

## **Comprehensive water quality assessment: A Case study of Dungarpur city of Rajasthan**

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DOI: 10.46609/IJSSER.2026.v11i05.017 URL: <https://doi.org/10.46609/IJSSER.2026.v11i05.017>

Received: 23 April 2026 / Accepted: 20 May 2026 / Published: 26 May 2026

### **ABSTRACT**

*Water is fundamental to human survival and socio-economic development, yet its availability and quality are under increasing pressure due to population growth, urbanisation, industrial activity, and climate change. Although water covers most of the Earth's surface, only a very small proportion is available for direct human use, and this limited supply is often threatened by pollution and uneven distribution. In rapidly growing urban areas, groundwater remains the main source of drinking water, but over-extraction and inadequate recharge have led to declining water tables and rising concern over supply quality. Against this background, the present study assessed the drinking water quality of Dungarpur city of Rajasthan, with particular emphasis on physico-chemical parameters and the Water Quality Index (WQI).*

*Water samples were collected from all 40 municipal wards of Dungarpur during July and August 2023, covering groundwater, surface water, domestic taps and public supply sources. Thirteen physico-chemical parameters were analysed, including pH, electrical conductivity (EC), total dissolved solids (TDS), total hardness, calcium, magnesium, sodium, potassium, bicarbonate, sulphate, chloride, fluoride and nitrate. The results were compared with Bureau of Indian Standards (BIS) drinking water guidelines, and WQI was calculated using the Brown method to classify overall suitability for drinking.*

*The findings reveal a highly uneven pattern of water quality across the city. While a few wards recorded acceptable values for most parameters, many exceeded permissible limits for EC, TDS, hardness, sodium, chloride, fluoride and nitrate. The WQI results ranged from excellent to not fit for drinking, but the overall pattern was worrying, with a large number of wards falling into poor or unsafe categories. Only two wards were classified as excellent, whereas several others showed very bad or unfit conditions, indicating serious contamination concerns. The study suggests that the water supplied in many parts of Dungarpur is not safe for direct consumption without treatment.*

*Overall, the assessment highlights the urgent need for regular monitoring, ward-wise intervention, source protection, improved treatment facilities and stricter control over contamination sources. The study provides a clear analytical picture of urban drinking water stress in Dungarpur and underlines the importance of targeted water quality management to protect public health.*

**Keywords:** Drinking water quality, Water Quality Index, BIS standards, groundwater, urban water management, Dungarpur city.

## **1. Introduction**

Water is one of the most important elements for human existence. Without it, life in any meaningful form would simply not be possible. It is no coincidence that most ancient civilisations grew up along rivers and continued to flourish there over time. Agriculture, industry, and countless other human activities depend heavily on this resource.

Although more than 70 per cent of the Earth's surface is covered with water, around 97 per cent of it is salty seawater and therefore unsuitable for human use. Of the remaining water, about 2 per cent is locked away in ice caps and glaciers. That leaves only about 1 per cent of the planet's water available to meet all human needs, including agriculture, domestic use, and industry. In other words, the amount of usable water is extremely limited, and its uneven distribution often becomes the root of conflict. Across the world, including in India, disputes over the sharing and use of river water are ongoing at several levels. The good news is that water is a renewable resource.

Since water resources are limited while demand is rising rapidly, careful planning and efficient implementation of programmes for assessing, developing, conserving, and managing water resources is absolutely essential(Kayastha, 1981).

Roughly two-thirds of the world's population — around four billion people — experience severe water scarcity for at least one month each year. More than two billion people live in countries where water supply is inadequate. Another study suggests that by 2025, half of the world's population may face water shortages. By 2030, nearly 700 million people could be displaced because of severe water stress (*Water Scarcity \textbar UNICEF, 2023*). According to the WWF, if current drinking water consumption continues, the situation will become much worse by 2025. Two-thirds of the world's population may face water scarcity, and ecosystems across the globe may come under even greater strain (*Water Scarcity \textbar Threats \textbar WWF, 2023*).

Population growth, rising industrial activity, and climate change are shaping up to be some of the biggest challenges in the coming decades. At the same time, water pollution is getting worse,

which only deepens the existing water shortage. This doesn't just affect water quality; it also reduces the amount of safe drinking water available. Groundwater contamination is especially alarming because once pollutants enter groundwater, they break down very slowly and are extremely expensive to remove.

Cities are also spreading fast, and with that growth comes more concrete surfaces and less natural land to absorb rainwater. In urban areas, water availability is becoming a major concern. To handle today's problems and secure water for the future, urban water distribution systems need better management and planning.

Water quality matters a lot more than many people realize. Because humans are involved in so many different activities, both surface water and groundwater can vary widely in quality from one city or state to another. Pollution from these activities often makes its way into water sources, which is why safe drinking water has become such an important issue.

Drinking contaminated water can cause serious health problems. That's why water intended for human use must be free from harmful physical, chemical, and bacteriological impurities. In simple terms, good drinking water should be clean, odorless, colorless, free from microorganisms, and pleasant to taste. It should also be soft enough to be comfortable for regular use.

Like in most Indian cities, water demand here is mainly met by pumping groundwater. The problem is that groundwater recharge is not keeping up with extraction. As a result, groundwater levels are dropping year after year. With rapid urban growth and population increase, cities are finding it harder and harder to meet standards for per capita water supply, water quality, supply duration, and pressure.

Taking all of these issues into account, the present study aims to assess the quality of drinking water supply in the study area.

## **2. Objective**

1. Measure and evaluate physico-chemical parameters across drinking and surface water sources in Dungarpur city.
2. Compare results to BIS and WHO standards.
3. Compute Water Quality Index (WQI) to categorize suitability for drinking.
4. Provide management recommendations.

### **3. Study Area**

Dungarpur is a city situated amidst the picturesque hills of the Aravallis. In the local dialect, small hills are referred to as “Dungri”, and a small settlement is called “Pur”. It is named Dungarpur due to its location amidst these hills. It is situated between 23°49' and 23°52' north latitude and 73°40' and 73°43' east longitude. Its average elevation above sea level is 379 meters.

All the rocks found here are approximately 2,000 to 2,500 million years old. The city primarily features sedimentary rocks—such as sandstone, shale, and limestone—while metamorphic rocks found here include quartz, slate, schist, soapstone, and gneiss.

The climate of Dungarpur city is arid. It remains quite hot during the summer months. The summer season commences in March and continues until mid-June. During the summer, the city's maximum temperature reaches up to 42°C, while the minimum remains around 24°C. June is the hottest month of the year. The winter season extends from the second fortnight of November until the end of February. During winter, the maximum temperature ranges up to 33°C, and the minimum drops to around 12°C. The monsoon season prevails from mid-June through September. Most of the rainfall here occurs due to monsoon activity. The region receives approximately 1,000 millimeters of rainfall during the monsoon season. The vegetation found here is of the savanna and monsoon types.

### **4. Materials and Methods**

To assess the quality of drinking water in the city, samples were collected during July and August 2023. The study covered all 40 municipal wards, with water samples taken from each ward to ensure a wide and representative coverage of the city.

- **Sampling Design** : The sampling approach included a mix of different water sources. In total, the samples are collected from 12 groundwater sites, 3 surface water sites and the remaining samples collected from domestic taps and public water supply systems. This design helped capture the overall condition of drinking water used by residents across the city, rather than relying on just one source type.
- **Analytical Method** : To evaluate the quality of water, 14 physical and chemical parameters were tested. EC (electrical conductivity), pH, TDS, hardness, calcium, magnesium, sodium, potassium, bicarbonate, sulfate, chloride, fluoride, and nitrate are used as parameters. These parameters were selected because they give a clear picture of the water's suitability for drinking and help identify any possible contamination or mineral imbalance.

**5. Results**

**5.1 Physical Chemical Parameters**

Water quality is generally evaluated through its “physical, chemical, and biological characteristics”. For urban populations, access to safe drinking water is a basic necessity, which makes the assessment of city water supplies especially important. Since maintaining water quality is a major challenge, it is necessary to compare the observed water parameters with the standards prescribed by the “Bureau of Indian Standards (BIS)” and the “Ministry of Health, Government of India”. These standards provide a practical benchmark for determining whether water is safe and suitable for drinking.

In this study, water samples were collected from different locations within the study area and tested for various quality parameters. The results were then compared with the applicable BIS drinking water standards to evaluate the overall suitability of the water supply. This kind of comparison is important because it helps identify whether the water meets the required safety limits or if certain parameters exceed acceptable levels. In short, understanding water quality standards is not just a technical exercise — it is essential for protecting public health and ensuring that drinking water remains within safe limits.

**Table 1 BIS Standard and test results of drinking water samples in various wards of the city**

BIS Standard	6.5-8.5	300 (µs/cm)	500-2000 (mg/l)	200-600 (mg/l)	75-200 (mg/l)	30-100 (mg/l)	50-200 (mg/l)	10-12 (mg/l)	300-600 (mg/l)	200-400 (mg/l)	250-1000 (mg/l)	1-1.5 (mg/l)	45 (mg/l)
Ward No.	pH	EC	TDS	TH	Ca	Mg	Na	K	Bicarbonate	Sulphate	Chloride	Fluoride	Nitrate
1	8.6	330	184	160	32.06	19.46	2.76	1.56	73.22	24.02	35.45	0.21	19.84
2	8.5	610	355	190	40.08	21.89	52.88	5.08	12.2	28.82	134.71	0.8	40.92
3	8.2	450	260	150	36	15	32	9	73	29	71	0.41	32
4	8.4	410	236	100	24.05	9.73	40.25	3.91	158.65	19.21	28.37	0.42	0
5	8.25	330	183	140	32.06	14.59	10.35	7.04	48.82	0	70.9	0.23	11.16
6	9	510	164	0	0	0	40.92	3.13	0	0	99.26	0.8	21.08
7	8.8	2060	1151	385	18	83	269	55	561	91	284	0.65	47
8	8.65	2010	1104	370	16.03	80.26	276.92	25.02	549.17	96.07	262.38	1	37.2
9	9.15	1900	1094	340	18	72	269	28	195	0	433	1.46	93
10	8.35	980	548	340	42.08	57.15	77.48	10.95	305.1	56.2	106.35	0.58	32.86
11	9.2	1560	911	65	4	13	329	11	293	29	312	2.08	55

12	8.85	2090	1158	160	4	36	381	28	220	38	433	1.82	43
13	8.7	1990	1117	375	22	78	270	20	220	19	425	1.32	125
14	7.9	8200	5248	0	0	0	0	0	0	0	2099.05	0.62	308.76
15	7.8	6350	3481	1350	52.1	296.7	827.54	32.06	134.24	48.03	2127.42	0.67	29.76
16	8.15	6700	4009	1070	100	199	1047	4	122	452	1858	0.45	289
17	9.4	1700	1007	75	6.01	14.59	356.04	3.91	353.91	163.31	198.56	2.3	39.68
18	8.9	2100	1217	450	12	102	253	78	159	134	454	1.16	20
19	8.5	640	371	140	18	23	90	6	207	38	64	0.35	16
20	8.55	10770	4864	0	0	0	1770.08	177.12	0	0	2836.56	1.66	80.6
21	8	3430	1964	230	16	46	706	5	842	134	610	11.1	25
22	7.8	830	473	280	82.16	18.24	55.2	0.78	73.22	38.43	156.01	0.18	89.9
23	8.85	460	243	70	14	9	20	98	61	10	21	0.39	27
24	8.75	430	247	80	16	10	62	5	61	10	71	0.48	32
25	8.1	750	424	300	54.11	40.13	37.95	3.13	109.84	38.42	177.25	0.08	17.98
26	8.2	360	190	115	20	16	26	5	183	0	21	0.55	10
27	8.4	1080	611	305	56.11	40.13	103.68	7.82	85.43	96.06	233.97	0.2	18.6
28	8.4	540	298	120	14	21	78	5	98	14	113	0.2	4
29	8.6	650	180	0	0	0	40	2.74	0	0	127.62	0.5	9.92
30	8	480	215	150	36.07	14.59	34.5	5.08	122.04	43.23	56.73	0	7.44
31	8.5	510	283	160	28.06	21.89	40	7.04	109.84	38.42	70.9	0.23	9.3
32	8.8	600	167	0	0	0	40.92	2.74	0	0	120.53	0.4	3.1
33	8.1	880	481	330	80.16	31.62	62.99	3.13	244.08	47.55	77.99	0.28	55.18
34	8.5	610	355	315	70	34	36	8	49	19	206	0.42	46
35	8.2	840	417	120	18	18	145	4	122	24	142	1.51	5
36	8.7	870	486	145	20.04	23.1	129.26	5.47	158.65	38.43	163.1	1.16	15.5
37	8.3	640	401	170	32.06	21.89	64.6	6.65	134.24	49.95	70.9	1.26	76.26
38	8.85	460	243	180	28.06	26.75	20	2.35	12.2	19.21	106.35	0.6	21.7
39	8.5	540	305	130	14.03	23.1	60.72	5.47	134.24	19.21	42.54	0.12	37.2
40	8.5	610	346	90	12	15	96	4	220	0	85	1.22	12

The samples show a “mixed water quality situation” across the study area. A few wards have parameters within acceptable BIS limits, but many locations exceed the standards for EC, TDS,

total hardness, sodium, chloride, fluoride and nitrate. This strongly suggests that the water in several wards is “not fit for direct drinking without treatment”. To find out the actual quality of water, water quality index has been calculated.

## 5.2 Water Quality Index (WQI)

The Water Quality Index (WQI) is a practical tool for summarizing the overall condition of water in a single value. Rather than examining each water quality parameter separately, it combines the effects of multiple physical, chemical, and bacteriological characteristics into one meaningful indicator. This makes it easier to judge whether water is suitable for drinking or other uses.

The concept of WQI was first introduced by Horton in 1965. His purpose was to support pollution control studies and to give the public a simple way to understand water quality. Later, Brown refined Horton’s approach and developed a modified formula that is now widely used for WQI calculation. Brown’s method assigns weight to different water quality parameters and combines them to produce a final index that reflects the overall status of the water sample.

In this study, the Water Quality Index was calculated using Brown’s formula. This approach is useful because it presents the overall suitability of water in a clear and concise way. Instead of dealing with a long list of individual test results, WQI provides a single score that makes comparison across different locations much easier. For drinking water samples collected from various wards of Dungarpur city, the index was determined by analyzing the samples and applying the Brown method. This helps in evaluating the real condition of drinking water in the city in a simple but scientifically sound manner.

Step 1. calculate the unit weight ( $W_n$ ) factor for each parameters by using the formula

$$W_n = \frac{K}{S_n}$$
$$S_n = \frac{1}{\frac{1}{s_1} + \frac{1}{s_2} + \frac{1}{s_3} + \dots + 1/S_n} = \frac{1}{\sum 1/S_n}$$

$S_n$  = Standard desirable value of the  $n^{\text{th}}$  parameters.

On summation of all selected parameters unit weight factor  $W_e$

Step 2. Calculate the subindex ( $Q_n$ ) value by using the formula

$$Q_n = Q_n = \frac{V_n - V_o}{S_n - V_o} \times 100$$

Where ,

$V_n$  = Value obtained from the test of the  $n^{th}$  parameter

$S_n$  = Standard Desirable Value of the  $n^{th}$  parameters

$V_o$  = Actual values of parameters in pure water (Generally,  $V_o=0$ )

$$Q_{pH} = \frac{V_{pH}-7}{8.5-7} \times 100$$

Step 3. Combining Step 1 & 2 , WQI is calculate as follows

$$\text{Overall } WQI = \frac{\sum W_n Q_n}{\sum W_n}$$

**Table 2 Water Quality Index Value and Rating**

Sr. No.	Water Quality Index	Level of Water Quality
1	0 - 25	Excellent
2	26 - 50	Good
3	51 - 75	Bad
4	76 - 100	Very Bad
5	> 100	Not fit for drinking

**Table 3 WQI in differnt wards of Dungarpur city**

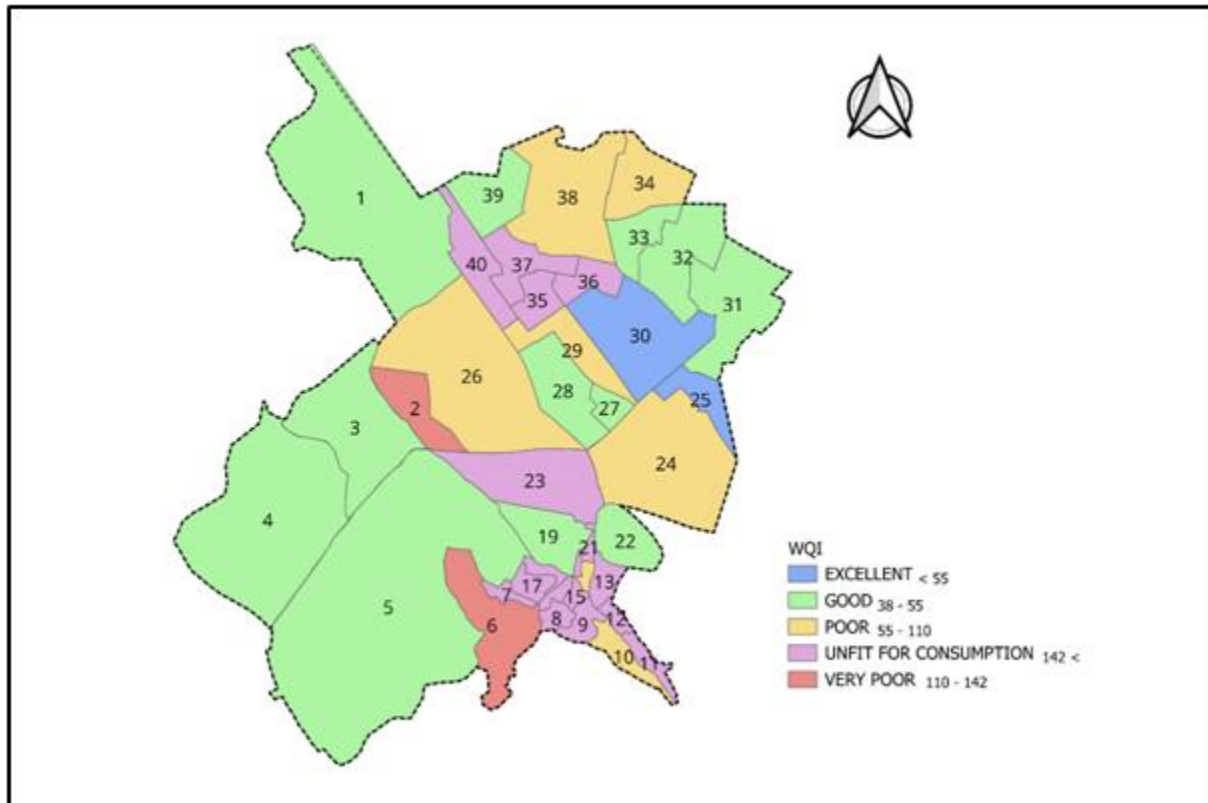
Ward No.	WQI	Level of Quality	Ward No.	WQI	Level of Quality
1	29.94	Good	21	877.42	Not fit for drinking
2	79.44	Very Bad	22	27.90	Good
3	49.43	Good	23	117.29	Not fit for drinking
4	45.90	Good	24	55.03	Bad
5	32.96	Good	25	22.16	Excellent
6	77.05	Very Bad	26	55.68	Bad

Ward No.	WQI	Level of Quality	Ward No.	WQI	Level of Quality
7	121.45	Not fit for drinking	27	39.03	Good
8	123.87	Not fit for drinking	28	32.43	Good
9	164.49	Not fit for drinking	29	51.50	Bad
10	70.58	Bad	30	13.60	Excellent
11	193.38	Not fit for drinking	31	36.14	Good
12	188.27	Not fit for drinking	32	44.87	Good
13	147.20	Not fit for drinking	33	39.16	Good
14	74.48	Bad	34	54.31	Good
15	141.18	Not fit for drinking	35	131.40	Not fit for drinking
16	114.90	Not fit for drinking	36	109.62	Not fit for drinking
17	206.52	Not fit for drinking	37	115.74	Not fit for drinking
18	177.86	Not fit for drinking	38	62.70	Bad
19	46.31	Good	39	28.21	Good
20	337.85	Not fit for drinking	40	109.51	Not fit for drinking

The WQI results show a wide variation in water quality across the 40 wards, ranging from “Excellent” to “Not fit for drinking”. This indicates that water quality is highly uneven and that some wards are receiving comparatively safe water, while others are facing serious contamination concerns. Overall a large number of wards fall under the “Not fit for drinking” category, which is worrying. This means the water in these areas is likely unsafe for direct human consumption without treatment. On the other hand, only two wards (ward no. 30 and 25) show “Excellent” quality, showing very low pollution levels and the best water conditions among all wards.

Wards (1, 3, 4, 5, 19, 22, 27, 28, 31, 32, 33, 34, and 39) fall into a relatively safe category. That said, this does not mean the water quality should be ignored. Regular monitoring is still important to make sure conditions do not worsen over time. The encouraging part is that these wards have “low WQI values compared with the others”, which suggests better water quality overall.

Figure 1 Ward-wise WQI of Dungarpur City



On the other hand, wards (10, 14, 24, 26, 29, and 38) are not really suitable for drinking without treatment. Their WQI values point to “moderate contamination”, which means there could be some health risks if the water is used directly. In these areas, treatment before consumption would be the safer option.

The most concerning areas are “ward no 2 and 6”, which are classified as “very bad.” This indicates poor water quality and conditions that are getting close to unsafe. These wards need immediate attention because the water may already be having negative effects on public health.

17 wards (Wards 7, 8, 9, 11, 12, 13, 15, 16, 17, 18, 20, 21, 23, 35, 36, 37, and 40) have WQI values well above acceptable limits, showing serious water quality problems. Ward no. 21 has the highest WQI at 877.42 which is extremely poor.

Ward 20 clearly stands out with the highest WQI at 337.85, which points to extremely poor water quality. Wards 17 and 11 also record very high WQI values of 206.52 and 193.38, respectively. These numbers strongly indicate severe pollution and suggest that the water in these wards is unsafe for drinking unless it is properly treated first.

The WQI results present a mixed but concerning picture. While a few wards appear to have acceptable or even good water quality, the overall trend points to a much bigger problem: most wards fall into the poor to very poor range. That suggests water resources in many areas are under significant stress.

## **6. Discussion**

The results clearly show that drinking water quality across Dungarpur city is highly uneven, and in many wards it is cause for serious concern. A clear and concerning pattern emerging from the results is that while readings in some wards fell within acceptable limits, numerous samples were found to violate the limits prescribed by the BIS regarding key water quality indicators—such as EC, TDS, total hardness, sodium, chloride, fluoride, and nitrate. Practically speaking, this implies that in many wards, the water is not suitable for direct consumption unless it undergoes prior purification.

The most striking observation is that this issue is not confined to a single parameter. In several wards, EC and TDS levels were elevated—a condition that typically indicates a significant concentration of dissolved salts in the water. Such a pattern often points to groundwater contamination, the dissolution of natural minerals, the ingress of sewage, or mixing with lower-quality water sources. Furthermore, excessive water hardness, along with high levels of chloride and sodium, signals a substantial mineral presence in the water; this phenomenon may be linked to specific geochemical conditions as well as to anthropogenic activities—such as sewage seepage and uncontrolled urban drainage.

Fluoride and nitrate are also a concern in some wards. These two matter a lot because long-term exposure can create serious health risks. High nitrate is often connected to sewage contamination, fertilizer use, or poor drainage management, while excess fluoride can lead to dental and skeletal problems. So even if the water looks fine, these chemical levels show that it may still be unsafe over time.

The pH values were mostly within or near the acceptable range, so acidity or alkalinity does not seem to be the main issue here. But that does not mean the water is safe overall. Even with a normal pH, the other parameters were well above acceptable limits in several wards. So a good pH reading does not make up for high salinity, hardness, nitrate, or chloride.

The Water Quality Index (WQI) gives the best overall summary of the situation. It ranged from excellent to not fit for drinking, which shows a highly uneven water-quality pattern across the city. Wards 25 and 30 were the only ones in the excellent category, meaning they had comparatively better water quality and fewer contamination issues. A few other wards were rated good, but that still does not mean the water can be ignored. Regular monitoring is still necessary

because water quality can shift quickly depending on season, source conditions, and local pollution pressure.

On the other hand, several wards showed “bad, very bad, or even unfit” conditions for drinking water. This is the major concern in the study. 17 Wards (7, 8, 9, 11, 12, 13, 15, 16, 17, 18, 20, 21, 23, 35, 36, 37, and 40) recorded WQI values far beyond the safe limit, which points to serious water quality deterioration. Among them, ward no. 21 stands out as the most alarming, with a WQI of 877.42, clearly showing extreme pollution and making the water unsuitable for drinking. Ward no. 20, with a WQI of 337.85, also raises serious concern. These figures strongly suggest that the water in these areas is heavily contaminated and needs immediate attention. If this water is used without treatment, it could create real public health risks.

The wards classified under the “bad” and “very bad” categories are also important because they may be moving toward even worse conditions. At first glance, these areas may not seem critical, but the WQI values show that the water quality is already compromised. Without timely action, these wards could easily shift into the “not fit for drinking” category. That is why early intervention matters so much.

Looking at the broader pattern, the results suggest differences in source water quality, local pollution pressure, and how effective the treatment and distribution systems are across the city. Some wards may be getting water from cleaner sources or may benefit from better pipeline conditions, while others could be affected by leakage, stagnation, sewage intrusion, or weak maintenance of supply lines. In fast-growing urban areas, this kind of uneven infrastructure often makes the problem worse, and the results from this study seem to reflect that situation pretty clearly.

What really stands out is that safe water access cannot be assumed just because water is supplied through a municipal system. The WQI results make it obvious that several wards need treatment before the water can be safely used, and some need urgent corrective action. Regular monitoring is not just helpful here—it is essential. Without it, contaminated water may continue reaching households without anyone realizing it.

From a practical point of view, the findings point to the need for better source protection, stronger treatment systems, strict monitoring, and better control of sewage and other pollution sources. Wards with high levels of “nitrate, chloride, fluoride, and TDS” should be prioritized for detailed investigation so the exact source of contamination can be identified. Public awareness is also important, because people need to understand that clear-looking water is not always safe to drink.

## **7. Conclusion**

This study makes it abundantly clear that the quality of drinking water in Dungarpur city is highly variable, and in several wards, it remains a matter of significant concern. While water quality in some wards was found to range from good to excellent, a large number of samples revealed that key parameters—such as EC, TDS, hardness, sodium, chloride, fluoride, and nitrate—exceeded the limits prescribed by the BIS. This indicates substantial disparities in water quality across the city, suggesting that in many areas, the water is not safe for direct consumption without proper treatment.

The Water Quality Index gives a clear and useful picture of the overall situation. It shows that the conditions are mixed, but the general trend is definitely concerning. Only Ward Nos. 25 and 30 fall into the excellent category, which is a positive sign. However, most of the other wards fall somewhere between good and not fit for drinking, which suggests that water quality is a serious issue across much of the area. What stands out most is the group of wards with very high WQI values, including Wards 7, 8, 9, 11, 12, 13, 15, 16, 17, 18, 20, 21, 23, 35, 36, 37, and 40. These results strongly suggest polluted and unsafe water conditions. Among them, Ward 21 is the most alarming since it has the highest WQI value. That means it should be treated as a top priority for immediate monitoring and corrective action.

Overall, the findings suggest that Dungarpur's drinking water problem is not just about one bad source or one isolated area. It appears to be a wider issue linked to source quality, groundwater stress, urban pollution, possible sewage intrusion, and weak control over distribution systems. So, the main conclusion is straightforward: a few wards are relatively safe, but a significant share of the city is receiving water that should not be used for drinking without treatment.

## **8. Recommendations**

Based on the findings, the following steps are strongly recommended:

1. Immediate treatment of unsafe water : Wards with very bad and not fit for drinking WQI values should not receive untreated water. Proper treatment must be ensured before supply.
2. Regular water quality monitoring : Water samples should be tested frequently, especially in the problem wards. Monitoring should not be occasional; it should be continuous.
3. Ward-wise action plan : Since the problem is not the same everywhere, each ward should be treated separately based on its water quality condition. A single city-wide approach will not work well enough.
4. Identify pollution sources : The high values of nitrate, chloride, TDS and fluoride suggest possible contamination from sewage leakage, wastewater seepage, groundwater

pollution, or natural geochemical processes. These sources must be identified and controlled.

5. Improve treatment and supply systems : The city should strengthen water treatment plants, pipe networks and distribution systems to reduce contamination during supply.
6. Protect groundwater sources : Since groundwater is a major source of drinking water, recharge areas should be protected from dumping, sewage entry, and chemical pollution.
7. Control sewage and urban waste discharge : Unplanned discharge into drains and open areas may be affecting water quality. Better sanitation and waste management are essential.
8. Create public awareness : People should be informed that clear-looking water is not always safe. Residents need to understand the importance of using treated or filtered water, especially in affected wards.
9. Prioritise the worst-affected wards : Wards such as 20, 21, 11, 12, 17, 18, 35, 36, 37 and 40 should be treated as priority zones because their WQI values show severe deterioration.
10. Further detailed studies : More research should be carried out to check seasonal variation, microbial contamination, and the exact sources of pollution. This will help in designing better solutions.

Overall, the study clearly shows that Dungarpur cannot afford to ignore its drinking water problem. A few wards are in good shape, but many are not. If the city wants safe water for everyone, then action is needed now, not later.

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