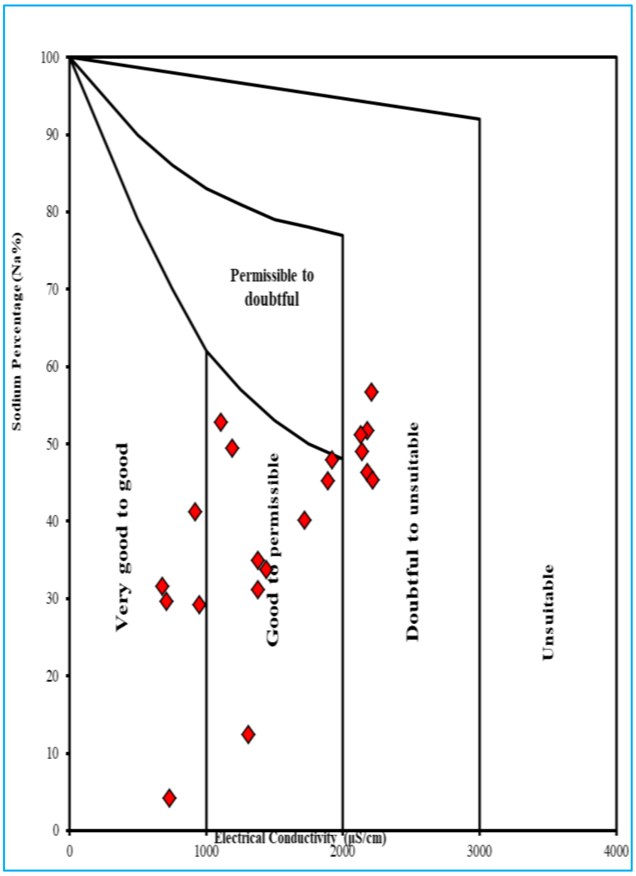

Fig 16 Wilcox diagram

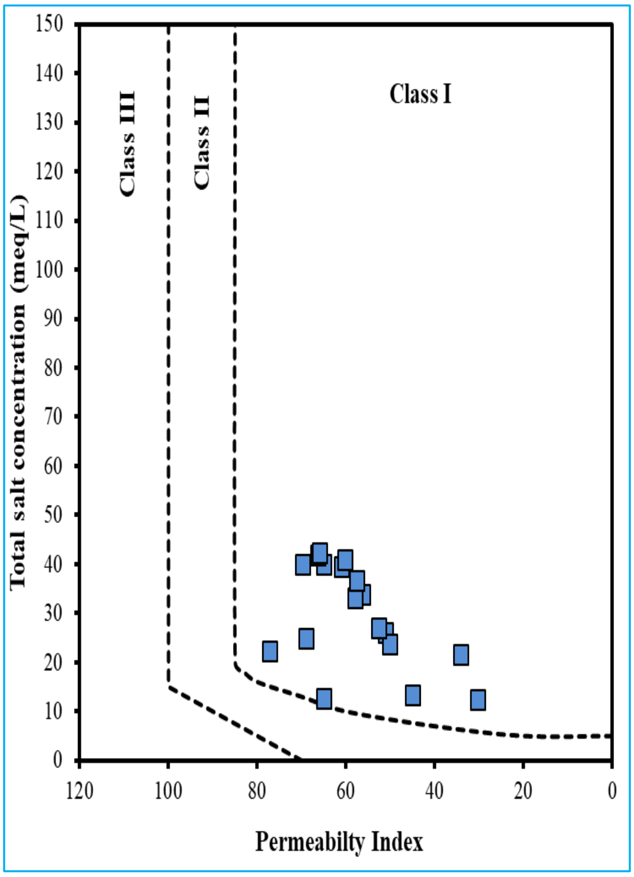

Fig.17 Doneen's irrigation diagram

Doneen's diagram for irrigation purposes

In order to classify the groundwater for irrigational, Doneen [17] created a diagram based on the Permeability Index (PI). Prolonged usage of irrigation water has to be an impact on soil permeability, which is also influenced by the soil's sodium, calcium, magnesium, and bicarbonate concentration. This given by PI, which was calculated using the equation:

$$PI = Na + \sqrt{HCO} / (Ca + Mg + Na)$$

Were, the concentration is expressed in meq/1.

The Permeability Index (PI) values in the current study area range between. According to Doneen [17], Class I and Class II waters are deemed acceptable and appropriate for irrigation, however Class III waters are not. 34 samples from the study area were found to be in Class I of the good category, meaning they were fit for irrigation [18].

CONCLUSION

In the Harur taluka area, the quality of the groundwater and its suitability for irrigational and drinking have been assessed. According to the groundwater quality data for agricultural purposes from this study, 74% of the water acceptable for irrigation during the post-monsoon season had an EC Value of groundwater sources suitable for irrigation. According on the spatial distribution map, every area of the research area is classified as Good, Medium, or Low. Fluoride variations in space that lie within the allowable 96% range indicate high-quality water. According to Doneen's diagram, every sample's autumn irrigation suitability state was noted throughout the post-monsoon season. The majority of groundwater samples, according to the study, are appropriate for irrigation. results of the current investigation, it's possible that regular groundwater analyses should be carried out to track the amount and kind of pollution. Humans must raise public knowledge in order to preserve groundwater quality within a particular range. The higher groundwater quality values found in the many groundwater samples taken in the Harur Taluka of the Dharmapuri district suggest that some water is not fit for human consumption directly. Therefore, raw water must be sustainably treated using a variety of suitable physical and chemical processes before being used for human consumption.

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