Maharashtra Bhugolshastra Sanshodhan Patrika
Double-blind peer-reviewed /refereed, International Research Journal of Geography
ISSN: 0971-6785 / Volume- 43 / Issue-1 / Jan-Jun 2026

Original Article

Assessment of Groundwater Quality for Drinking Purposes Using Water Quality Index in Ahilyanagar District, Maharashtra, India

Dr. Rajendra B. Zolekar
K.V. N. Naik Shikshan Prasarak Sanstha's Arts, Commerce and Science College Nashik, Canada Corner, Nashik Maharashtra, India.
Email: raj4mezolekar@gmail.com

Manuscript ID:
MBP-2026-430110
ISSN: 0971-6785

Volume 43
Issue 1
Pp. 86-98
June - 2026

Submitted: 25 Jan. 2026
Revised: 25 Mar. 2026
Accepted: 20 May. 2026
Published: 30 Jun. 2026

Abstract

Groundwater is the primary source of drinking water in Ahilyanagar District, Maharashtra, where increasing agricultural and anthropogenic activities have raised concerns regarding water quality. This study evaluates the hydrogeochemical characteristics and drinking water suitability of groundwater using the Water Quality Index (WQI) approach. A total of 100 groundwater samples obtained from the Central Ground Water Board (CGWB) were analyzed using major physicochemical parameters, including pH, TDS, total hardness, calcium, magnesium, sodium, potassium, bicarbonate, chloride, sulfate, nitrate, and fluoride. WQI was computed based on World Health Organization (WHO) and Bureau of Indian Standards (BIS) guidelines to assess groundwater quality for drinking purposes. The results reveal considerable spatial variation in groundwater quality across the district. WQI values ranged from 12 to 598, with 21% of samples classified as excellent, 40% as good, 24% as poor, 10% as very poor, and 5% as unsuitable for drinking. Elevated concentrations of TDS, hardness, chloride, sulfate, nitrate, and sodium were identified as the major factors influencing groundwater deterioration. Areas with poor to unsuitable water quality are mainly associated with intensive agricultural practices, excessive fertilizer application, and anthropogenic activities. The study concludes that while a majority of groundwater samples are suitable for drinking, nearly 39% require treatment before consumption. The findings provide useful information for groundwater management and sustainable water resource planning in Ahilyanagar District.

Keywords: *Water Quality index, Groundwater, Ahilyanagar, Hydrogeochemical*

Introduction

The increasing trend of water crises related to pollution, distribution, and utility management has attracted many scholars (Bindraban et al., 2006). In some of these studies, the main focus points are water pollution, soil pollution, land-use changes, and salinity monitoring. According to the Food and Agriculture Organization (FAO),

Website: https://www.mbppune.org.in
DOI: 10.5281/zenodo.21352543
OPEN ACCESS

Address for correspondence:
Rajendra B. Zolekar, K.V. N. Naik Shikshan Prasarak Sanstha's Arts, Commerce and Science College Nashik, Canada Corner, Nashik Maharashtra, India.

How to cite this article:
Zolekar, R. B. (2026). Assessment of Groundwater Quality for Drinking Purposes Using Water Quality Index in Ahilyanagar District, Maharashtra, India. Maharashtra Bhugolshastra Sanshodhan Patrika Double-blind Peer-reviewed /refereed, International Research Journal of Geography, 43(1), 86–98. https://doi.org/10.5281/zenodo.21352543

approximately five million people die each year from water-borne illnesses, according to the FAO. According to FAO and UNESCO, more than half of the world's current irrigation systems are affected to some degree by secondary salinization and water logging (Deosthali 2005, Raja Babu et al. 2005). It is a main non-point cause of water pollution. Hunter (2003) has underlined the need for prompt investigation and possible remedial action based on results of more than 50% of EC, TN or TP measurements exceeding the guidelines for healthy agriculture. Gaballah et al. (2005) have proved two critical problems in Dakahlia and Sohag (Egypt) agricultural lands, i.e. salinization and water pollution. Gozalez-Nunez et al. (2004) have evaluated current level of salinization of soils to suggest the need of quality analysis and early warning system to prevent the spread of ionization for management of salt-affected soil in Cuba. The problem of salinization is observed in millions of hectares of land, leading to a severe reduction in crop productivity. The growth in groundwater for irrigation in Punjab and Pakistan shows a decline in the water table (Kijne, 1995). However, the incidence of salinity has not been reduced at the same rate. Recently, Bari and Smettem (2006) have developed a salt and water balance model to represent the stream salinity process with land-use changes. Scheierling (1996) has focused on overcoming agricultural water pollution in the European Union. Said et al. (1999) were developed a decision support system for water quality management for River Nile to cost-effective alternatives for water quality in Egypt. Soerens et al. (2003) have reviewed the history of water quality disputes and discussed technical, administrative, and political efforts for River Illinois. Changhua et al. (1999) have analyzed recent Chinese reports on public health and water resources to understand the recent trends in China's environmental risk. He concluded that high water pollution increases the risk of infections and parasitic diseases. Secondly, the lack of coordination between environmental and public health objectives, a complex and fragmented system to manage water resources. Therefore, the present work has been devoted to analyzing groundwater quality assessment for human health and agriculture.

Deosthali (2005) has been given thirst on prioritization of villages for reclamation of salt-affected areas in irrigated tracts of Sangli District (M.S.) using GIS and Remote Sensing. Kumar (2007) delineated heavy metal contamination zones in the shallow alluvial aquifers, Ankaleshwar industrial estate, south Gujarat, India, has been done using GIS-based color composites and overlays. Groundwater mapping has been done using a Geographical Information System (GIS) approach. The study area, Ahilyanagar district has been recognized for intensive agriculture of sugarcane, onion, Tomoto, Pomogrenate, Bajara, Jawar, Vegetable, etc. However, the groundwater resource in the study region is exploited for domestic, agriculture and drinking reason (Zolekar and Bhagat 2015) and contaminated from different sources like extensively used fertilizers and chemicals, industrial wastage, domestic effluents and hospital discharge (Selvakumara et al. 2017). The groundwater chemistry with spatial variation in the region isn’t analyzed to check the suitability for drinking water. Therefore, the study was focused on analysis qualities and hydrogeochemical characterization of groundwater for drinking purposes. The hydrogeochemical parameters used in the context of groundwater quality and their detailed spatial explanation are distinct from other studies in the literature.

Study area

Ahmednagar district is located in the western region of Maharashtra, India. It lies between the geographical coordinates of latitude 18.20°N to 19.50°N and longitude 73.90°E to 75.90°E. The district covers a total geographical area of approximately

Maharashtra Bhugolshastra Sanshodhan Patrika
Double-blind peer-reviewed /refereed, International Research Journal of Geography
ISSN: 0971-6785 / Volume- 43 / Issue-1 / Jan-Jun 2026

17,048 square kilometers, making it one of the largest districts in Maharashtra by area (Fig. 1). The district is characterized by semi-arid to drought-prone conditions, receiving an average annual rainfall of about 500–700 mm. The terrain includes plateaus, hilly regions, and river valleys. Major rivers flowing through the district include the Pravara, Mula and Godavari. Agriculture is the primary occupation in Ahmednagar, heavily dependent on groundwater for irrigation. The major crops grown in the district include: Sugarcane, Cotton, Millets, Bajra, Jowar, Pulses, Wheat, Onions and vegetables.

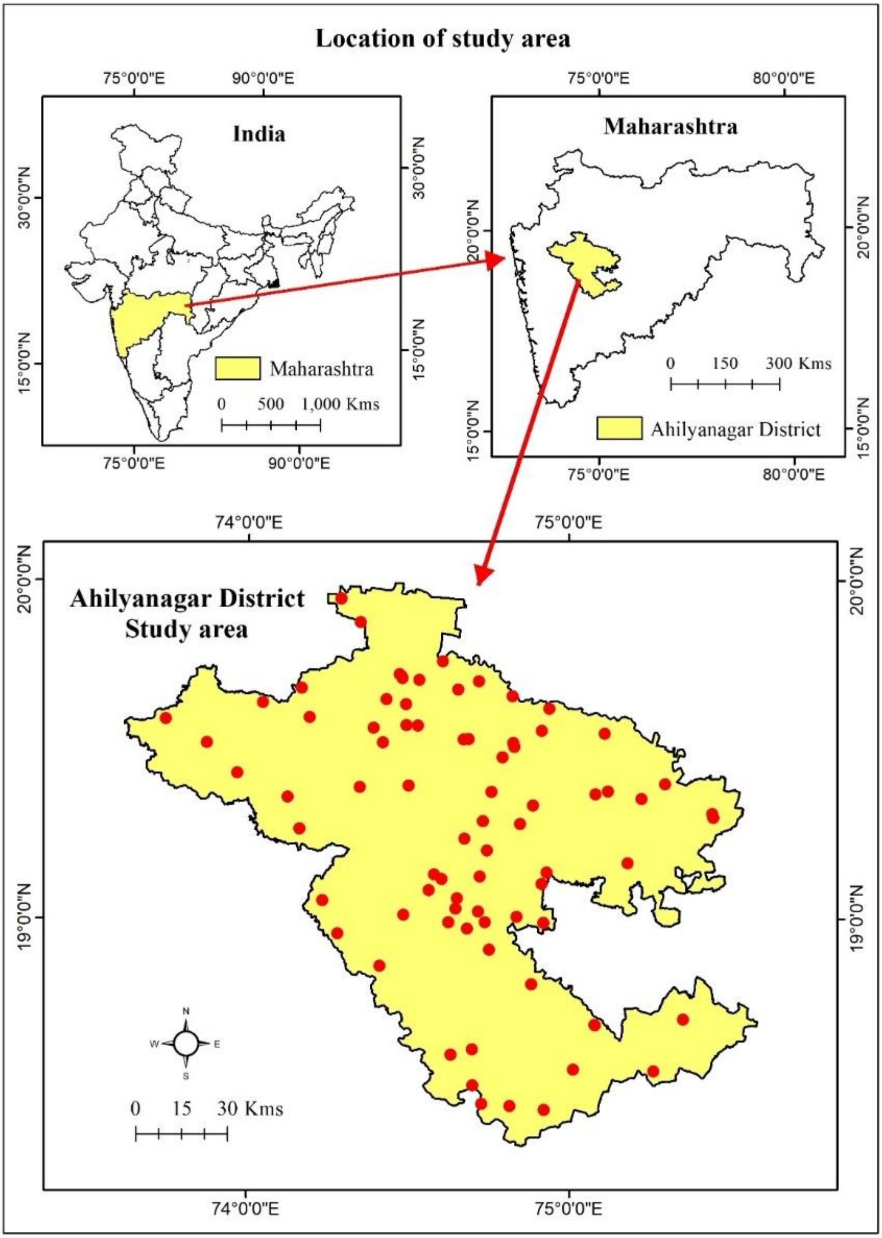

Fig. 1 Location map of study area: Ahilyanagar District

Sugarcane cultivation, due to its high-water requirement, places a significant stress on groundwater resources, especially in drought-prone talukas like Parner, Jamkhed, and Karjat. Over-extraction of groundwater for agriculture has led to a decline in water table levels and deterioration in water quality in several areas. Fertilizer and pesticide use in irrigated farming contributes to nitrate and pesticide contamination in groundwater.

Ahmednagar district has a population of approximately 4.5 million (2021 est.), with a substantial rural population relying on groundwater for drinking and domestic needs.

The growing pressure on groundwater resources in Ahmednagar district, both in terms of quantity and quality, necessitates systematic and scientific assessment. Understanding spatial and temporal variations in groundwater quality is essential for sustainable water resource management, public health safety, and informed agricultural planning.

Database amd methodology:

The present study relies entirely on secondary groundwater quality data compiled for Ahilyanangar District. Groundwater quality information was procured from the online report of the Central Ground Water Board (CGWB), which provides standardized hydrochemical datasets for scientific and public use. A total of 100 groundwater sample records from different monitoring stations across the district were included in the analysis, ensuring wide spatial representation of varying hydro-geological and land-use settings.The dataset comprised key physico-chemical parameters commonly used to evaluate groundwater suitability for drinking and domestic purposes. These parameters included pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), major cations (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}), major anions (HCO_3^{-}, SO_4^{2-}, Cl^{-}, NO_3^{-}), along with other relevant hydrochemical indicators. All parameters were compiled systematically into a database (Table 1) for statistical interpretation and comparative analysis.

To determine the overall suitability of groundwater for human consumption, the Water Quality Index (WQI) method was adopted. The WQI was calculated using standard procedures that involve assigning weights to individual water quality parameters based on their relative importance to human health, determining quality ratings for each sample, computing sub-index values, and deriving a final WQI score. Based on these scores, groundwater quality was classified into categories such as excellent, good, poor, very poor, and unsuitable for drinking. The secondary dataset facilitated an integrated assessment of groundwater status in the district without requiring manual sampling. Interpretation of spatial and temporal variations in hydrochemical characteristics provided insight into potential natural and anthropogenic influences on groundwater quality.

3.1 Water Quality Index (WQI)

WQI is useful to determine the physical, chemical, and biological nature of water for drinking and domestic purposes (Wanda et al., 2012). Several researchers have carried out WQI quite successively to analyze the water quality for domestic, drinking, industrial, etc. purposes (Tiwari and Mishra, 1985; Singh and Hussian, 2016; Tiwari et al., 2017; Adimalla, 2018). Therefore, WQI was used for hydrogeochemical characterization of groundwater and its suitability for drinking purposes basis on the standard range suggested by the World Health Organization (WHO, 1997) and Bureau of Indian Standards (BIS) (Revised 2003).

The WQI has been calculated in four steps:

Weights were assigned for each of the 12 water quality parameters i.e., pH, TDS, TH, Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, HCO_3^{-}, Cl^{-}, NO_3^{-}, SO_4^{2-} and F^{-}based on relative importance in the overall water quality (Table 1). TDS, Fluoride, Chloride, Nitrate, Sulphate, and Sodium are the most important parameters for the determination of water quality; therefore, maximum weight (5) was assigned to them (Table 1) (Tiwari et al. 2017). Bicarbonate shows less significance in formation water quality in the region and is assigned a minimum weight (1). pH, Calcium, and Magnesium (3) assigned weights 3 whereas Potassium and Total hardness 2 based on their importance (Table 1).

The relative weights for each criterion were calculated using equation (Eq. 1).

$$W_i = \frac{\mathrm{w_i}}{\sum_{i=1}^{n} \mathrm{w_i}} \qquad (1)$$

Where W_i shows relative weight, w_i is the weight of each criterion and n is a number of criteria (Table 1).

The quality rating range (q_i) was calculated (Eq. 2) by dividing the value of each sample of parameters (C_i) by its respective standards (S_i) suggested by WHO (1997) and BIS (2003) and multiplied by hundred (100).

$$q_i = \frac{\mathrm{C_i}}{\mathrm{S_i}} \times 100 \qquad (2)$$

Lastly, sub-index (SI_i) was calculated (Eq. 3) using relative weights (W_i) and quality rating scale (q_i) for the determination of WQI (Eq.4).

$$SI_i = \mathrm{W_i} \times \mathrm{q_i} \qquad (3)$$

$$WQI = \Sigma \mathrm{SI_i} \qquad (4)$$

Where, SI_i is the sub index of each parameter.

Table 1: Relative weight of chemical parameters

Chemical parameters	**Standards (BIS 2003/ WHO 1997)**	**Weight (w_i)**	**Relative weight (W_i)**
pH	8.5	3	0.068
Total dissolved solids (TDS)	500	5	0.114
Fluoride (F^-)	1	5	0.114
Chloride (Cl^-)	250	5	0.114
Nitrate (NO_3^-)	45	5	0.114
Sulphate (SO_4^{2-})	200	5	0.114
Bicarbonate (HCO_3^-)	200	1	0.023
Calcium (Ca^{2+})	75	3	0.068
Magnesium (Mg^{2+})	30	3	0.068
Sodium (Na^+)	50	5	0.114
Potassium (K^+)	100	2	0.045
Total hardness (TH)	300	2	0.045
		Σ wi = 44	Σ Wi =1

Results and discussion

4.1 Classification of water quality index

WQI classifies water quality on the basis hydrochemical parameters into categories of excellent water (EW), good water (GW), poor water (PW), very poor water (VPW) and unsuitable for drinking purposes (UDP) (Table 2). WQI values vary from 12 to 598 with an mean value of 114.

Maharashtra Bhugolshastra Sanshodhan Patrika
Double-blind peer-reviewed /refereed, International Research Journal of Geography
ISSN: 0971-6785 / Volume- 43 / Issue-1 / Jan-Jun 2026

Table 2: Classification of WQI range and category of water

WQI range	**Category of water**	**Percentage of samples in this category**
<50	Excellent water	21
50-100	Good water	40
100-200	Poor water	24
200-300	Very Poor water	10
>300	Unfit for drinking purpose	05

1The groundwater quality in Ahilyanagar district has been assessed based on the Water Quality Index (WQI), and the findings have been categorized into five distinct classes. According to the data, 21% of the water samples fall under the 'Excellent' category, having a WQI of less than 50, which indicates that the water is highly suitable for drinking without any treatment. The highest proportion of samples, 40%, are classified as 'Good' with a WQI range between 50 and 100, also indicating suitability for drinking purposes with minimal concern (Table 2). On the other hand, 24% of the samples fall into the 'Poor' category, with a WQI between 100 and 200, suggesting that the water is marginally suitable and may require some form of treatment before consumption. Additionally, 10% of the samples are considered 'Very Poor', having WQI values ranging from 200 to 300, which means the water is largely unsuitable and requires significant treatment before it can be safely used. Most critically, 5% of the groundwater samples have a WQI greater than 300, placing them in the 'Unfit for Drinking' category (Table 2 & 3). Water in these areas poses a potential health risk and should not be consumed without proper and extensive treatment. Due to extensive use of chemical fertilizer, high TDS and TH of about 24% of groundwater samples are classified in 'Poor water' for drinking. About 10% and 5% land of groundwater samples is classified into the class 'very poor' and 'unfit water' for drinking (Table 2 & 3). There is need to protection of groundwater from intensive use of chemical fertilizer and contamination of agro based industry.

Table 3: Water quality index (WQI) value of the groundwater in the Ahilyanagar

Sr. No	Village	Longitude	Latitude	WQI	WQI_Classes
1	Deothan	74.05	19.64	58.53	Good water
2	Kotul	73.97	19.43	106.17	Poor water
3	Panshet	73.74	19.59	24.09	Excellent water
4	Rajura	73.87	19.52	115.85	Poor water
5	Jawala â,¬	75.26	18.55	23.81	Excellent water
6	0galwadi	75.08	18.69	19.07	Excellent water
7	0galwadi	75.35	18.70	13.43	Excellent water
8	0galwadi	75.08	18.69	12.72	Excellent water
9	0galwadi	75.08	18.69	13.56	Excellent water
10	Baradgaonsudrik	74.82	18.45	45.13	Excellent water
11	Karzat	75.01	18.56	85.52	Good water
12	Rassin	74.92	18.44	40.91	Excellent water
13	Rassin	74.92	18.44	153.41	Poor water
14	Siddhatek	74.73	18.46	160.50	Poor water
15	Chas0liEw	74.29	19.95	551.41	Unfit for drinking

Maharashtra Bhugolshastra Sanshodhan Patrika
Double-blind peer-reviewed /refereed, International Research Journal of Geography
ISSN: 0971-6785 / Volume- 43 / Issue-1 / Jan-Jun 2026

					purpose
16	Chas0li PYT	74.29	19.95	598.05	Unfit for drinking purpose
17	Shajapur	74.35	19.88	146.20	Poor water
18	Arangaon	74.72	19.02	37.95	Excellent water
19	Bambordi (Ghumat)	74.74	18.99	147.95	Poor water
20	Borwadi	74.63	18.99	57.09	Good water
21	Borwadi	74.63	18.99	57.11	Good water
22	Chas	74.65	9.03	74.18	Good water
23	Chincholi Patil	74.92	18.99	75.57	Good water
24	Dehre	74.68	19.24	180.88	Poor water
25	Deulgaonsidhi	74.75	18.91	30.57	Excellent water
26	Jadhav Wadi	74.68	18.97	129.16	Poor water
27	Khatgaontakli	74.60	9.12	181.77	Poor water
28	Khaudgaon	74.92	9.11	49.15	Excellent water
29	Nimgaon Gha0	74.58	19.13	114.26	Poor water
30	Nimgaon Vagha	74.65	19.06	99.71	Good water
31	Pimpalgoan	74.75	19.20	75.80	Good water
32	Sawedi	74.72	19.13	338.19	Unfit for drinking purpose
33	Singwekeshan	74.85	19.28	112.94	Poor water
34	Ukadgaon	74.84	19.01	220.77	Very poor water
35	Bhalgaon	74.94	19.62	167.47	Poor water
36	Karwandi	74.89	19.34	300.94	Very poor water
37	Karwandi	74.89	19.34	102.34	Poor water
38	Niwasa Bk	74.92	19.56	91.43	Good water
39	Sirasgaon	75.11	19.55	43.86	Excellent water
40	Tilapur	74.83	19.52	94.70	Good water
41	Tilapur	74.83	19.52	94.74	Good water
42	Telkudgaon	75.08	19.37	29.95	Excellent water
43	Alkuti	74.23	19.06	92.02	Good water
44	Alkuti	74.23	19.06	96.81	Good water
45	DaithanGunjal	74.56	19.09	43.83	Excellent water
46	Loni Havell	74.49	19.01	72.69	Good water
47	Nijhoj	74.28	18.96	64.32	Good water
48	Wadegavan	74.41	18.86	54.27	Good water
49	Pathardi	75.18	19.17	90.66	Good water
50	AdgaonEw	74.43	19.65	80.78	Good water
51	DathEw	74.42	19.52	359.91	Unfit for drinking purpose
52	EkrukheEw	74.53	19.71	231.28	Very poor water
53	Loni Ew	74.49	19.58	221.08	Very poor water
54	Loni Ew	74.49	19.58	34.31	Excellent water
55	Pimpri 0rmal Ew	74.49	19.64	207.33	Very poor water
56	PuntambeEw	74.61	19.76	201.98	Very poor water
57	Rahata	74.48	19.71	116.46	Poor water

58	Rahata Ew	74.48	19.72	94.22	Good water
59	Rahata Ew	47.48	19.72	44.77	Excellent water
60	TisgaonEw	74.53	19.57	77.42	Good water
61	Tisgaon Ow	74.53	19.57	89.79	Good water
62	Brahmangaon	74.67	19.53	139.41	Poor water
63	Brahmani	74.76	19.38	80.55	Good water
64	Brahmani	74.76	19.38	59.68	Good water
65	Manjiri	74.79	19.48	43.05	Excellent water
66	Manjiri	74.79	19.48	43.05	Excellent water
67	Nimbhari	74.83	19.51	123.09	Poor water
68	Nimbhari	74.83	19.51	123.09	Poor water
69	Tahrabad	74.50	19.40	59.26	Good water
70	Tahrabad	74.50	19.40	59.29	Good water
71	Vambori	74.73	19.29	53.65	Good water
72	Vambori	74.73	19.29	53.65	Good water
73	Vambori	74.73	19.29	67.41	Good water
74	Bota	74.16	19.27	24.56	Excellent water
75	Bota	74.16	19.27	65.86	Good water
76	Bota	74.16	19.27	76.69	Good water
77	Ghulevadi	74.19	19.60	126.48	Poor water
78	Karhe	74.17	19.68	81.44	Good water
79	Kauthe APTEw	74.12	19.36	66.65	Good water
80	kauthemalkapur	74.35	19.39	34.70	Excellent water
81	0mgaonjali	74.39	19.57	57.53	Good water
82	Bhatkudgaon	75.12	19.38	108.08	Poor water
83	Bodhegaon	75.45	19.30	73.35	Good water
84	BodhegaonGhotan	75.45	19.31	373.09	Unfit for drinking purpose
85	Ghatan	75.30	19.40	176.38	Poor water
86	Shevgaon	75.23	19.36	114.62	Poor water
87	Belwandi	74.93	19.14	116.54	Poor water
88	Ghoghargaon	74.88	18.81	212.33	Very poor water
89	Ghoghargaon	74.88	18.81	67.77	Good water
90	Matarpimpri	74.63	18.60	31.22	Excellent water
91	Matarpimpri	74.63	18.60	57.66	Good water
92	Shrigonda	74.70	18.62	57.69	Good water
93	PadegaonPyt	74.70	18.51	60.34	Good water
94	MalewadiEw	74.72	19.71	148.09	Poor water
95	Newkamalpur	74.83	19.66	118.95	Poor water
96	Newkamalpur	74.83	19.66	61.42	Good water
97	NimgaonEw	74.66	19.68	272.02	Very poor water
98	PadegaonEw	74.69	19.53	272.06	Very poor water
99	NimgaonEw	74.66	19.68	81.88	Good water
100	PadegaonEw	74.69	19.53	278.24	Very poor water

4.2 Spatial analysis of water quality index:

1. **Excellent Groundwater Quality** is observed in the western part of Akola and Jamkhed Tehsils, as well as in the eastern part of the project area. These regions display optimal water quality, likely due to fewer industrial activities and a lower reliance on fertilizers.
2. **Good Groundwater Quality** is observed in the western part of Akola Tehsil, Sangamner, Parner, and Shrigonda Tehsils. These areas still maintain relatively good water quality, likely due to balanced agricultural practices and fewer contaminants from industrial activities.
3. **Poor Groundwater Quality** is seen in areas such as Kopargaon, Rahuri, and parts of Nagar, Nevasa, and Pathardi Tehsils in Ahilyanagar district. The decline in water quality here can be attributed to the extensive use of fertilizers in agriculture and industrial activities, particularly from the sugarcane industry, which contributes to contamination of the groundwater.
4. **Very Poor Groundwater Quality** is observed in areas like Shrirampur, Shevgaon, and Nagar Tehsils in Ahilyanagar district. These areas exhibit significantly degraded water quality, possibly due to industrial discharge and high levels of fertilizer runoff.
5. unfit groundwater for drinking purposes: Furthermore, there are some patches of unfit groundwater for drinking purposes found in parts of Sangamner, Rahata, and Rahuri Tehsils. This suggests localized contamination issues, likely due to a combination of industrial activities and improper waste disposal.

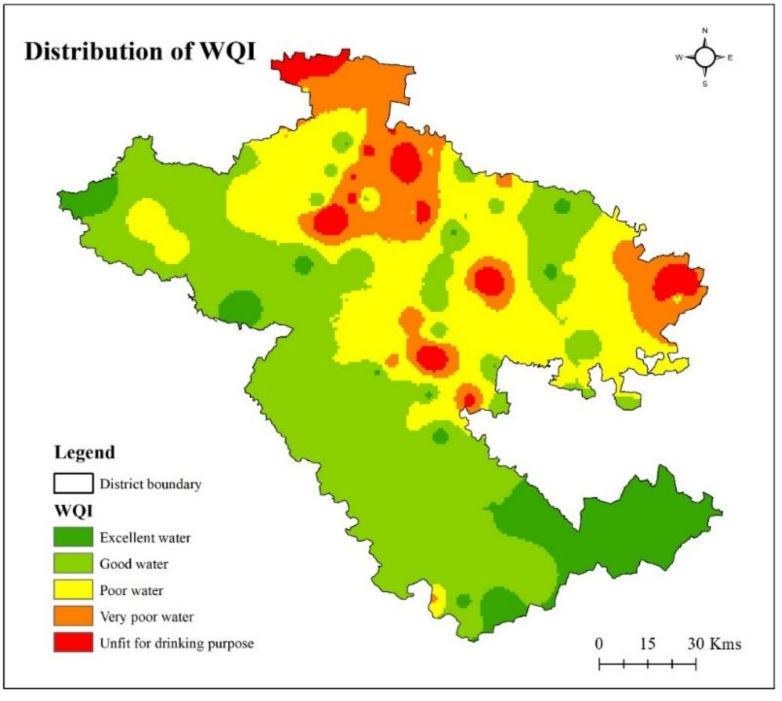

Fig. 2 Spatial distribution of water quality assessment

5. Findings & Conclusions:

5.1 Major findings:

1. Excellent groundwater quality is observed in the western parts of Akola and Jamkhed Tehsils, as well as the eastern part of the project area, likely due to fewer industrial activities and lower fertilizer use.
2. Good groundwater quality is observed in the western part of Akola Tehsil, Sangamner, Parner, and Shrigonda Tehsils, likely due to balanced agricultural practices and minimal industrial contaminants.
3. Poor groundwater quality is seen in Kopargaon, Rahuri, and parts of Nagar, Nevasa, and Pathardi Tehsils, primarily due to extensive fertilizer use and industrial activities, particularly from the sugarcane industry.
4. Very poor groundwater quality is observed in Shrirampur, Shevgaon, and Nagar Tehsils, likely due to industrial discharge and high fertilizer runoff.
5. Localized patches of unfit groundwater for drinking are found in parts of Sangamner, Rahata, and Rahuri Tehsils, indicating contamination from industrial activities and improper waste disposal.
6. The pH range of 7.3 to 7.3 in Nashik district is within the safe limits of 6.5 to 8.5 as per WHO and BIS guidelines, indicating optimal water quality for consumption.
7. The average TDS value of 499.7 mg/L falls within the acceptable range for drinking water, although the wide variation in TDS levels, from 141 to 1748 mg/L, indicates areas with potentially unsafe water quality.
8. The average TH value of 364.9 mg/L in Ahilyanagar is classified as moderately hard, which is acceptable for drinking but may cause issues like scaling in pipes and affect taste.
9. The average calcium concentration of 106.4 mg/L in Ahilyanagar exceeds the recommended limit of 75 mg/L by BIS, indicating potential issues with water hardness and scaling.
10. The average magnesium concentration of 44.2 mg/L in Ahilyanagar is within the moderately hard category but the high maximum value of 345 mg/L may cause scaling and taste problems in some areas.
11. While the average sodium concentration of 141.8 mg/L is acceptable for taste and health, the high maximum value of 1108 mg/L in some areas may make the water unpalatable and unsuitable for consumption, especially for those with heart or kidney issues.
12. The potassium concentration in Ahilyanagar is within acceptable limits, with an average of 907 mg/L, but some values exceed the ideal range for drinking water quality.
13. The average bicarbonate concentration of 217.9 mg/L is safe by WHO standards, but the high variability in values across Ahilyanagar suggests inconsistent water quality.
14. The average chloride concentration of 310.0 mg/L is above the WHO ideal level of 250 mg/L but within the maximum permissible limits; however, some areas exceed the limits, leading to taste and corrosion issues.
15. The average sulfate concentration of 197.8 mg/L is within safe limits, but the high maximum concentration of 3560 mg/L in some areas exceeds WHO and BIS guidelines, potentially causing taste and health issues.
16. High nitrate levels in some regions of Ahilyanagar may present health risks, with concentrations exceeding safe limits, though the average level is within acceptable drinking water standards.
17. The average fluoride concentration of 0.1 mg/L in Ahilyanagar is below the optimal range of 0.5 to 1.5 mg/L, indicating insufficient fluoride for dental health protection.

5.2 Conclusion

Groundwater is a best alternative for drinking purposes of Ahilyanagar district in India. The hydro-geochemical parameters of groundwater play a significant role in determination of water quality. However, the groundwater resources in the study region are contaminated due to excessive use of fertilizers and chemicals, industrial wastage, domestic effluents, etc. Therefore, in order to understand the groundwater quality, hundred (n=100) groundwater samples were collected, analyzed and evaluated for drinking purposes. The results of the parameters were compared to WHO (1997) and BIS (2003). These techniques have been used to achieve the objective of the present study and the following conclusions are reached. The WQI shows that 21% groundwater samples fall in the 'excellent water' (24%) and 'good water' (40%) categories and can be used different purposes. Remaining groundwater samples (39%) come under 'poor' to 'unfit for water drinking' categories and need to be processed before its utilization. he presents study can be utilized to improve the groundwater quality in Ahilyanagar district by government or the non-government planners. The objectives of the study achieved and methodology formulated and results of the study are useful. Therefore, present research project has been successfully executed.

Acknowledgements
The author sincerely acknowledges the Principal and Management of K.V.N. Naik Shikshan Prasarak Sanstha's Arts, Commerce and Science College, Nashik, for their continuous encouragement, support, and institutional facilities provided during the course of this research work. The author is also grateful to the Central Ground Water Board (CGWB), Government of India, for providing access to the groundwater quality data used in this study.

References

1. Adimalla, N., (2018). Groundwater quality for drinking and irrigation purpose and potential health risks assessment: a case study from semi-arid region of south India. Exposure and Health http://org/10.1007/s12403-018-0288-8
2. APHA (1995) Standard method for the examination of water and waste water (14th Ed.) Washington D.C.Amer. Public Health Association
3. APHA (1998) Standard methods for the examination of water and waste water, 20th
4. Bari, M.A., & Smettem, K.R.J. (2006). *A Daily Salt Balance Model for Stream Salinity Generation Process Following Land Use Changes*. Hydrology and Earth System Sciences, 10, 519–534.
5. Bindranban, P.S., Hendsdijk, H., Cao.W., Shai, Q., Thiyagarajan, T.M., Krogt, W. Van Der and Wardana, I.P (2006): "Transforming inundated rice cultivation", Water Resources Development, Routledge, Vol. 22(1), pp. 87-100.
6. BIS (2003) Indian standard drinking water specifications. Bureau of Indian Standards, New Delhi
7. Central Water Commission of India (2016) On the spot study of water situation in drought affected areas of the. Government of India
8. Changhua Wu, Crescencia Maurer, Yi Wang, Shouzheng Xue, and Devra Lee Davis (1999): "Water Pollution and Human Health in China", Environ Health Perspect, Vol.107, pp. 251-256.
9. Deosthali Vrishali (2005): "Prioritization of villages for reclamation of salt-affected areas in irrigated tracts of Sangli District (M.S.)- A GIS and Remote

Sensing approach", A technical report- GR 01/05, Department of Geography, University of Pune.

10. Doke, A.B., Zolekar, R.B., Patel, S. & Das, S. (2021) Geospatial mapping of groundwater potential zones using multi-criteria decision-making AHP approach in hard rock basaltic terrain in India. Ecological Indicators 127, 1-16.
11. FAO (1996): "Control of water pollution from agriculture". FAO irrigation and drainage paper – 55.
12. FAO and WHO (2008) Viruses in food: scientific advice to support risk management activities. Microbiological risk assessment series (13) Rome, Italy http://www.fao.org/tempref/docrep/fao/011/i0451e/i0451e00.pdf
13. Gaballah, M.S., et al. (2005). *Development of a system of good agricultural practice for sustainable agriculture in Dakahlia and Sohag Governorates, Egypt.*
14. González-Núñez, L.M., Tóth, T., & García, D. (2004). *Integrated Management for the Sustainable Use of Salt-Affected Soils in Cuba.* Revista de la Facultad de Agronomía (or related Cuban soil management publication).
15. Kijne, J.W., & Kuper, M. (1995). *Salinity and Sodicity in Pakistan's Punjab: A Threat to Sustainability of Irrigated Agriculture?* International Journal of Water Resources Development, 11(1), 73–86.
16. Kumar, S., Shirke, K. D., & Pawar, N. J. (2008). *GIS-based colour composites and overlays to delineate heavy metal contamination zones in the shallow alluvial aquifers, Ankaleshwar industrial estate, south Gujarat, India.*

Environmental Geology, 54(1), 117–129.

1. Raja Babu, C., Vijayalakshmi C. and Mohandass S. (2005): "Evaluation of rice (Oryza sativa L.) genotypes for salt tolerance**",** Journal of Food, Agriculture & Environment, Vol. 3(1), pp. 190-194.
2. Said, A., Shawky, A., ElMasry, N, Ezzat, M. and Hassan, M. (1999) : "Analysis of Nile water pollution control strategies: a case study using the decision support system for water quality management", Proceedings of the 2nd Inter-Regional Conference on Environment-Water, September 1-3, 1999.
3. Scheierling, Susanne M. (1996): "Overcoming Agricultural Water Pollution in the European Union", Finance & Development / September 1996, pp. 32-35
4. Selvakumar S, Chandrasekar N, Kumar G (2017)Hydrogeochemical characteristics and groundwater contamination in the rapid urban development areas of Coimbatore, India.Water Resources and Industry 17: 26-33
5. Singh S, Hussian A (2016) Water quality index development for groundwater quality assessment of Greater Noida sub-basin, Uttar Pradesh, India. Cogent Engineering 3: 1-17
6. Soerens, Thomas S., Fite, Edward H., and Hipp, Janie (2003): "Water quality in the Illinois river: conflict and cooperation between Oklahoma and Arkansas", Diffuse Pollution Conference Dublin, 2003.
7. Tiwari AK, Singh AK, Mahato MK, (2017) Assessment of groundwater quality of Pratapgarh district in India for suitability of drinking purpose using water quality index (WQI) and GIS technique. Sustain. Water Resour. Manag. DOI https://doi.org/10.1007/s40899-017-0144-1
8. Tiwari TN, Mishra M (1985) A preliminary assignment of water quality index of major Indian rivers. Indian Journal of Environment Protection 5(4): 276-279

Maharashtra Bhugolshastra Sanshodhan Patrika
Double-blind peer-reviewed /refereed, International Research Journal of Geography
ISSN: 0971-6785 / Volume- 43 / Issue-1 / Jan-Jun 2026

9. Wanda EMM, Gulula LC, Phiri G (2012) Hydrochemical assessment of groundwater used for irrigation in Rumphi and Karonga districts, Northern Malawi. Physics and Chemistry of the Earth 50(52): 92-97
10. Zolekar, R.B. and Bhagat, V.S., (2015) multi-criteria land suitability analysis for agriculture in hilly zone: Remote sensing and GIS approach. Computers and Electronics in Agriculture 118-C:300-321