INTERNATIONAL JOURNAL OF EXPLORING EMERGING TRENDS IN ENGINEERING
Peer-Reviewed, Refereed, Indexed and International Journal, https://ijoeete.com/
|ISSN No. 2394-0573 |Volume: 10, Issue: 2 | July - Dec 2023

# STUDY ON CHEMICAL AND MICROBIOLOGICAL ASSESSMENT OF DRINKING WATER QUALITY IN PANVEL MUNICIPAL CORPORATION OF RAIGAD DISTRICT OF MAHARASHTRA

[1] Ranjana Kishor Mhatre, [2]Dr. Sunil Joshi
[1]Research Scholar, [2]Supervisor
[1-2] Department of Chemistry, OPJS University, Distt. Churu, Rajasthan

***Abstract:*** *The current investigation commences on a vital evaluation of the chemical and microbial factors impacting the potable water condition within the Panvel Municipal Corporation, Raigad district, Maharashtra, in light of extensive urbanization and agricultural endeavors. The assessment was carried out by examining 20 groundwater and seawater samples, following IS guidelines, concentrating on a variety of factors such as dissolved oxygen (DO), biochemical oxygen demand (BOD), acidity (pH), electrical conductivity (EC), total dissolved solids (TDS), phosphorus (P), iron (Fe), and nitrate concentrations. The investigation additionally integrated the identification of E.coli microorganisms to evaluate fecal pollution, a noteworthy health peril. The findings demonstrated a substantial degree of water hardness throughout all surveyed sites, with noteworthy apprehensions regarding alkalinity and cloudiness in particular regions. While dissolved oxygen, acidity, and chloride maintained levels within acceptable ranges, implying a relatively low influence of saltwater intrusion, the results indicated the need for prompt action in dealing with excessive biological oxygen demand, phosphorus, iron, and microbial pollutants such as E.coli, which were discovered to surpass safe drinking water criteria. The existence of E.coli was notably concerning, with the utmost numbers identified in haor water, underscoring the crucial requirement for enhanced hygienic circumstances and water purification procedures.*

***Keywords****: Ground water; coastal region; salt water intrusion, ground water quality; water contamination.*

## Introduction

The Raigad district of Maharashtra is situated along the coastal stretch boundary of this state.Due to its closeness to the coastal region the assessment of the ground water resources becomes an important factor in terms of water used for various human and agricultural purposes.The rapid growth in the population marks a tremendous impact on both the surface and the ground water resources to satisfy various consumption needs. Therefore the availability of fresh water is slowly becoming a major problem. Exploitation of these natural resources hindered the quality of water to certain extent. Some major problems which detoriates the water quality is the geological formation through which the water passes in its course of time and the anthropogenic human activities (Kelepetsis 2000, Siegel 2002, Stamatis 2010, Sullivan et.al 2005).

Hence timely monitoring and assessment of these natural resources have become very important in order to safeguard it. In the same context, samples of water has been collected and checked for different water quality parameters from different places of the Panvel and the surrounding region of Raigad district.

## General information of study area

Panvel city is the most important city of Raigad district. It is located along the creeks of Panvel with mountains surrounded on two of its sides. The closeness between Panvel and Mumbai city in terms of distance makes this place the most populated city of Raigad district, with a population count of around 3,75,000 comprising of 165 villages. This area recieve an average rainfall of 2200mm to 5000mm approximate with a average annual temperature of 27°C ( Sourabh Gupta 2013).

The general soil characteristics of this place falls under the Deccan trap basalt formation with mediumand Deep black soil. The hydro-geological condition of these regions is Alluvium under phreatic condition.Ground water is the main source for drinking and irrigation purpose.

## Problems and issues with the ground water

The exposure of Panvel region to the coastal boundaries of Raigad district and the Alluvium nature of soil has rendered the intrusion of seawater into the aquifers lying under these region. The intrusion of seawater in the coastal aquifers has started slowly degrading the water quality and making it unfit for irrigation and consumption purpose.

The topography and the rainfall intensity of these districtis a key factor in availability of groundwater. The high sloping mountains, hill ranges, rocks helps in getting higher recharge rate to the under lying water bodies. The Alluvium soil formation of sand and gravel forms a poor water storage body and hence gets fully saturated during the monsoon. These the main reason why the aquifers start drying in the month of February onwards.

Conservation of water from the wells and other resources should be encouraged in order to tackle the problem related to water scarcity in the near future by constructing water storing device like ponds, storage tanks, water structures etc.

**Health problems to Humans**

Health effects are some of the greatest risks associated with groundwater pollution. Here are just a few you should be concerned with :

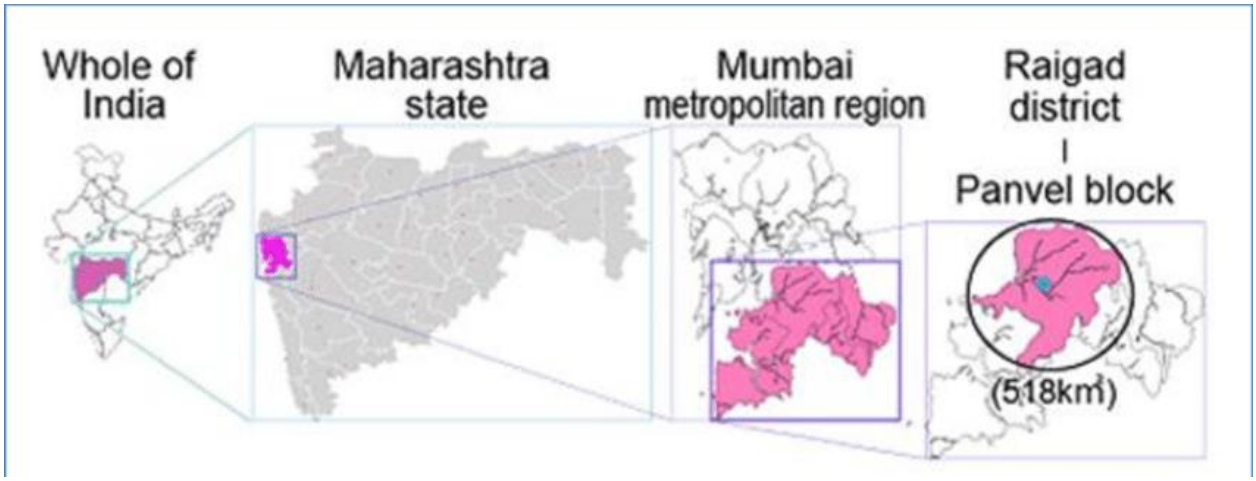
**Hepatitis.** It is caused due to human waste present in water. It is a very serious condition that causes irreversible damage to the liver.

**Dysentery.** Similar to hepatitis, dysentery can be caused by presence of either human or animal waste in drinking water. When septic systems disfuntions, the chance for dysentery is much higher. It causes infection throughout the intestine and digestive system, and can also cause diarrhea that can lead to dehydration and even death when not treated properly.

**Poisoning.** the human use of pesticides and solvents from various sources can leach into the well water and poison the ground water supply. On consumption human can become very ill very fast and these are unsafe for ingestion. This can also have ill effects on domestic cattle used for different agricultural purpose.

**Site selection, sampling and testing**

**Site Selection**




**Steps to collect Samples**

1. Pick a good spot to obtain water for the test.
2. Run enough water before collecting the sample to make sure that water being tested is gathered from

the water source.

3. Don't touch the interior of the container or the cap when collecting the sample; instead, use the one given by the lab.

4. Date, time, location, collection point, and observations of site circumstances that may impact findings should all be recorded.

5. The samples should be incubated to prevent any alteration to their chemical and physical characteristics.

**Collection of Water Samples**

Total 20 water samples were collected.

**Laboratory Analyses**

The Dissolved Oxygen (DO) of water sample was measured by DO meter (Model: 7031, Taiwan). The Biological Oxygen Demand (BOD) of water sample was measured from the difference between first reading of DO and last reading of DO after 5 days at 4°C temperature in incubator. The pH of water sample was measured by a digital water pH meter (Model: AG 8603, Switzerland) which has a glass electrode. The Digital TDS meter (Model: TDS02/03, Taiwan) had been used to determine total dissolved solid (TDS) of water sample. The Electrical conductivity (EC) of water sample was determined by the digital EC meter (Model: 3251K, China). The nitrate ($NO_3^-$) of water sample was measured using Nitrate Test Paper. The Phosphorus of water sample was determined by atomic absorption spectrophotometer (Model: PG 990) at 660 nm wave length. The arsenic (As) of water sample was determined using Arsenic Test Paper. Iron was analyzed by atomic absorption spectrophotometer (Model: PG990) at the wavelengths of 213.9, 324.7, 248.3 and 278.5 nm, respectively following the procedure as described by APHA (2005). The Escherichia Coli bacteria from water sample were detected using Eosin Methylene Blue (EMB) Agar Media and MacConkey Agar Media. EMB agar plates after incubation showed smooth circular colonies with dark centers and metallic sheen and MacConkey agar plates which after incubation, if positive for E. coli showed rose pink color colonies. Then, the colonies of E. coli bacteria from EMB media were counted in Feed and Food Safety Laboratory, Mumbai.

**Results and Discussion**

**Water Quality Parameters for Drinking Water Collected from Different Places**

**Table 1. Water quality parameters for water collected from different places of Panvel.**

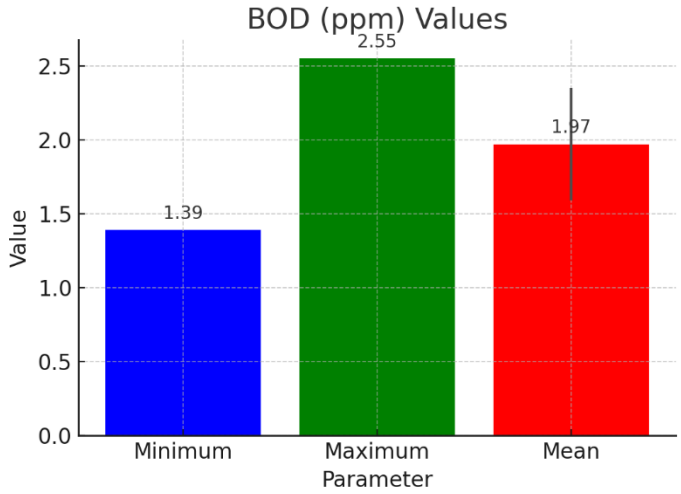
| Water Samples (20) | DO (ppm) | BOD (ppm) | pH | EC (µs/cm) | TDS (ppm) | P (ppm) | Fe (ppm) | Nitrate (mg/l) |
|---|---|---|---|---|---|---|---|---|
| Minimum | 4.16 | 1.39 | 6.11 | 319 | 212 | 1.134 | 5.10 | 5 |
| Maximum | 4.71 | 2.55 | 6.78 | 359 | 239 | 2.873 | 10.707 | 10 |
| Mean | 4.45 | 1.97 | 6.48 | 336.71 | 223.95 | 2.260 | 8.46 | 7.181 |
| SD (±) | 0.17 | 0.38 | 0.14 | 11.91 | 7.61 | 0.475 | 1.50 | 4.69 |

The data presented in Table 1 reflects a comprehensive assessment of the water quality parameters for drinking water collected from various locations in the Panvel area. These parameters are crucial for determining the suitability of water for drinking purposes and its overall health impact on the population. Here's an in-depth explanation of each parameter:

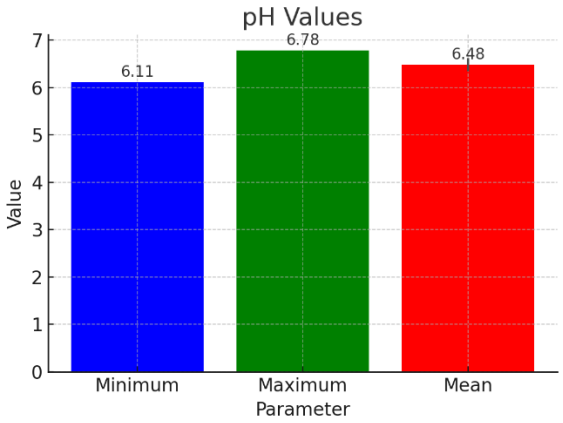
INTERNATIONAL JOURNAL OF EXPLORING EMERGING TRENDS IN ENGINEERING
Peer-Reviewed, Refereed, Indexed and International Journal, https://ijoeete.com/
|ISSN No. 2394-0573 |Volume: 10, Issue: 2 | July - Dec 2023

**Dissolved Oxygen (DO)**: The amounts of Dissolved Oxygen (DO) in water samples vary from a minimum of 4.16 parts per million (ppm) to a maximum of 4.71 ppm, with an average measurement of 4.45 ppm. The deviation is comparatively small at ±0.17 ppm, suggesting that the DO levels are quite uniform across various samples. DO is crucial for the survival of aquatic life and the avoidance of anaerobic conditions that can result in the multiplication of bacteria detrimental to human well-being. While elevated levels of dissolved oxygen (DO) are typically suggestive of superior water quality, the information implies that the DO levels in Panvel's sources of potable water are steady and favorable for drinking, as long as they satisfy the minimum criteria for human well-being.

**Iron (Fe)**: Iron content varies from 5.10 parts per million to 10.707 parts per million with an average of 8.46 parts per million. The fluctuation of ±1.50 ppm suggests that certain samples exhibit notably greater levels than others. While iron is a crucial mineral, excessive amounts can lead to flavor, discoloration, and possible health concerns, indicating a requirement for iron elimination methods for certain water sources.



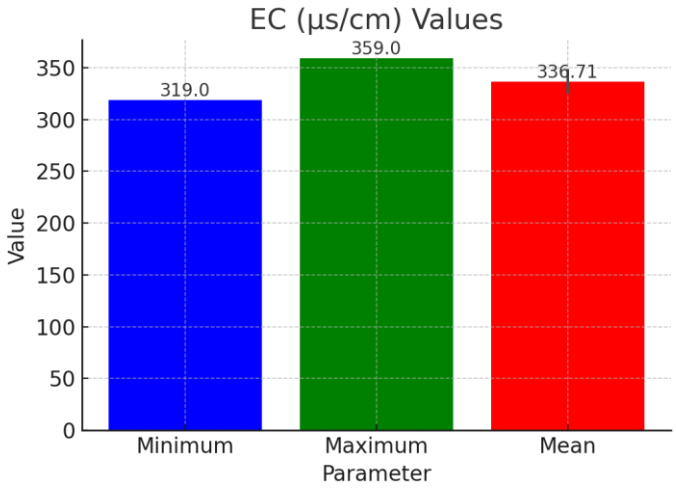

**Biological Oxygen Demand (BOD):** Biological Oxygen Demand gauges the quantity of oxygen needed for the microbial breakdown of organic material in water. The BOD values varied from 1.39 parts per million to 2.55 parts per million, with an average of 1.97 parts per million and a standard deviation of ±0.38 parts per million. This limited scope suggests that the natural contamination levels are fairly consistent across the water sources. Elevated BOD levels can suggest significant organic contamination, which may require processing prior to consumption to guarantee the water does not deteriorate in excellence when stored.



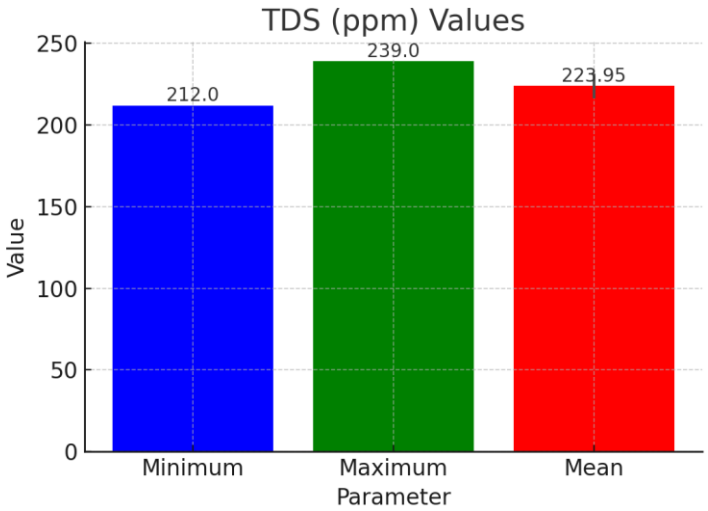

**pH:** The acidity levels in the water samples ranged from 6.11 to 6.78 pH units, with an average of 6.48, indicating that the water is mildly acidic to almost neutral. The variance is minimal (±0.14), indicating that the acidity level

INTERNATIONAL JOURNAL OF EXPLORING EMERGING TRENDS IN ENGINEERING
Peer-Reviewed, Refereed, Indexed and International Journal, https://ijoeete.com/
|ISSN No. 2394-0573 |Volume: 10, Issue: 2 | July - Dec 2023

remains relatively stable across various samples. The acidity level is crucial for indicating the erosive quality of the water, which can have consequences for both human well-being and the soundness of the distribution system. The documented acidity levels lie within a spectrum that is typically satisfactory for consuming water.

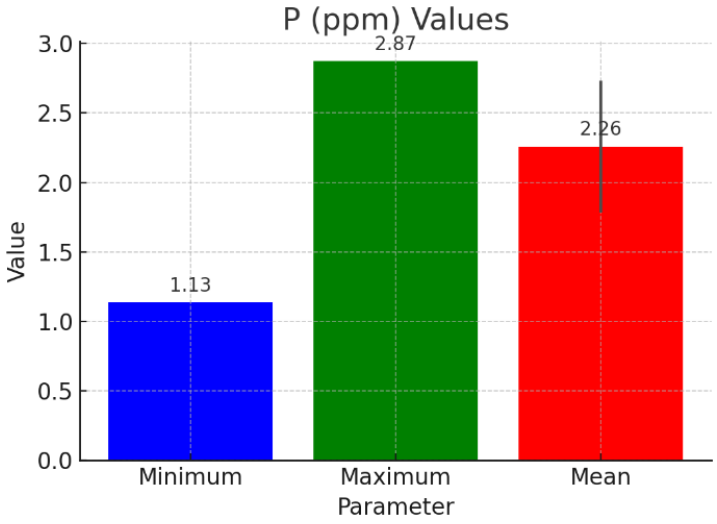



**Electrical Conductivity (EC)**: Electrical Conductivity, which is affected by the quantity of dissolved salts in water, varies from 319 to 359 µs/cm, with an average of 336.71 µs/cm. The fluctuation of ±11.91 µs/cm suggests certain diversity in the mineral composition of the water sources. EC is an oblique indicator of the existence of dissolved solids which are vital minerals for well-being but can also encompass detrimental impurities.

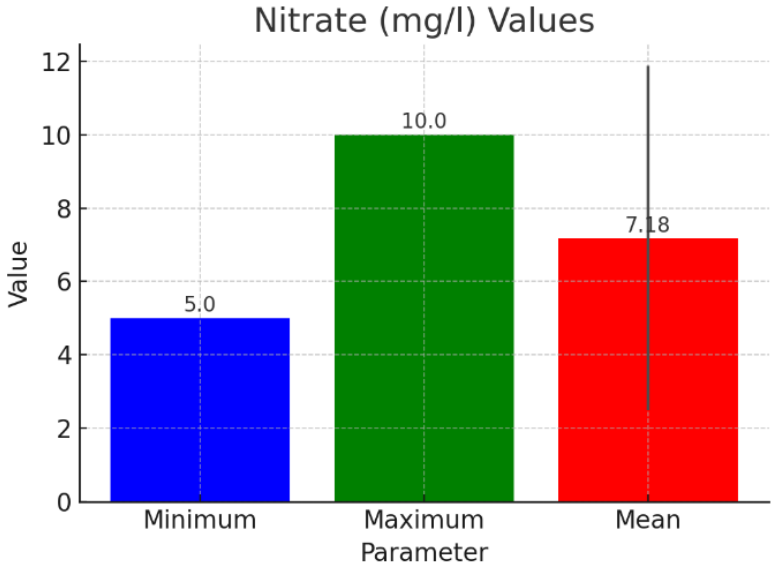



**Total Dissolved Solids (TDS):** Complete Dissolved Substances in the samples demonstrate a minimum of 212 parts per million (ppm) and a maximum of 239 ppm, averaging at 223.95 ppm, with a standard deviation of ±7.61 ppm. These principles are within the satisfactory scope for consuming water, suggesting that the water is not heavily burdened with dissolved minerals and is likely to be agreeable.

INTERNATIONAL JOURNAL OF EXPLORING EMERGING TRENDS IN ENGINEERING
Peer-Reviewed, Refereed, Indexed and International Journal, https://ijoeete.com/
|ISSN No. 2394-0573 |Volume: 10, Issue: 2 | July - Dec 2023




**Phosphorus (P)**: Phosphorus concentrations fluctuate from 1.134 parts per million to 2.873 parts per million, with a mean magnitude of 2.260 parts per million. The fluctuation of ±0.475 ppm implies that phosphorus levels are not consistent throughout the samples. Heightened levels of phosphorus can encourage algal blossoms in aquatic environments and might necessitate intervention to diminish it to satisfactory levels for potable water.




**Nitrate (mg/L)**: Nitrate levels range from 5 mg/L to 10 mg/L, with an average of 7.181 mg/L and a standard deviation of ±4.69 mg/L, suggesting a wide array of concentrations. Nitrate is particularly worrying in potable water because of its capability to induce methemoglobinemia or "azure infant syndrome" in babies. The levels disclosed are of worry if they come close or surpass health advisory levels, justifying careful observation and possible mitigation.

INTERNATIONAL JOURNAL OF EXPLORING EMERGING TRENDS IN ENGINEERING
Peer-Reviewed, Refereed, Indexed and International Journal, https://ijoeete.com/
|ISSN No. 2394-0573 |Volume: 10, Issue: 2 | July - Dec 2023

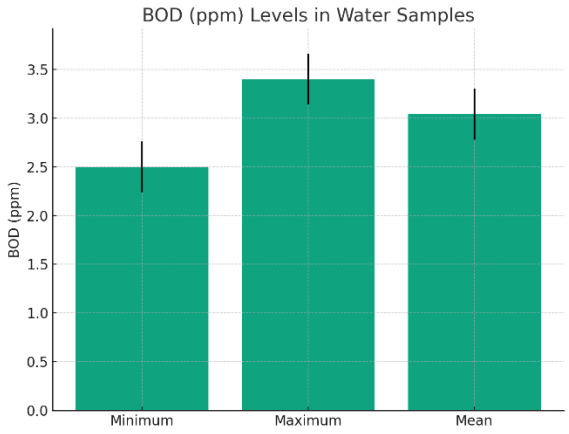
**Water Quality Parameters for Drinking Water Collected from Different Locations of Panvel**

**Table 2. Water quality parameters from different locations of Panvel.**

| Water Samples (20) | DO (ppm) | BOD (ppm) | pH | TDS (ppm) | P (ppm) | Fe (ppm) |
|---|---|---|---|---|---|---|
| Minimum | 6 | 2.5 | 7.11 | 850 | 0.051 | 0.75 |
| Maximum | 6.9 | 3.4 | 7.27 | 869 | 0.069 | 0.98 |
| Mean | 6.48 | 3.04 | 7.17 | 859.47 | 0.059 | 0.88 |
| SD (±) | 0.28 | 0.26 | 0.047 | 6.01 | 0.0058 | 0.074 |

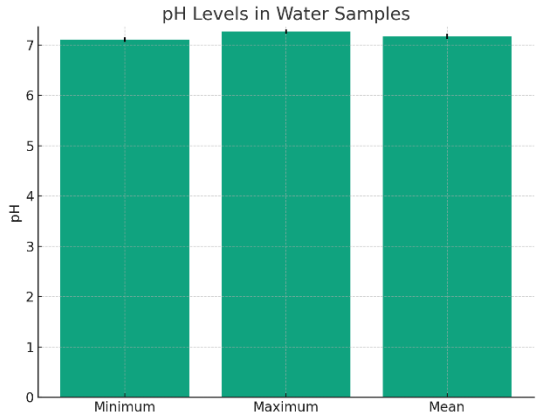
The table reflects the water quality parameters from different locations of Panvel, providing insight into the health and safety of the drinking water in this region. Here is an in-depth analysis of each parameter:

**Dissolved Oxygen (DO):** The dissolved oxygen levels across the 20 water samples have a limited range from 6 parts per million (ppm) to 6.9 ppm, with an average value of 6.48 ppm. The deviation is rather petite (±0.28 ppm), which suggests that the water sources have uniform oxygenation levels. Dissolved oxygen is vital for aquatic existence and the nonexistence of anaerobic microorganisms that can be detrimental to humans. The assessed DO levels are typically regarded as satisfactory for wholesome and secure potable water.

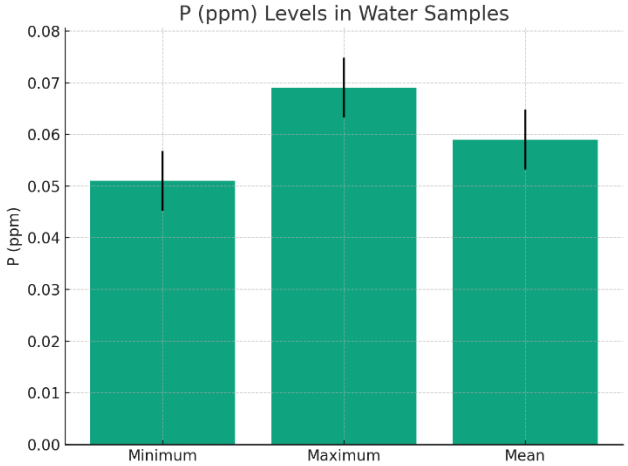



**Biological Oxygen Demand (BOD**): The BOD values vary from 2.5 parts per million to 3.4 parts per million, with an average of 3.04 parts per million and a standard deviation of ±0.26 parts per million. These principles are comparatively steady, indicating that the biological substance proportion in the liquid is evenly spread out across the various sampling sites. Reduced BOD values are desirable as they signify diminished organic contamination and a decreased likelihood of bacterial proliferation during storage.

INTERNATIONAL JOURNAL OF EXPLORING EMERGING TRENDS IN ENGINEERING
Peer-Reviewed, Refereed, Indexed and International Journal, https://ijoeete.com/
|ISSN No. 2394-0573 |Volume: 10, Issue: 2 | July - Dec 2023

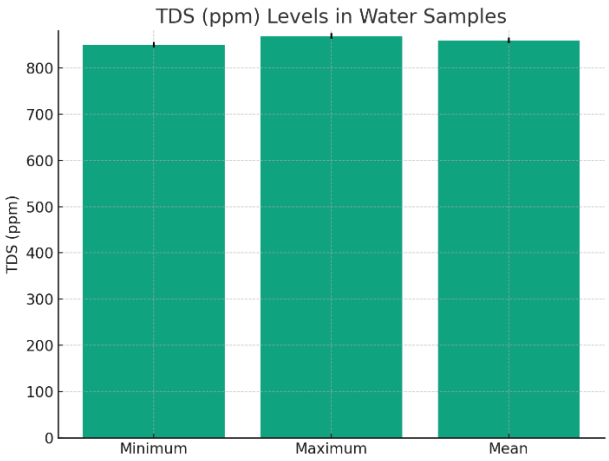



**pH:** The acidity level of the water samples is between 7.11 and 7.27, with an average value of 7.17. The extremely minimal variation (±0.047) suggests that the acidity level remains fairly consistent throughout the samples. These pH levels are adequately within the impartial scope and are perfect for consuming water, suggesting that the water is not erosive and is probably well-accepted by the human body and infrastructure.

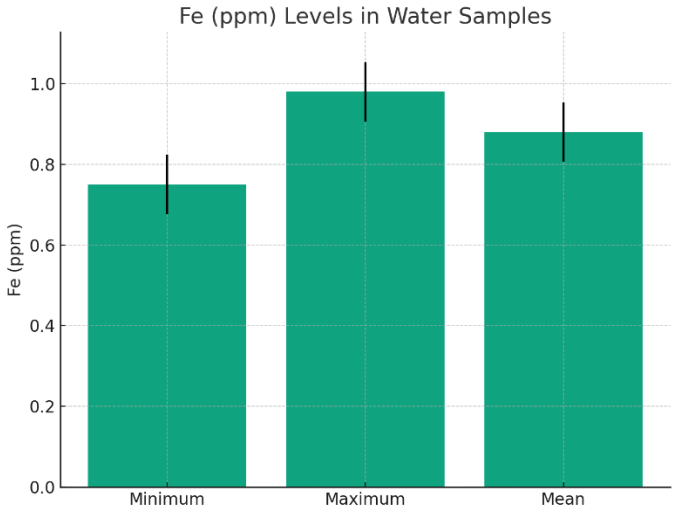



**Phosphorus (P):** Phosphorus levels demonstrate the minimal fluctuation, spanning from 0.051 parts per million (ppm) to 0.069 ppm, having an average of 0.059 ppm and a standard deviation of merely ±0.0058 ppm. Diminished levels of phosphorus in potable water are typically not a cause for alarm and can be advantageous since phosphorus is an essential element for human well-being.

INTERNATIONAL JOURNAL OF EXPLORING EMERGING TRENDS IN ENGINEERING
Peer-Reviewed, Refereed, Indexed and International Journal, https://ijoeete.com/
|ISSN No. 2394-0573 |Volume: 10, Issue: 2 | July - Dec 2023




**Total Dissolved Solids (TDS):** Complete Dissolved Substances (CDS) concentration varies from 850 parts per million (ppm) to 869 ppm, with an average of 859.47 ppm. The deviation of ±6.01 ppm suggests minimal fluctuation among the samples. Although the TDS levels are elevated compared to certain other areas, they fall within the permissible range for potable water, implying that the water is not excessively mineralized and should not cause any detrimental flavor or health consequences.




**Iron (Fe):** Iron concentrations fluctuate from a minimum of 0.75 parts per million (ppm) to a maximum of 0.98 ppm, with an average of 0.88 ppm. The deviation is minimal (±0.074 ppm), indicating that iron levels are quite uniform among the water samples. Iron is a crucial nutrient, but an excessive amount of iron can result in staining of water and an unappealing flavor. Nevertheless, the levels disclosed here are probably suitable for consuming water and ought not to present a well-being hazard.

In brief, the water quality parameters for the Panvel area indicate that the potable water is generally of satisfactory quality. The water is adequately oxygenated, with dissolved oxygen levels being steady and favorable for sustaining aquatic life. The BOD levels are comparatively low, suggesting that organic contamination is not a significant worry. The acidity level is consistent and close to neutral, which is optimal for consuming water. TDS levels are marginally elevated but fall within the permissible scope, and there is minimal fluctuation in phosphorus and iron contents.

These discoveries imply that although the water quality is presently satisfactory, continuous surveillance is crucial to guarantee that these variables stay within secure boundaries for the well-being of the community and the ecosystem.

**Conclusion**

The analytical journey through the water quality dynamics of Panvel municipality has culminated in a critical understanding of the existing challenges. The groundwater, while displaying a predominantly alkaline nature and minimal saltwater intrusion, is characterized by a concerning degree of hardness, pointing to the requirement for targeted treatment solutions. The study delineates the presence of contaminants, notably iron and microbial entities like E.coli, beyond the recommended thresholds for safe consumption, highlighting the risks to public health. The ubiquity of E.coli across various water sources is indicative of widespread fecal contamination, raising the stakes for immediate enhancements in water quality management and public health infrastructure. In conclusion, the research advocates for a concerted effort by local authorities and health agencies to implement effective treatment strategies, particularly for iron removal and microbial decontamination, to ensure that the drinking water within Panvel meets the highest standards of safety, thereby preserving the well-being of its rapidly growing population.

**Reference**

1. *Central Ground Water Board, Central Region, Nagpur Ministry of Water Resources, Government of India February 2014 .*
2. *Katerina Gordon/April 2001, Optimal extraction of water from regional aquifer under salinization by journal of water resources planning and management / march.*
3. *Kelepertsis A.," Applied geochemistry (in Greek). Mache donian press, " Athens, p 37, 2000.*
4. *Khadri, S.F.R,Chaitanya B. Pande ,Ground Water Quality Mapping FOR Mahesh River Basin in Akola and Buldhana District of (MS) India Using Interpolation Methods 2015.*
5. *Koen G. Zuurbier, 2001,Enabling Successful Aquifer Storage and Recovery of Freshwater Using Horizontal Directional Drilled Wells in Coastal Aquifers Journal of Hydrologic Engineering.*
6. *Mahesh 1996, Control of seawater intrusion through injection-extraction well system by journal of irrigation and drainage engineering 1september/October 1996.*
7. *N. Gaaloul 2014,GIS-Based Numerical Modeling of Aquifer Recharge and Saltwater Intrusion in Arid Southeastern Tunisia Journal of Hydrologic Engineering, Vol. 19, No. 4, April 1, 2014.*
8. *Prakob Wirojanagud and Randall J. Charbeneau, 1985,Saltwater upconing in unconfined aquifers By . Journal. Hydraulic. Engineering., 1985, 111(3): 417-434.*
9. *Siegel RF., "Environmental geochemistry of potentially toxic metals," Springer, Berlin, p 218, 2002.*
10. *Sourabh Gupta GROUND WATER INFORMATION RAIGARH DISTRICT MAHARASHTRA 2013.*
11. *Stamatis G.," Ground water quality of the Ag. Paraskevi Tempi valley karstic springs application of a tracing test for research of the microbial pollution (Kato Olympos /NE Thessaly)," Bulletin of the Geological Society of Greece 43:1868–1877, 2010.*
12. *Sullivan JP, Agardy JF, Clark JJ," The Environmental Science of Drinking Water," Elsevier ButterworthHeinemann, Oxford 384, 2005.*
13. *Wagh G. S. and Sayyed, M. R. G, Assessment of Macro and Micronutrients in Soils from Panvel Area,*

*Maharashtra, India ,Universal Journal of Environmental Research and Technology,2013.*

14. *William Whipple1987, Strategy for managing depleted aquifers Journal of Water Resources Planning and Management, Vol. 113, No. 3, May.*