# Quality Characterization of Groundwater for Human Consumption using Water Quality Index for Gandhinagar District, Gujarat

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**Abstract:** As we know, Water is an important parameter for survival of biotic component. Current analysis deals with ground water characteristic of Gandhinagar District, Gujarat. The properties of water and the water quality index are closely related. It is a number between 1 and 100 that represents the overall water quality at a specific location and time based on different water quality attributes. Better water quality is demonstrated by a lower water quality index. The land use pattern and waste disposal system have the most impacts on groundwater quality. The word "water quality" refers to the physical, chemical, or biological properties of the water. This was discovered by the collection of 50 groundwater samples from various locations across Gandhinagar and the comprehensive physicochemical examination of each sample. The following 10 factors have been taken into account when calculating the WQI.: PH, Sodium (Na+) , Total Hardness(CaCO3), Calcium, Magnesium, Chloride, Fluorides, Iron, Nitrate and Sulphate(SO4). The Bureau of Indian Standards (BIS, 2012) has been taken into account when determining whether groundwater is fit for drinking and for calculating WQI. Understanding the structure and operation of a specific water body may be aided by the physicochemical investigation. For the Gandhinagar District, the WQI was determined to be within the advised ranges, and all significant villages have values that fall into the Good category for water quality (B grade).

## 1. INTRODUCTION

Water is one of the most priceless elements in India's huge variety of natural resources, which include a vast array of agricultural resources. One of the most important natural riches in the world is water. One of the most priceless and vital natural resources are water. The common proverb "Without water, there is no life" refers to the fact that water is a necessary component of all daily tasks that sustain life. [1] Water not only sustains the life of animals and plants but also holds a special place in various businesses [2]. India also faces the issue of water scarcity brought on by the country's rapid population increase, industrialization, and urbanization. Understanding the structure and operation of a specific water body may be aided by the physicochemical investigation [3, 4 and 5]. The primary cause of bore well water pollution in many communities is the use of pesticides, fertilizers, manures, and lime waste dumps, among other things. Numerous researchers have examined the physicochemical characteristics of drinking or ground water in numerous communities throughout various talukas in Gujarat State [6,7]. Numerous studies have concentrated on the hydro-chemical properties and pollution of groundwater caused by anthropogenic wastewater intervention, mostly by agricultural operations and industrial and domestic wastewater, in diverse basins as well as in metropolitan areas. [8]. Monitoring the water quality of numerous rivers and ground waters requires a rising number of regular assessments of various water quality variables [9, 10]. India lacks a suitable water plan, and its water resources are being developed in an uncontrolled manner due to short-term economic objectives and political expediency. [11]. Due to a lack of surface water supplies, the majority of people in India rely primarily on groundwater resources for applications including drinking, residential, industrial, and agricultural irrigation. In this study, 50 groundwater samples taken from wells and hand pumps were analyzed for their physicochemical characteristics and compared to WHO drinking and household water quality criteria based on the Water Quality Index (WQI). The Bureau of Indian Standards (BIS), formerly known as the Indian Standard Institute (ISI), has prescribed the quality specifications for drinking water in its document IS 10500:2012. These specifications serve as a benchmark to assess the suitability of water for consumption.

## 2. MATERIAL AND METHODS

### 2.1 Study Area

Gandhinagar is located at coordinates 23.22 degrees north and 72.68 degrees east. It sits at an average elevation of 81 meters (266 feet). Positioned on the western banks of the Sabarmati River, Gandhinagar is situated in the northeast-central part of Gujarat. The city spans an area of 326 square kilometers.

During the summer months, the Sabarmati River experiences reduced water flow, leading to a narrow stream of water. Gandhinagar is often referred to as the 'Tree Capital of India' due to its abundant greenery. The topography of Gandhinagar exhibits significant variation, with most of the land being arid and dry, dependent on the prevailing climatic conditions.

Gandhinagar boasts various wetland features, including mudflats, lakes, creeks, salt marshes, swamps, estuaries, and reservoirs.

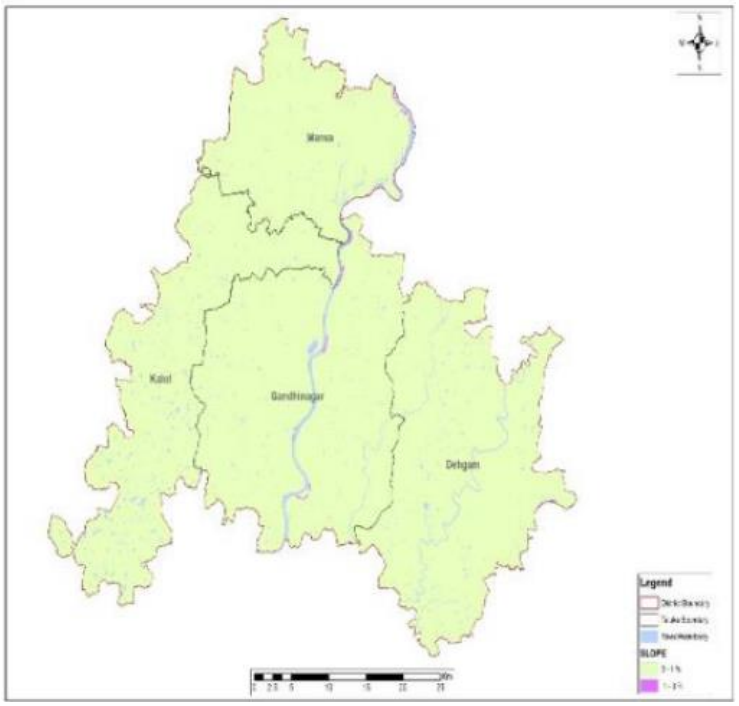


**Figure 1:** Gandhinagar Tehsil map.

### 2.2 Selection of Sampling Points

The primary criteria for selecting sampling points were determined based on several factors, including population density, areas with industrial or anthropogenic activities such as wastewater discharge from industries, sewage disposal from Gandhinagar Municipal Corporation, and the river catchment areas. These factors were taken into consideration to ensure a representative sampling of various sources that could potentially impact water quality in Gandhinagar. It was crucial to assess the water quality in areas where the direct discharge of solid waste and industrial waste into rivers occurred. Special attention was given to selecting sampling locations that had sufficient groundwater potential. The Gujarat Government played a key role in identifying suitable sites and drilling bore wells for this purpose. This ensured comprehensive monitoring of water quality and the identification of any potential pollution sources in Gandhinagar.

### 2.3. Sample Collection

In May 2019, the drinking water samples from the entire Gandhinagar district in Gujarat State were collected from 50 different villages. The samples were collected in the morning hours from bore wells situated in various villages across Gandhinagar taluka. The sampling process covered villages located in the north, south, east, and west regions of the district, ensuring a comprehensive representation of the water quality in Gandhinagar.[12]

In this study, the examination of water quality in Gandhinagar involved the assessment of several key parameters. The major parameters considered were pH, Sodium (Na+), Total Hardness (CaCO3), Calcium, Magnesium, Chloride, Fluorides, Iron, Nitrate, and Sulphate (SO4). A total of 50 sampling data points were obtained from the State Water Data Centre (SWDC), with its regional office located at Kherva, Mehesana.

The water samples were collected in polythene bottles and analyzed for the aforementioned parameters using standard procedures outlined by the SWDC unit [13]. The analysis followed the prescribed methods as described in (Table 1), which provided guidelines for the examination of the water quality parameters.

**Table 1: Methods used for analysis of quality parameters for water**

| Quality parameters studied | Method used |
|---|---|
| **pH** | Recorded by pH meter |
| **Sodium (Na+)** | Flame photometric method |
| **TH** | EDTA titration |
| **CH** | EDTA titration |
| **Magnesium Harness** | EDTA titration |
| **Chloride** | Mohr's method |
| **Fluoride** | Alizarin spectrophotometric method |
| **Iron(Fe)** | Colorimetric method |
| **Nitrate(NO3-)** | Colorimetric PDA method |
| **Sulphate(SO4)** | Gravimetric method |

Sampling data for groundwater quality analysis for both drinking and irrigation purposes were obtained from the regional office located in Kherva, Mehsana, which is the State Water Data Centre (SWDC). A total of 50 water samples were collected and analyzed. The details of the analysis are presented in the table below (Table 2)

**Table 2 Details of Pre and post monsoon 2019 sampling Locations**

| Sr no | Tahsil / Taluk | Village |
|---|---|---|
| 1 | Dehgam | Antroli |
| 2 | Dehgam | Dehgam-I |
| 3 | Dehgam | Dehgam-II |
| 4 | Dehgam | Dehgam-III |
| 5 | Dehgam | Devkaran Na Muvada |
| 6 | Dehgam | Dharisana |
| 7 | Dehgam | Harsoli |
| 8 | Dehgam | Hilol |
| 9 | Dehgam | Jindva |
| 10 | Dehgam | Kadjodra |
| 11 | Dehgam | Palaiya I |
| 12 | Dehgam | Patna Kuva |
| 13 | Dehgam | Sanoda |
| 14 | Dehgam | Palaiya II |
| 15 | Gandhinagar | Adraj Moti |

| Sr no | Tahsil / Taluk | Village |
|---|---|---|
| 16 | Gandhinagar | Bhat-I |
| 17 | Gandhinagar | Bhat-II |
| 18 | Gandhinagar | Gandhinagar |
| 19 | Gandhinagar | Gandhinagar-II |
| 20 | Gandhinagar | Indroda |
| 21 | Gandhinagar | Isanpur Mota-I |
| 22 | Gandhinagar | Isanpur Mota-II |
| 23 | Gandhinagar | Isanpur Mota-III |
| 24 | Gandhinagar | Karai |
| 25 | Gandhinagar | Koba |
| 26 | Gandhinagar | Koteshwar |
| 27 | Gandhinagar | Magodi |
| 28 | Gandhinagar | Medra |
| 29 | Gandhinagar | Unava |
| 30 | Gandhinagar | Valad |
| 31 | Kalol | Aluva |
| 32 | Kalol | Bhoyan Moti |
| 33 | Kalol | Chhatral |
| 34 | Kalol | Dingucha-I |
| 35 | Kalol | Dingucha-II |
| 36 | Kalol | Limbodara |
| 37 | Kalol | Mubarakpura |
| 38 | Kalol | Nasmed(Dabhla) |
| 39 | Kalol | Rancharada |
| 40 | Mansa | Bilodra |
| 41 | Mansa | Delvad |
| 42 | Mansa | Rampura |
| 43 | Mansa | Mansa |
| 44 | Mansa | Lodra |
| 45 | Mansa | Parbatpura |
| 46 | Mansa | Pundhara-I |
| 47 | Mansa | Pundhara-II |
| 48 | Mansa | Rangpur-I |
| 49 | Mansa | Rangpur-II |
| 50 | Mansa | Samou |

### 2.4 Water Quality Index

To determine the Water Quality Index (WQI) using the weighted arithmetic method, the following steps are typically executed:

1 Select the specific aspects of water quality that will be considered during the analysis. pH, temperature, dissolved oxygen, total dissolved solids (TDS), turbidity, and biochemical oxygen demand (BOD) are some examples of these factors. The objectives of the study and any applicable regulations or guidelines govern the selection of the parameters.

2 Assigning Weights: Assign the proper weights to each criterion based on its proportional importance in determining the water's quality. These weights indicate how significant each parameter is in determining the overall quality of the water. Typically, weights range from 0 to 1, with higher weights indicating greater significance.

3 Data acquisition: Collect water samples from a variety of sources or sampling points while using the correct sample collection procedures and following all applicable protocols. Depending on the objectives and specifications of the study, a different number of samples may be taken.

4 Analysis in a Lab: In a lab, evaluate the gathered water samples using defined test procedures for each parameter. Each parameter in the samples has quantitative values according to the results.

5 The parameter values received from the laboratory analysis should be normalized to a similar scale or range, typically 0 to 100. This normalization makes it easier to aggregate and compare various parameters.

6 Sub-indices are calculated for each parameter by multiplying its normalized value by the weight that was allocated to it. The relative weighting of each parameter in the final WQI computation is taken into account in this stage.

7 WQI Calculation: To determine the overall Water Quality Index (WQI), add the sub-indices obtained in step 6 together. The summation yields a single numerical result that summarizes the evaluation of the water's overall quality.

8 Using a predetermined scale or classification system, interpret the calculated WQI value. This makes it possible to classify water quality as excellent, good, fair, poor, or extremely poor, giving decision-makers and managers useful data.

It is crucial to keep in mind that the precise computations and weighting factors may change depending on regional or national regulations, academic research, or local regulatory frameworks.

$$WQI=\Sigma WQI/\Sigma W_i \quad (1)$$

Where, Wi is relative weight, wi is the weight of every parameter and n is the quantity of parameter.

$$Q_i=100(V_i-V_0/S_n-V_0) \quad (2)$$

$V_i$ is estimated concentration of ith parameter in the analyzed water. $V_0$ is the ideal value of this parameter in pure water $V_0$= 0 (except pH =7.0 and DO = 14.6 mg/l .$S_n$ is recommended standard value of $i^{th}$ parameter. The unit weight ($W_i$) for each water quality parameter is calculated by using the following equation.

$$W_i=K/S_n \quad (3)$$

K = the proportionality constant for calculating the Water Quality Index (WQI)

$$k=1/(\Sigma(1/Sn)) \quad (4)$$

**Table 3 Details Analysis of Pre monsoon 2019**

| Village | PH | NA | TH | CA | MG | FE | Cl | $SO_4$ | $NO_3$ | F |
|---|---|---|---|---|---|---|---|---|---|---|
| Antroli | 8 | 235 | 650 | 60 | 122 | 0.02 | 206 | 202 | 65 | 1 |
| Dehgam-I | 8 | 270 | 300 | 32 | 53 | 0 | 411 | 93 | 27 | 0 |
| Dehgam-II | 8 | 190 | 545 | 52 | 107 | 0 | 345 | 210 | 19 | 1 |
| Dehgam-III | 8 | 241 | 500 | 36 | 99 | 0.57 | 213 | 200 | 48 | 1 |
| Devkaran Na Muvada | 8 | 219 | 620 | 56 | 117 | 0 | 227 | 142 | 100 | 1 |

| Village | PH | NA | TH | CA | MG | FE | Cl | $SO_4$ | $NO_3$ | F |
|---|---|---|---|---|---|---|---|---|---|---|
| Dharisana | 8 | 180 | 620 | 48 | 122 | 0 | 249 | 19 | 140 | 1 |
| Harsoli | 8 | 257 | 550 | 40 | 109 | 0.46 | 213 | 78 | 111 | 1 |
| Hilol | 9 | 190 | 550 | 12 | 126 | 0.16 | 213 | 91 | 125 | 1 |
| Jindva | 8 | 258 | 580 | 56 | 106 | 0 | 298 | 208 | 144 | 1 |
| Kadjodra | 9 | 220 | 580 | 51 | 108 | 0 | 326 | 228 | 16 | 1 |
| Palaiya-I | 8 | 219 | 620 | 56 | 117 | 0 | 227 | 142 | 100 | 1 |
| Patna Kuva | 8 | 190 | 550 | 50 | 122 | 0 | 249 | 19 | 140 | 1 |
| Sanoda | 9 | 245 | 546 | 34 | 110 | 1 | 213 | 78 | 111 | 1 |
| Palaiya-II | 8 | 150 | 334 | 198 | 80 | 0 | 656 | 429 | 34 | 1 |
| Adraj Moti | 7.2 | 129 | 430 | 103 | 76 | 0.9 | 128 | 134 | 42 | 0.9 |
| Bhat-I | 7.6 | 224 | 238 | 43 | 57.5 | 1.1 | 108 | 135 | 34 | 2.1 |
| Bhat-II | 8 | 207 | 567 | 24 | 37.7 | 1.3 | 165 | 225 | 70 | 1.3 |
| Gandhinagar | 7.77 | 120 | 543 | 37 | 65.1 | 1.6 | 156 | 150 | 20 | 1.6 |
| Gandhinagar-II | 7.4 | 135 | 350 | 45 | 68.7 | 0.7 | 85 | 158 | 60 | 0.7 |
| Indroda | 7.96 | 156 | 565 | 65 | 55 | 1.04 | 134 | 140 | 34 | 1 |
| Isanpur Mota-I | 7.84 | 165 | 459 | 34 | 34 | 1.4 | 165 | 232 | 70 | 1.4 |
| Isanpur Mota-II | 7.6 | 140 | 500 | 86 | 23.9 | 1 | 109 | 252 | 99 | 1 |
| Isanpur Mota-III | 7.3 | 120 | 340 | 67 | 52 | 1.5 | 129 | 222 | 56 | 1.5 |
| Karai | 7.27 | 147 | 657 | 72 | 46.3 | 1.2 | 167 | 99 | 50 | 1.2 |
| Koba | 7.6 | 143 | 489 | 76 | 43 | 1.2 | 122 | 34 | 43 | 2.2 |
| Koteshwar | 7.1 | 122 | 430 | 45 | 32 | 0.9 | 149 | 146 | 35 | 2.65 |
| Magodi | 8 | 134 | 450 | 78 | 30 | 0.9 | 145 | 134 | 42 | 0.9 |
| Medra | 7.5 | 333 | 223 | 67 | 43 | 2.1 | 112 | 335 | 120 | 2.1 |
| Unava | 7.2 | 125 | 435 | 58 | 23.7 | 1.3 | 109 | 159 | 70 | 1.3 |
| Valad | 7.2 | 201 | 399 | 76 | 35 | 1.04 | 165 | 140 | 134 | 1.04 |
| Aluva | 8 | 245 | 330 | 190 | 42 | 0.01 | 650 | 422 | 90 | 1.5 |
| Bhoyan Moti | 8.2 | 310 | 290 | 123 | 73.8 | 0 | 621 | 350 | 56 | 1.6 |
| Chhatral | 7.73 | 324 | 320 | 168 | 41.5 | 0.01 | 640 | 422 | 44 | 1.5 |
| Dingucha-I | 7.8 | 320 | 250 | 134 | 80 | 0 | 625 | 350 | 54 | 1.6 |
| Dingucha-II | 7.9 | 190 | 360 | 170 | 76 | 0.01 | 640 | 422 | 44 | 1.5 |
| Limbodara | 8.2 | 256 | 280 | 106 | 56 | 0 | 646 | 350 | 34 | 1.6 |
| Mubarakpura | 7.6 | 324 | 330 | 178 | 56 | 0.01 | 632 | 422 | 45 | 1.5 |
| Nasmed(Dabhla) | 7.7 | 320 | 330 | 120 | 56.9 | 0 | 622 | 350 | 56 | 1.6 |
| Rancharada | 8.7 | 330 | 390 | 134 | 42 | 0.01 | 590 | 422 | 55 | 1.5 |
| Bilodra | 8 | 211 | 250 | 157 | 77.6 | 0.02 | 579 | 355 | 65 | 1.6 |
| Delvad | 8.2 | 149 | 300 | 136 | 89.7 | 0 | 576 | 410 | 23 | 1.2 |
| Rampura | 7.9 | 170 | 340 | 132 | 90.1 | 0.01 | 598 | 380 | 43 | 1.55 |

| Village | PH | NA | TH | CA | MG | FE | Cl | $SO_4$ | $NO_3$ | F |
|---|---|---|---|---|---|---|---|---|---|---|
| Mansa | 8.3 | 190 | 330 | 157 | 78.9 | 0 | 611 | 429 | 22 | 1.5 |
| Lodra | 8.5 | 149 | 380 | 136 | 89.7 | 0 | 574 | 410 | 34 | 1.2 |
| Parbatpura | 7.8 | 170 | 250 | 130 | 78.9 | 0.01 | 591 | 380 | 22 | 1.55 |
| Pundhara-I | 7.9 | 211 | 200 | 157 | 77.6 | 0.02 | 624 | 355 | 56 | 1.65 |
| Pundhara-II | 8.2 | 149 | 400 | 130 | 89.7 | 0 | 567 | 410 | 60 | 1.2 |
| Rangpur-I | 7.8 | 150 | 250 | 130 | 101 | 0.01 | 591 | 380 | 67 | 1.2 |
| Rangpur-II | 8.1 | 190 | 334 | 156 | 75 | 0 | 568 | 429 | 44 | 1.6 |
| Samou | 8.3 | 234 | 345 | 160 | 80 | 0.02 | 610 | 429 | 56 | 1.8 |

**Table 4 Calculations of WQI for Pre Monsoon 2019 Data**

| Sr. No. | Tahsil / Taluk | Village | WQI | AVE WQI |
|---|---|---|---|---|
| 1 | Dehgam | Antroli | 41.43 | 46.58 |
| 2 | Dehgam | Dehgam-I | 36.87 | |
| 3 | Dehgam | Dehgam-II | 43.15 | |
| 4 | Dehgam | Dehgam-III | 66.16 | |
| 5 | Dehgam | Devkaran Na Muvada | 29.18 | |
| 6 | Dehgam | Dharisana | 30.16 | |
| 7 | Dehgam | Harsoli | 143.18 | |
| 8 | Dehgam | Hilol | 50.05 | |
| 9 | Dehgam | Jindva | 48.50 | |
| 10 | Dehgam | Kadjodra | 15.52 | |
| 11 | Dehgam | Palaiya | 29.12 | |
| 12 | Dehgam | Patna Kuva | 30.13 | |
| 13 | Dehgam | Sanoda | 55.23 | |
| 14 | DEHGAM | Palaiya | 33.56 | |
| 15 | Gandhinagar | Adraj Moti | 30.36 | 41.16 |
| 16 | Gandhinagar | Bhat-I | 29.11 | |
| 17 | Gandhinagar | Bhat-II | 32.45 | |
| 18 | Gandhinagar | Gandhinagar | 54.78 | |
| 19 | Gandhinagar | Gandhinagar-II | 67.35 | |
| 20 | Gandhinagar | Indroda | 40.28 | |
| 21 | Gandhinagar | Isanpur Mota-I | 42.81 | |
| 22 | Gandhinagar | Isanpur Mota-II | 24.68 | |
| 23 | Gandhinagar | Isanpur Mota-III | 38.12 | |
| 24 | Gandhinagar | Karai | 31.70 | |
| 25 | Gandhinagar | Koba | 53.26 | |
| 26 | Gandhinagar | Koteshwar | 70.58 | |
| 27 | Gandhinagar | Magodi | 36.66 | |

| Sr. No. | Tahsil / Taluk | Village | WQI | AVE WQI |
|---|---|---|---|---|
| 28 | Gandhinagar | Medra | 49.76 | |
| 29 | Gandhinagar | Unava | 30.68 | |
| 30 | Gandhinagar | Valad | 26.03 | |
| 31 | Kalol | Aluva | 39.13 | |
| 32 | Kalol | Bhoyan Moti | 39.13 | |
| 33 | Kalol | Chhatral | 38.60 | |
| 34 | Kalol | Dingucha-I | 39.21 | |
| 35 | Kalol | Dingucha-II | 39.44 | 41.15 |
| 36 | Kalol | Limbodara | 36.37 | |
| 37 | Kalol | Mubarakpura | 61.02 | |
| 38 | Kalol | Nasmed(Dabhla) | 38.63 | |
| 39 | Kalol | Rancharada | 38.82 | |
| 40 | Mansa | Bilodra | 44.22 | |
| 41 | Mansa | Delvad | 30.33 | |
| 42 | Mansa | Rampura | 87.18 | |
| 43 | Mansa | Mansa | 36.83 | |
| 44 | Mansa | Lodra | 30.56 | |
| 45 | Mansa | Parbatpura | 40.08 | 42.4 |
| 46 | Mansa | Pundhara-I | 45.19 | |
| 47 | Mansa | Pundhara-II | 30.76 | |
| 48 | Mansa | Rangpur-I | 33.39 | |
| 49 | Mansa | Rangpur-II | 39.12 | |
| 50 | Mansa | Samou | 48.78 | |

**Table 5 Details Analysis of Post monsoon 2019**

| Village | pH | NA | TH | CA | MG | Fe | Cl | $SO_4$ | $NO_3$ | F |
|---|---|---|---|---|---|---|---|---|---|---|
| Antroli | 7 | 222 | 550 | 55 | 111 | 0.02 | 212 | 220 | 56 | 1.32 |
| Dehgam-I | 8.20 | 256 | 340 | 34 | 34 | 0.2 | 345 | 143 | 34 | 0.33 |
| Dehgam-II | 8.2 | 178 | 456 | 45 | 78 | 0.08 | 234 | 234 | 32 | 0.61 |
| Dehgam-III | 7.75 | 230 | 458 | 50 | 87 | 0.17 | 211 | 213 | 43 | 1.2 |
| Devkaran Na Muvada | 7.5 | 256 | 600 | 45 | 45 | 0.09 | 235 | 146 | 123 | 1.5 |
| Dharisana | 8.16 | 198 | 589 | 65 | 99.9 | 0 | 254 | 190 | 134 | 1 |
| Harsoli | 7 | 234 | 510 | 34 | 102 | 0.46 | 211 | 87 | 154 | 1.23 |
| Hilol | 8.77 | 187 | 520 | 23 | 122 | 0.16 | 198 | 98 | 111 | 1.22 |
| Jindva | 8.18 | 250 | 550 | 50 | 107 | 0.3 | 300 | 243 | 123 | 0.85 |
| Kadjodra | 8.2 | 180 | 540 | 70 | 98 | 0 | 312 | 245 | 120 | 0.51 |
| Palaiya-I | 7.3 | 233 | 600 | 34 | 41 | 0.1 | 245 | 176 | 99 | 1.1 |
| Patna Kuva | 8 | 168 | 456 | 54 | 45 | 0.07 | 189 | 28 | 143 | 1.09 |

| Village | pH | NA | TH | CA | MG | Fe | Cl | $SO_4$ | $NO_3$ | F |
|---|---|---|---|---|---|---|---|---|---|---|
| Sanoda | 8.7 | 100 | 389 | 33 | 76 | 0.09 | 221 | 39 | 90 | 1.17 |
| Palaiya-II | 7.8 | 123 | 339 | 178 | 111 | 0.09 | 546 | 146 | 29 | 1.31 |
| Adraj Moti | 7 | 134 | 431 | 79 | 67 | 0.03 | 120 | 165 | 45 | 0.9 |
| Bhat-I | 7.5 | 232 | 300 | 54 | 45.6 | 0.01 | 178 | 120 | 35 | 1.08 |
| Bhat-II | 7.9 | 198 | 433 | 34 | 30.2 | 0.005 | 165 | 199 | 87 | 1.2 |
| Gandhinagar | 7.5 | 134 | 432 | 33 | 67.1 | 0.03 | 129 | 145 | 45 | 1.09 |
| Gandhinagar-II | 7.2 | 135 | 401 | 42 | 76 | 0.002 | 109 | 134 | 56 | 0.76 |
| Indroda | 8.00 | 167 | 598 | 60 | 65.1 | 0 | 128 | 122 | 45 | 1.70 |
| Isanpur Mota-I | 7.5 | 145 | 350 | 32 | 56.5 | 0.03 | 165 | 22 | 34 | 1.02 |
| Isanpur Mota-II | 7.3 | 134 | 437 | 8 | 33.1 | 0 | 145 | 243 | 109 | 1.01 |
| Isanpur Mota-III | 7.2 | 111 | 340 | 55 | 43.1 | 0.01 | 165 | 221 | 65 | 0.59 |
| Karai | 7.11 | 165 | 650 | 64 | 34 | 0.011 | 134 | 89 | 67 | 1 |
| Koba | 7.5 | 134 | 490 | 59 | 43 | 0 | 125 | 32 | 45 | 1.04 |
| Koteshwar | 7 | 178 | 420 | 43 | 21 | 0.9 | 167 | 134 | 65 | 0.91 |
| Magodi | 7.8 | 122 | 430 | 69 | 35 | 0.06 | 122 | 122 | 54 | 0.99 |
| Medra | 7.3 | 267 | 334 | 56 | 39.1 | 0.001 | 109 | 324 | 99 | 1.19 |
| Unava | 7.1 | 123 | 400 | 34 | 32.2 | 0 | 112 | 167 | 75 | 1.36 |
| Valad | 7.2 | 197 | 453 | 65 | 33 | 0 | 143 | 143 | 132 | 1.14 |
| Aluva | 7.8 | 234 | 441 | 120 | 23 | 0.01 | 234 | 154 | 98 | 1.59 |
| Bhoyan Moti | 8 | 345 | 345 | 99 | 70 | 0 | 230 | 328 | 65 | 1.63 |
| Chhatral | 7.6 | 287 | 300 | 120 | 54.1 | 0.01 | 256 | 397 | 34 | 1.11 |
| Dingucha-I | 7.6 | 200 | 278 | 130 | 78 | 0 | 365 | 350 | 89 | 1.56 |
| Dingucha-II | 7.7 | 187 | 300 | 166 | 67.1 | 0.01 | 345 | 321 | 34 | 1.23 |
| Limbodara | 8.1 | 178 | 250 | 98 | 55.5 | 0.08 | 234 | 287 | 23 | 1.6 |
| Mubarakpura | 7.2 | 287 | 300 | 133 | 55.98 | 0.01 | 450 | 234 | 33 | 1.2 |
| Nasmed(Dabhla) | 7.5 | 245 | 321 | 109 | 56 | 0.03 | 456 | 327 | 66 | 1.41 |
| Rancharada | 8.2 | 324 | 359 | 124 | 40 | 0.01 | 234 | 234 | 52 | 1.81 |
| Bilodra | 7.9 | 178 | 268 | 154 | 45 | 0.02 | 122 | 309 | 45 | 1.1 |
| Delvad | 8 | 123 | 296 | 123 | 78.1 | 0.1 | 550 | 380 | 43 | 1.09 |
| Rampura | 7.5 | 177 | 325 | 131 | 45 | 0.01 | 554 | 380 | 31 | 1.05 |
| Mansa | 8.1 | 123 | 311 | 146 | 65 | 0.08 | 456 | 390 | 67 | 0.09 |
| Lodra | 8.2 | 145 | 358 | 129 | 87 | 0.3 | 500 | 410 | 23 | 1.2 |
| Parbatpura | 7.5 | 123 | 235 | 120 | 77.1 | 0.04 | 567 | 390 | 65 | 1.02 |
| Pundhara-I | 7.5 | 233 | 234 | 123 | 67 | 0.01 | 590.1 | 355 | 25 | 1.01 |
| Pundhara-II | 8.1 | 267 | 387 | 145 | 78 | 0.09 | 543 | 410 | 56 | 1.2 |
| Rangpur-I | 7.7 | 231 | 287 | 119 | 109 | 0.01 | 576 | 380 | 59 | 1.12 |
| Rangpur-II | 7.9 | 171 | 324 | 143 | 67 | 0.02 | 554 | 430 | 40 | 1.51 |
| Samou | 8.1 | 210 | 340 | 133 | 87 | 0.02 | 543 | 346 | 32 | 1.8 |

**Table 6 Calculations of WQI for Post Monsoon 2019 Data**

| Sr. No. | Tahsil / Taluk | Village | WQI | AVE WQI |
|---|---|---|---|---|
| 1 | Dehgam | Antroli | 38.18 | 52.28 |
| 2 | Dehgam | Dehgam-I | 58.35 | |
| 3 | Dehgam | Dehgam-II | 36.26 | |
| 4 | Dehgam | Dehgam-III | 71.41 | |
| 5 | Dehgam | Devkaran Na Muvada | 58.43 | |
| 6 | Dehgam | Dharisana | 27.05 | |
| 7 | Dehgam | Harsoli | 80.89 | |
| 8 | Dehgam | Hilol | 71.2 | |
| 9 | Dehgam | Jindva | 71.11 | |
| 10 | Dehgam | Kadjodra | 16.1 | |
| 11 | Dehgam | Palaiya | 51.63 | |
| 12 | Dehgam | Patna Kuva | 44.64 | |
| 13 | Dehgam | Sanoda | 51.49 | |
| 14 | Dehgam | Palaiya | 55.31 | |
| 15 | Gandhinagar | Adraj Moti | 30.05 | 43.77 |
| 16 | Gandhinagar | Bhat-I | 28.47 | |
| 17 | Gandhinagar | Bhat-II | 30.17 | |
| 18 | Gandhinagar | Gandhinagar | 55.7 | |
| 19 | Gandhinagar | Gandhinagar-II | 68.78 | |
| 20 | Gandhinagar | Indroda | 40.5 | |
| 21 | Gandhinagar | Isanpur Mota-I | 32.13 | |
| 22 | Gandhinagar | Isanpur Mota-II | 24.84 | |
| 23 | Gandhinagar | Isanpur Mota-III | 88.88 | |
| 24 | Gandhinagar | Karai | 27.1 | |
| 25 | Gandhinagar | Koba | 49.67 | |
| 26 | Gandhinagar | Koteshwar | 95.34 | |
| 27 | Gandhinagar | Magodi | 38.79 | |
| 28 | Gandhinagar | Medra | 29.32 | |
| 29 | Gandhinagar | Unava | 32.14 | |
| 30 | Gandhinagar | Valad | 28.14 | |
| 31 | Kalol | Aluva | 40.27 | 42.12 |
| 32 | Kalol | Bhoyan Moti | 39.56 | |
| 33 | Kalol | Chhatral | 51.85 | |
| 34 | Kalol | Dingucha-I | 38.36 | |
| 35 | Kalol | Dingucha-II | 32.91 | |
| 36 | Kalol | Limbodara | 57.52 | |

| Sr. No. | Tahsil / Taluk | Village | WQI | AVE WQI |
|---|---|---|---|---|
| 37 | Kalol | Mubarakpura | 31.78 | |
| 38 | Kalol | Nasmed(Dabhla) | 41.67 | |
| 39 | Kalol | Rancharada | 45.18 | |
| 40 | Mansa | Bilodra | 31.96 | |
| 41 | Mansa | Delvad | 52.19 | |
| 42 | Mansa | Rampura | 85.49 | |
| 43 | Mansa | Mansa | 56.22 | |
| 44 | Mansa | Lodra | 54.72 | |
| 45 | Mansa | Parbatpura | 29.08 | 44.53 |
| 46 | Mansa | Pundhara-I | 27.77 | |
| 47 | Mansa | Pundhara-II | 32.97 | |
| 48 | Mansa | Rangpur-I | 31.74 | |
| 49 | Mansa | Rangpur-II | 39.23 | |
| 50 | Mansa | Samou | 48.46 | |

## 3. RESULT

Based on the information provided, the Water Quality Index (WQI) analysis for Gandhinagar District was conducted using the Weighted Arithmetic Water Quality Index Method. The results of the analysis for both pre-monsoon and post-monsoon 2019 are presented in Table 4 and Table 6, respectively.

Table 7 provides the rating or classification of the WQI values obtained for each station. It indicates that all stations, except for the post-monsoon data for the Dehgam station, fall within the 26 to 50 category range of the Water Quality Index. The specific ratings or categories associated with these WQI values may vary depending on the scale or classification system used in the study.

From the provided formula and the calculated Water Quality Index (WQI) values, the quality of water in Gandhinagar District can be assessed. By referring to the Water Quality Ratings in Table 7, it is possible to determine the rating or classification of the water quality based on the obtained WQI values. This classification helps in evaluating whether the water is suitable for drinking or not.

Additionally, Figure 2 presents a comparison between the pre-monsoon and post-monsoon WQI values, allowing for an analysis of any changes in water quality between these two periods.

To provide further insights or interpretations, it would be helpful to have access to Table 7 and Figure 2 along with their respective data.

Based on the information provided and the analysis presented in Figure 2, it can be inferred that the Water Quality Index (WQI) for post-monsoon is higher compared to pre-monsoon. This suggests that the quality of water tends to degrade after the rainy season.

The observations from the current study indicate that the WQI values ranged from 41.15 to 46.58 before the rainy season, while they ranged from 42.12 to 52.28 after the rainy season. This indicates a slight increase in the WQI values after the rainy season, indicating a relatively lower water quality compared to the pre-monsoon period.

It's important to note that the interpretation of water quality trends and the impact of the rainy season on water quality may vary depending on specific factors such as the local environment, sources of water, and sampling locations. Further analysis and investigation may be required to determine the exact reasons for the observed changes in water quality before and after the rainy season.

Based on the provided information, the post-monsoon Water Quality Index (WQI) for Deham village falls under the poor zone. This indicates that the water quality in Deham village is relatively lower or less suitable for drinking or other purposes after the rainy season.

**Table 7 Water Quality rating as per weighted arithmetic Water Quality Index Method**

| WQI value | Rating of Water Quality | Grading |
|---|---|---|
| **0-25** | Excellent water quality | A |
| **26-50** | Good water quality | B |
| **51-75** | Poor water quality | C |
| **76-100** | Very Poor water quality | D |
| **Above 100** | Unsuitable for water quality | E |

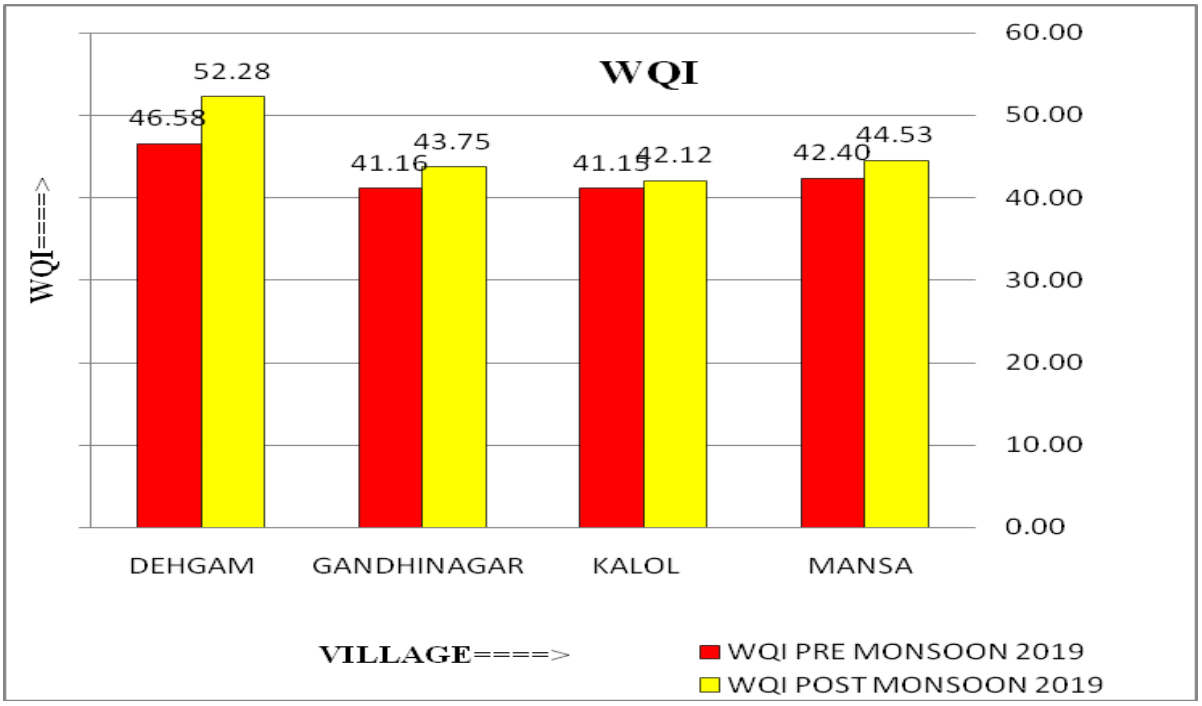


**Figure 2:** Water Quality Index for Pre and Post monsoon 2019.

## 4. CONCLUSION

Based on the provided information and the Water Quality Index (WQI) values calculated using the given formula, the quality and suitability of water for human health can be assessed. By referring to Table-9 and examining the physicochemical parameters such as pH, Sodium (Na+), Total Hardness (CaCO3), Calcium, Magnesium, Chloride, Fluorides, Iron, Nitrate, and Sulphate (SO4) at the fifty different stations in the study area, it is observed that all values are within the recommended limits.

Furthermore, based on the grading system used, it can be concluded that all major villages fall under the category of "Good Water Quality" with a grading of B. This implies that the water quality in these villages is considered suitable for human consumption and other purposes, as all parameters meet the recommended limits.

These findings indicate that the water in the study area is within the acceptable range for the mentioned physicochemical parameters and can be deemed safe for human consumption.

It's important to note that the specific recommended limits and grading system used for water quality assessment may vary based on regional or national guidelines and standards.

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