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Groundwater Quality Assessment for Drinking and Irrigation: A Case Study of Talaja, Bhavnagar

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Abstract: In many parts of the world, groundwater is the best and most practical supply of fresh water for drinking, as well as for agricultural and industrial uses. Depending on the intended usage, water quality varies. Environmental quality management has long placed a premium on the assessment of groundwater quality. Since groundwater is the sole significant supply for residential consumption and irrigation, the study sites in Talaja Taluka in the Bhavnagar district are very important and require careful consideration. The goal of the current study is to evaluate the groundwater's appropriateness for drinking in relation to the village of Talaja in the district of Bhavnagar.

In the current study, various seasonal groundwater quality data were gathered from various organisations, such as GWRDC, for several consecutive years (pre-monsoon and post-monsoon 2001to2022). The respective physicochemical characteristics were observed for eight parameters; in particular pH, Calcium, Chloride, Fluoride, Total hardness, Magnesium, Nitrate, and Total dissolve solids. With the help of the Bureau of Indian norms' (BIS) established norms, suitability for drinking is assessed. Water Quality Index is created using the Weighted Arithmetic Index approach. The collected groundwater quality data from 21 wells were used to calculate the Sodium Adsorption Ratio (SAR), Residual Sodium Carbonate (RSC), and Electrical Conductivity (EC), which are all categorised by salinity and alkalinity according to the standards recommended by the Central Soil Salinity Research Institute (CSSRI) of India for irrigation purposes. For various stages of this work, Q GIS is utilised to generate themed maps. Maps that can be utilised to better comprehend the current water quality situation in the research region will be used to present the findings of the water quality analysis work

Keywords: Groundwater, Water quality index, Irrigation water, QGIS.

I. INTRODUCTION

Because it has been consumed, circulated, and deteriorated continually over the years, the amount of water on earth has remained constant, making water a renewable resource. Water resources are the water sources that are presently used or may be used in the future. Water is used for a variety of purposes, including those related to agriculture, industry, the home, recreation, and the environment. Most human activities call for fresh water. About 97.5% of the world's water resources are saline water, primarily found in the oceans, according to the International Maize and Wheat Improvement Center's annual report, while 2.5% are available as fresh water. A limited resource, fresh water is trapped in ice caps, glaciers, and deep subsurface reservoirs. One of the universe's five elements is water. In actuality, water has the closest ties to the beginning and evolution of life on Earth. The most prevalent and necessary substance in all life systems is water. Its weight percentage in living things varies from 60 to 99.7%. It serves as an internal medium for all bio-chemical processes. The main component of photosynthesis is water. Food production, both of plant and animal origin, depends on it.

II. STUDY AREA

Gujarat, an Indian state, contains Talaja as a town and municipality in the Bhavnagar district. Talaja Jain Temple is located in Talaja. Gujarat is the home of Talaja.

Below are some noteworthy facts about this region:

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The Talaja Caves are situated in Gujarat, an Indian state, in the Bhavnagar district.

• Because the exact genesis date is uncertain, it is thought that this cave may have been constructed before the first century CE.

The coordinates of Talaja are 21.35°N 72.05°E. [2] It is generally 19 metres (62 feet) above sea level.

• Talaja is situated on National Highway No. 8 between Mahuva (40 km) and Bhavnagar (50 km) in Gujarat.It is a Tehsil location that includes Alang, one of the biggest ship breaking yards at one time.

An easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it. The district's average annual temperature of 30.66°C (87.19°F) is 4.69% higher than the national average for India. Talaja generally experiences 22.9 wet days (6.27% of the time) and receives about 27.62 millimetres (1.09 inches) of precipitation yearly. Most of the land in the Talaja region has a slope of 0% or less, and it slopes generally towards the sea. Tansa, Sarvadar, Trambak, Juna Padar, and other large hill ranges may be found in this region between the villages of Talaja and Chhaya along the shore. Away from the coast, the hill ranges are found in the interior of the land. Tansa hill is 203.57 metres high, and Trambak hill reaches a maximum elevation of 300.61 miles

Talaja area soils The weathering of trap rock and wind-blown sands creates the clayey to sandy loam that makes up the soil in coastal locations.

• Brown-Black Cotton Soil When trap rocks are revealed, this type of soil predominates and covers a large portion of Talaja, Ghogha, and Rajula Talukas. Clayey Yellow Soil It comes from Talaja's breakdown. Talaja and neighbouring areas with exposed clayey strata have this kind of soil.Coastal Dunes Sandy Soil This type of soil is found in Mahuva, Rajula, and Una talukas closest to the coast. Marshy Coastal Saline Soil This kind of clayey and muddy soil developed as a result of the interaction between the local soils and sea water.

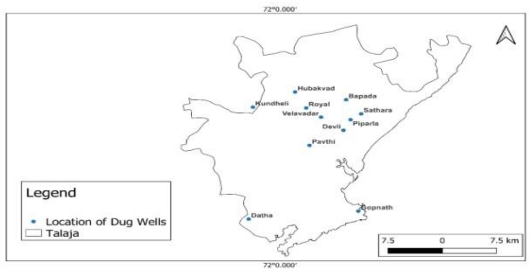

Fig: map of study area

III. DATA COLLECTION AND METHODOLOGY

The numerous tasks that have been required to be completed during the current inquiry are provided here. The study objectives and problem were specified in the preceding chapter of introduction and chapter 2 of the literature component.

The following categories are essentially how the tasks can be separated.

Data on the quality of ground water has been gathered from a number of organisations, including the Water and Sanitation Management Organisation and the Gujarat Water Resources Development Corporation.

Water Quality Index (WQI) calculation for potency [with reference to BIS standards bureau of Indian standard]. classification of the groundwater for irrigation suitability in accordance with the Central Soil Salinity Research Institute, India, and determination of the EC, SAR, and RSC.The creation of thematic maps using GIS software.

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A mathematical tool known as a "water quality index" is used to convert enormous amounts of data about water quality into a single number that summarises the state of various quality criteria.

Water Quality Index (Weighted Arithmetic Index)
The water quality indexes often show the extent of water pollution. It is a method of evaluating the water quality. By numerically combining all of the water quality criteria, an index number is created, which gives a comprehensive and simple explanation of the water. The index can be used in this way to evaluate water quality in relation to its ideal state and to shed light on how much human activity is affecting water quality. One of the best methods for informing the concerned user community and decision-makers about the general quality state of water is the Water Quality Index (WQI). As a result, it becomes a crucial factor in the evaluation and administration of groundwater.

The Weighing Factor
The weightage of each parameter is first computed for the water quality index. Different water quality parameters are given weights that are inversely correlated to the recommended standards for that parameters.Gives information on weight ages, BIS criteria, and water quality parameters.
Water Quality Rating is WL. (va - vi)/(si - vi) = qi

Where .
The actual value in the water sample is called Va.

With the exception of pH and DO, Vi is the ideal value (0).

Si represents the average value.

Calculating the Water Quality Index
A WQI is essentially a collection of many criteria that can be used to assess the overall quality of water. pH is one of the variables in the WQI. Magnesium, Nitrates, Total Dissolved Solids, Total Hardness, Calcium, Chlorides, and Fluorides. The quality rating's numerical value is then multiplied by a weighting factor based on the importance of the test to water quality. An overall water quality index is created by adding the sum of the obtained values.
The following equation, suggested by Tiwari and Mishra in 1985, is used to determine WQI. And Table 4.3 shows the water quality according to the WQI.Index of Water Quality:

Table 1. Unit Weightage of parameters based on BIS for Drinking Water (All values are in mg / l except pH)

Parameter	Standard Value (Sn & Si)	Assigned Weightage Factor (Wi)
PH	8.5	0..1363529
Calcium	75	0.01545
Chloride	250	0.004636
Fluoride	1.5	0.772666
Total hardness	300	0.0038633
Magnesium	30	0.038633
Nitrate	45	0.025755
Total dissolved solids	500	0.00231800

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Table 2 Water Quality Scale with reference to WQI

Water Quality Index (WQI)	**Quality of Water**
0-24	**EXCELLENT**
25-49	**GOOD**
50-74	**POOR**
75-100	**VERY POOR**
>100	**UNFIT FOR DRINKING**

provides the ground water characterization according to the Central Soil Salinity Research Institute's (CSSRI) recommended criteria.ARC GIS software is used to create spatial distribution maps for EC, SAR, and RSC that show the locations of the district's saline and alkali waters based on various groundwater sample types.

Selected parameters and their calculation

EC, SAR, and RSC have been chosen as study parameters. Equations 3.5 and 3.6 are used to compute the sodium absorption ratio (SAR) and residual sodium carbonate (RSC) based on the analysis data.

SAR(meq L-1)= Na+..........3.5

√Ca+2 +Mg+2/2

CO3 + HCO3 = RSC(meq L-1) (Ca +2 + Mg +2)........

Relevance of particular irrigation electrical conductivity (EC) parameters:

Electrical conductivity provides information on the dangers of saline in water.When determining whether water is suitable for irrigation, EC is crucial. In irrigation water with too much EC, salty water is produced.The structure, permeability, and aeration of the soil are also impacted by high EC, which indirectly affects plant growth. The maximum allowed value for irrigation water is 2(dSm-1), according to (CSSRI).

Table 3 Categorization of ground water on the basis of EC,SAR and RSC, standards suggested by CSSRI ,India

WATER QUALITY	**ELECTRICAL CONDUCTIVITY (dsm-1)**	**SAR (meq L-1)**	**RSC (meq L-1)**
A. Good	**<2**	**<10**	**<2.5**
B.Saline waters			
1.Marginally saline	**2-4**	**<10**	**<2.5**
2.Saline	**>4**	**<10**	**<2.5**
3.High SAR Saline	**>4**	**>10**	**<2.5**
C.Alakali waters			
1.Marginally alkali	**<4**	**<10**	**2.5-4**
2.Alkali	**<4**	**<10**	**>4**
3.Highly alkali	**Variable**	**>10**	**>4**

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IV. RESUILT AND DISCUSSION

In the Gujarati state of Talaja, there is a census town. Talaja is located in Gujarat's Bhavnagar district and in Talaja tehsil. The geolocation of the Talaja is located between 21.3578° N latitude and 72.0347° E longitude. According to the 2011 census, there were 215,274 people living in the Talaja taluka in Bhavnagar, which has a 776 km2 area. 99 villages make up Talaja. About 50 metres (164 feet) above sea level, on average, is what you will find at Talaja Taluka. Nearly 27°C (81°F) is the Talaja Taluka's average yearly temperature. For the pre- and post-monsoon seasons of 2017–2021, the study is being conducted for Talaja taluka's ele one station. In accordance with the technique outlined in the preceding chapter, the appropriateness of Groundwater at various

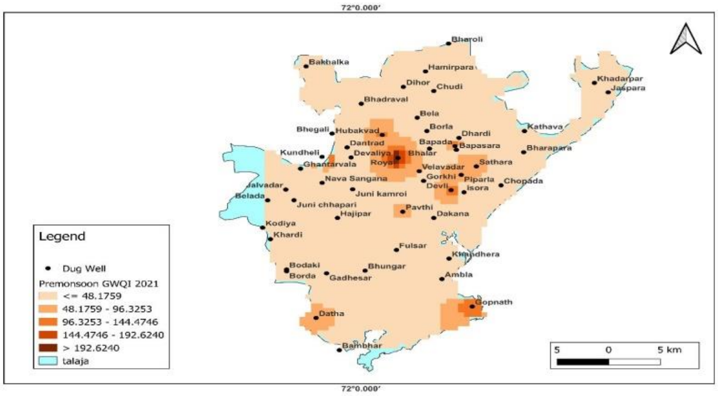

Fig. Thematic map of Gwqi - pre monsoon 2021

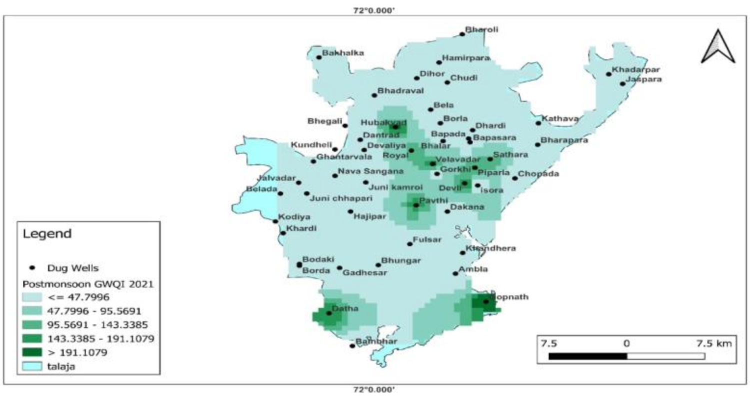

Fig. Thematic map of Gwqi post monsoon 2021

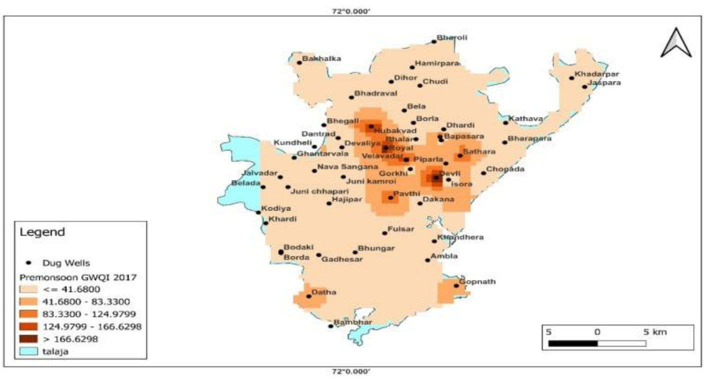

Fig. Thematic map of Qwqi premonsoon 2017

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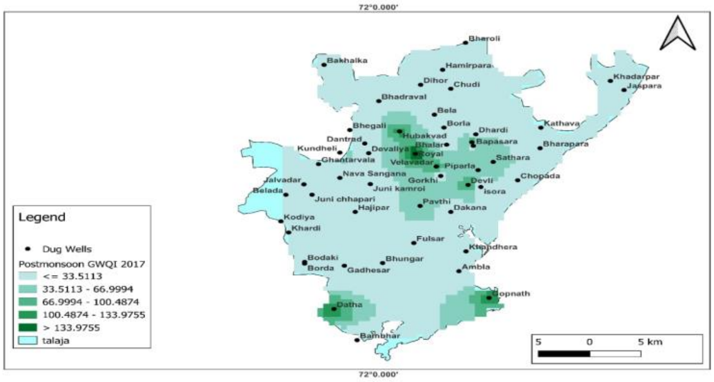

Fig. Thematic map of Gwqi post monsoon 2017

Table 4 PRE MONSOON ANALYSIS RESULT

YEAR	TOTAL WELL	NO.OF DATA NOT AVAILABLE	NO.OF DATA AVAILABLE	EXCELLENT	GOOD	POOR	VERY POOR	UNFIT FOR DRINKING
2021	11	0	11	0	4	3	4	0
2017	11	0	11	1	3	5	2	0

Table 5 POST MONSOON ANALYSIS RESULT

YEAR	TOTAL WELL	NO.OF DATA NOT AVAILABLE	NO.OF DATA AVAILABLE	EXCELLENT	GOOD	POOR	VERY POOR	UNFIT FOR DRINKING
2021	11	0	11	0	4	3	4	0
2017	11	0	11	2	2	5	2	0

V. CONCLUSION

The wells with the numbers 9, 10, 11, 5, 7, 3, 2, 1 that are part of the velvad, royal, habukad, kundheli, sathara, pavthi, gopanath, datha, and have a GWQI range from 2017 to 2021 had poor water quality throughout the pre-monsoon and post-monsoon seasons.The high GWQI value at this well has been discovered to be mostly caused by increased groundwater levels of nitrate, hardness, flouride, and total dissolved solids. The higher value of calcium and magnesium was substantially connected with one another and represents how hard the natural water is. With a few exceptions, the groundwater can be categorised as appropriate for irrigation given specific circumstances like good management and a competent drainage system. The findings of these investigations showed that the factors influencing the chemistry of groundwater are the weathering of silicate minerals, the dissolution.

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REFERENCES

1. Nagaraju A, Veeraswamy, G., Sridhar, Y. and Thejaswi, A. (2017) Assessment of groundwater quality in Gudur area of Andhra Pradesh, South India, Fresenius Environ, Bull., Vol.26(5), pp. 3597-3606.
2. Veeraswamy, G, Nagaraju , A, Balaji, E , Sridhar, Y, Rajasekhar, A .(2018) water quality assessment in terms of water quality index in gudur area, Nellore district, Andhra Pradesh International Journal of Technical Research & Science.Vol.3,No.1,pp.1-6
3. Fischer, G., & Heilig, G. K. (1997). Population momentum and the demand on land and water resources. Philosophical Transactions of the Royal Society B: Biological Sciences, 352(1356), 869–889
4. Ayers, R.S. and Westcot, D.W, Water quality for agriculture. irrigation and drainage. Food and Agriculture Organization of the United Nations, 1985. Rome, Italy, 29: 1-117
5. APHA (2005). Standard methods for the examination of water and wastewater. In: Eaton A.D., Clesceri, L.S., Rice, E.W., Greenberg, A.E., and Franson, M.H. (eds.), American Public Health Association, Washington D.C., USA, p. 1368.
6. Crawford, M.D., Gardner, M.J. and Morris, J.N. (1972). Water hardness, Rainfall and cardiovascular mortality. Lancet 1, pp. 1396-1397
7. Nagaraju A, Sreedhar Y, Kumar KS, Thejaswi A and Sharifi Z (2014) Assessment of Groundwater Quality and Evolution of Hydrochemical Facies around Tummalapalle area, Cuddapah District, Andhra Pradesh, South India. J Environ Anal Chem. 1: 112. Doi: 10.4172/JREAC.1000112
8. Kelly, W.P. (1940). Permissible composition and concentration of irrigated waters. In: Proceedings of the A.S.C.F, pp. 607
9. Alagbe, S.A. (2006). Preliminary evaluation of hydrochemistry of the Kalambaina formation, Sokoto Basin, Nigeria. Environmental Geology. Vol. 51, pp. 39
10. Collins, R. and Jenkins, A. (1996).The impact of agricultural land use on stream chemistry in the Middle Hills of the Himalayas, Nepal. J Hydro, Vol. 185, pp. 71-86.