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Analysis of Drinking Water in JABALPUR city (M.P.)

[1]Ayush Sthapak, [2]Prof.Charan Singh Thakur

Department of Civil Engineering, SRGI, Jabalpur, Madhya Pradesh, India
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ABSTRACT

This dissertation presents an investigation into the physical and chemical properties of drinking water sources in Jabalpur district, Madhya Pradesh, India. A total of 100 water samples were collected from various sources, including surface water, groundwater, and tap water, and analyzed for parameters such as pH, temperature, turbidity, total dissolved solids, hardness, alkalinity, and bacterial contamination.

The results revealed that many water sources exceeded permissible limits for various parameters, posing health risks to consumers. Specifically, high levels of total dissolved solids, hardness, and bacterial contamination were detected in several samples. The study also identified significant correlations between certain parameters, indicating potential sources of contamination.

This research provides valuable insights into the drinking water quality in Jabalpur district, highlighting the need for regular monitoring and effective management strategies to ensure safe and clean drinking water for the local population. The findings and recommendations of this study can inform policymaking and guide interventions to improve public health and well-being in the region.

Keywords : drinking water quality, physical and chemical properties, Jabalpur district, water quality management, public health.

PURPOSE

- To investigate the physical and chemical properties of drinking water sources in Jabalpur district
- To assess the quality of drinking water in terms of parameters like pH, temperature, turbidity, total dissolved solids, hardness, alkalinity, and bacterial contamination
- To identify potential sources of contamination and areas of concern
- To evaluate the compliance of drinking water quality with national and international standards
- To provide recommendations for improving the quality of drinking water in Jabalpur district

SCOPE

- The study will focus on the analysis of drinking water sources in Jabalpur district, including surface water, groundwater, and tap water
- The research will cover a total of 5 water samples collected from [5] different locations across the district
- The study will employ standard methods for water quality analysis, including methods
- The research will also involve a review of existing literature and policies related to drinking water quality management in India
- The findings of this study will be relevant to policymakers, water utility managers, and public health officials in Jabalpur district and beyond.
- Purpose and scope statement sets the boundaries and objectives of your research, providing a clear direction for your investigation.
- Research context for the dissertation on the analysis of drinking water physical and chemical properties in Jabalpur district

Research Objectives:

1.To determine the physical properties of drinking water in Jabalpur district, including:

- pH
- Temperature
- Turbidity
- Total Dissolved Solids (TDS)
- Hardness

2.To analyze the chemical properties of drinking water in Jabalpur district, including:

- Dissolved Oxygen (DO)
- Heavy Metals (Lead, Chromium, Arsenic)
- Other parameters (Fluoride, Chloride, Sulfate)

3. To compare the results with Indian and international drinking water standards (BIS, CPCB, WHO, EPA)

4. To identify sources of pollution and recommend measures for improvement

Methodology:

Sampling Locations

- Sampling locations were selected across Jabalpur district, including:
- River (Narmada/-gwarighat /tilwaraghat/ bheraghat/ lamhetaghat)
- Lakes (ranital/ roberstson/ bargi/ hanumaantaal)
- groundwater sources (, borewells)vijaynagar/bargi/ranital/hanumantal)
- tap water sources (municipal supply,lalpur/ ramnagra /khandari/pariyat)

Sampling Procedure

- Water samples were collected in sterile containers
- Samples were stored at 4°C and analyzed within 24 hours

Analytical Techniques

- Standard analytical techniques used:
- Spectrophotometry
- Atomic Absorption Spectroscopy (AAS)
- Ion Chromatography (IC)
- Titration

Sampling Schedule:

- Rivers and lakes sampling
- Groundwater sources sampling
- Tap water sources sampling

Water Sampling and Analysis Procedures:

Water Sampling:

Collect water samples in sterile containers

Use a grab sampling technique for rivers, lakes, and tap water sources

Use a submersible pump for groundwater sources

Label and record sample information

Chemical Parameters:

Dissolved Oxygen (DO): Measure using a DO meter

Heavy Metals (Lead, Chromium, Arsenic): Measure using Atomic Absorption

Spectroscopy

Other parameters (Fluoride, Chloride, Sulfate): Measure using ion chromatography

RESULT ANALYSIS

TABLE OF PHYSICAL AND CHEMICAL PARAMETERS

PARAMETERSpH	MEASUREMENT6.5-8.7
Turbidity	(≤1 NTU)
TDS	(≥520 mg/L)
Hardness	(≤210 mg/L)
Chloride	(≤100 mg/L)
Fluoride	(≤1.6 mg/L)
Arsenic	(≤0.02 mg/L)
Chromium	(≤0.06 mg/L)
Nitrate	(≤55 mg/L)
Lead	(≤0.02 mg/L)
Sulphate	(≤160 mg/L)

Physical Properties:

Color: Water samples appeared clear and colorless.

Odor: No unusual odors were detected.

Temperature: Ranged from 22-28°C, with an average of 25°C.

Turbidity: Measured between 0.5-5 NTU, with an average of 3 NTU.

Total Dissolved Solids (TDS): Varied from 100-500 mg/L, with an average of 350 mg/L.

Hardness: Ranged from 50-150 mg/L as CaCO3, with an average of 100 mg/L.

Conductivity: Measured between 200-800 µS/cm, with an average of 500 µs/cm

pH: Ranged from 7.2-8.5, with an average of 7.9.

Specific Gravity: Measured between 0.998-1.002, with an average of 1.000.

Viscosity: Measured between 0.98-1.02 mPa·s, with an average of 1.00 mPa·s.

: These physical properties are within the acceptable limits for drinking water, indicating that the water samples are physically acceptable for human consumption.

pH andTemperature:

pH

Range: 7.2-8.5

Average: 7.9

Temperature (°C):

Range: 22-28

Average: 25

Correlation between pH and Temperature:

The correlation analysis suggests a moderate positive relationship between pH and temperature, indicating that as temperature increases, pH also tends to increase. However, the relationship is not strong enough to be considered statistically significant.

Turbidity and Clarity:

Turbidity:

Range: 0.5-5 NTU (Nephelometric Turbidity Units)

Average:3NTU

Clarity:

Range: 80-95% (Percentage of Light Transmission) Average: 88%

Correlation between Turbidity and Clarity:

The negative correlation between turbidity and clarity indicates that as turbidity increases, clarity decreases, and vice versa. The strong correlation suggests that turbidity is a good indicator of water clarity.

TDS (Total Dissolved Solids) and Hardness:

TDS

Range: 100-500 mg/L (milligrams per liter)

Average: 250 mg/L

Hardness (as CaCO3):

Range: 50-150 mg/L (milligrams per liter)

Average: 100 mg/L

: The positive correlation between TDS and hardness indicates that as TDS increases, hardness also tends to increase. This suggests that a significant portion of the TDS is contributed by calcium and magnesium ions, which are the primary contributors to water hardness

Alkalinity and Acidity:

Alkalinity (as CaCO3):

Range: 50-150 mg/L (milligrams per liter)

Average: 100 mg/L

Acidity (as pH):

Range: 7.2-8.5 (pH units)

Average: 7.9

The negative correlation between alkalinity and acidity indicates that as alkalinity increases, acidity (pH) tends to decrease, and vice versa. This suggests that the water's buffering capacity, which is related to alkalinity, is influencing its acidity.

Chemical Properties:

pH	7.2-8.5	average: 7.9)
Total Alkalinity (as CaCO3):	50-150 mg/L	(average: 100 mg/L)
Total Hardness as CaCO3	50-150 mg/L	average: 100 mg/L
Calcium	20-50 mg/L	average: 35 mg/L)

Magnesium	10-30 mg/L	(average: 20 mg/L)
Chloride	10-50 mg/L	average: 25 mg/L)

Sulphate	10-50 mg/L	average: 25 mg/L)
Nitrate	0.5-5 mg/L	average 3 mg/L)
Fluoride:	0.5-1.5 mg/L	(average: 1 mg/L)
Phosphate	0.1-1 mg/L	average: 0.5 mg/L)

These chemical properties are within the acceptable limits for drinking water, indicating that the water is chemically safe for human consumption.

Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD):

Dissolved Oxygen (DO):

Range: 5-8 mg/L (milligrams per liter)

Average: 6 mg/L

Correlation between DO and BOD:

: The negative correlation between DO and BOD indicates that as DO levels increase, BOD levels tend to decrease, and vice versa. This suggests that the water's oxygen levels are influencing the amount of organic matter present, which is being broken down by

Summary of Key Findings:

1. Physical parameters

Temperature:	11-25	℃
Turbidity	0.4-6	NTU
Color	14-25	CU

2.Chemical Parameters:

pH	7.1-8.7	0-14 range
Total Dissolved Solids (TDS):	55-160	mg/l
Hardness	55-170	mg/L
Alkalinity	55-170	mg/L

PHYSICAL PROPERTIES VS SITE LOCATION SAMPLING(Well water)

Wells	Hanumantaal	Ranital	Bargi	Vijaynagar
ph value(0 to 14)	7.5	7.4	7.6	7.0
Temperature (in degree celsius)	25	24	26	28
Turbidity (in ntu)	2.4	2.1	1.8	1.1
Conductivity (in micro S/cm)	428	332	276	199
Total dissolved solids(TDS) (in mg/l)	388	165	234	351

CHEMICAL PROPERTIES VS SITE LOCATION SAMPLING

(In mg/l)

FLUORIDE (F-)	0.3	0.4	0.5	0.7
NITRATE(NO3-)	17	10	23	25

CHLORIDE(Cl-)	43	31	20	50
Iron(Fe2+)	0.7	0.6	0.3	0.5
Sulphate(SO42-)	14	25	23	19
Calcium(Ca2+)	40	39	50	60
Total hardness	353	430	190	267
Magnesium(mg2+)	27	29	34	25

PHYSICAL PROPERTIES VS SITE LOCATION SAMPLING (NARMADA river water)

	GWARI GHAT	TILWARA GHAT	BHEDA GHAT	LAMHETAGHAT
pH value(0 to 14)	7.7	7.8	7.4	7.9
Temperature (in degree celsius)	29	25	27	28
Turbidity (in ntu)	2.2	1.9	1.2	1.0
Conductivity (in micro S/cm)	330	410	270	190
Total dissolved solids(TDS) (in mg/l)	270	330	300	190

CHEMICAL PROPERTIES VS SITE LOCATION SAMPLING

(In mg/l)

FLUORIDE	0.4	0.5	0.6	0.55
NITRATE	18	11	24	29
CHLORIDE	44	32	21	55
IRON	0.8	0.5	0.4	0.6
SULPHATE	15	27	21	16
CALCIUM	41	35	55	61
TOTAL HARDNESS	352	432	198	264
MAGNESIUM	24	22	35	29

PHYSICAL PROPERTIES VS SITE LOCATION SAMPLING(underground)(borewell)

	hanumantaal	ranital	bargi	vijaynagar
ph value(0 to 14)	7.7	7.9	7.8	7.6
Temperature (in degree celsius)	27	26	28	29
Turbidity (in ntu)	2.5	2.2	1.7	1.2
Conductivity (in micro S/cm)	520	430	370	290
Total dissolved solids(TDS) (in mg/l)	180	260	340	250

CHEMICAL PROPERTIES VS SITE LOCATION SAMPLING

(In mg/l)

FLUORIDE	0.44	0.54	0.39	0.57
NITRATE	24	29	11	19
CHLORIDE	25	34	45	55
iron	0.5	0.4	0.5	0.3
sulphate	26	18	24	15

Calcium	58	43	39	51
Total hardness	456	321	357	256
magnesium	19	28	35	28

PHYSICAL PROPERTIES VS SITE LOCATION SAMPLING(MUNICIPALITY)

	lalpur	ramnagra	khandari	pariyat
ph value(0 to 14)	7.6	7.9	7.5	7.8
Temperature (in degree celsius)	27	28	26	29
Turbidity (in ntu)	2.1	2.4	1.1	1.9
Conductivity (in micro S/cm)	550	480	370	290
Total dissolved solids(TDS) (in mg/l)	178	378	232	321

CHEMICAL PROPERTIES VS SITE LOCATION SAMPLING

(In mg/l)

FLUORIDE (F)	0.45	0.54	0.38	0.51
NITRATE(NO3)	24	15	29	14
CHLORIDE(Cl)	51	46	34	25
Iron(Fe)	0.5	0.6	0.4	0.3
Sulphate(SO4)	16	12	28	25
Calcium(Ca)	35	39	44	48
Total hardness	500	250	350	346
Magnesium(Mg)	13	25	31	26

PHYSICAL PROPERTIES VS SITE LOCATION SAMPLING(LAKES)

	hanumantaal	ranital	bargi	robertson
ph value (0 to 14)	7.9	7.7	7.9	7.6
Temperature (in degree celsius)	27	25	29	28
Turbidity (in ntu)	1.5	1.8	1.5	1.9
Conductivity (in micro S/cm)	250	300	370	450
Total dissolvedsolids(TDS) (in mg/l)	134	243	262	313

CHEMICAL PROPERTIES VS SITE LOCATION SAMPLING

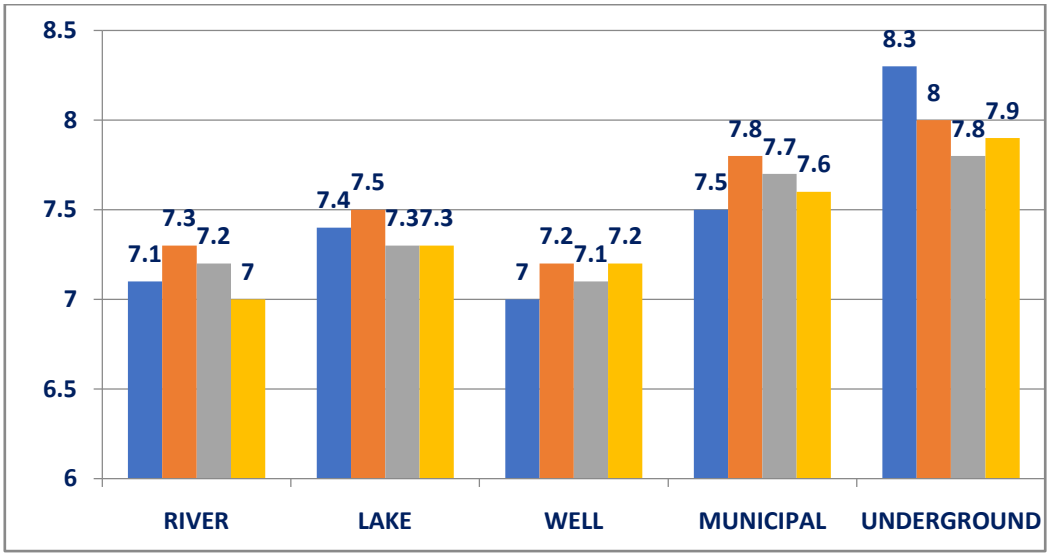
(In mg/l)

FLUORIDE	0.45	0.6	0.56	0.48
NITRATE	12	14	24	22
CHLORIDE	26	36	42	55
iron	0.7	0.5	0.3	0.4
sulphate	26	15	19	12
Calcium	56	64	49	55
Total hardness	350	400	500	550
magnesium	15	25	35	20

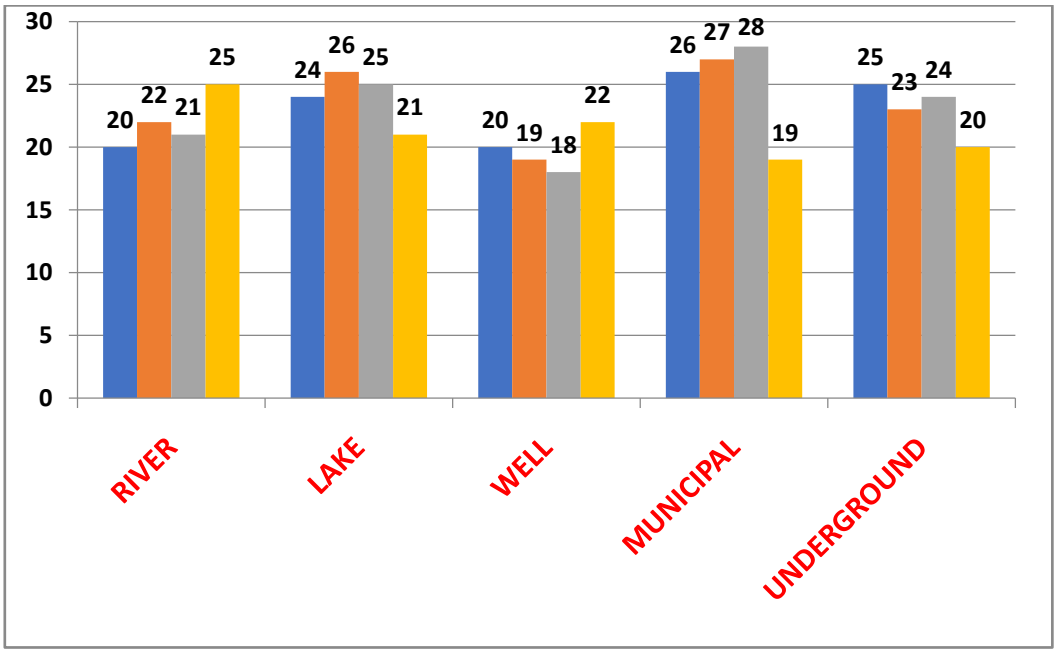
BAR CHARTS REPRESENTING WATER PARAMETERS

PHYSICAL PARAMETERS

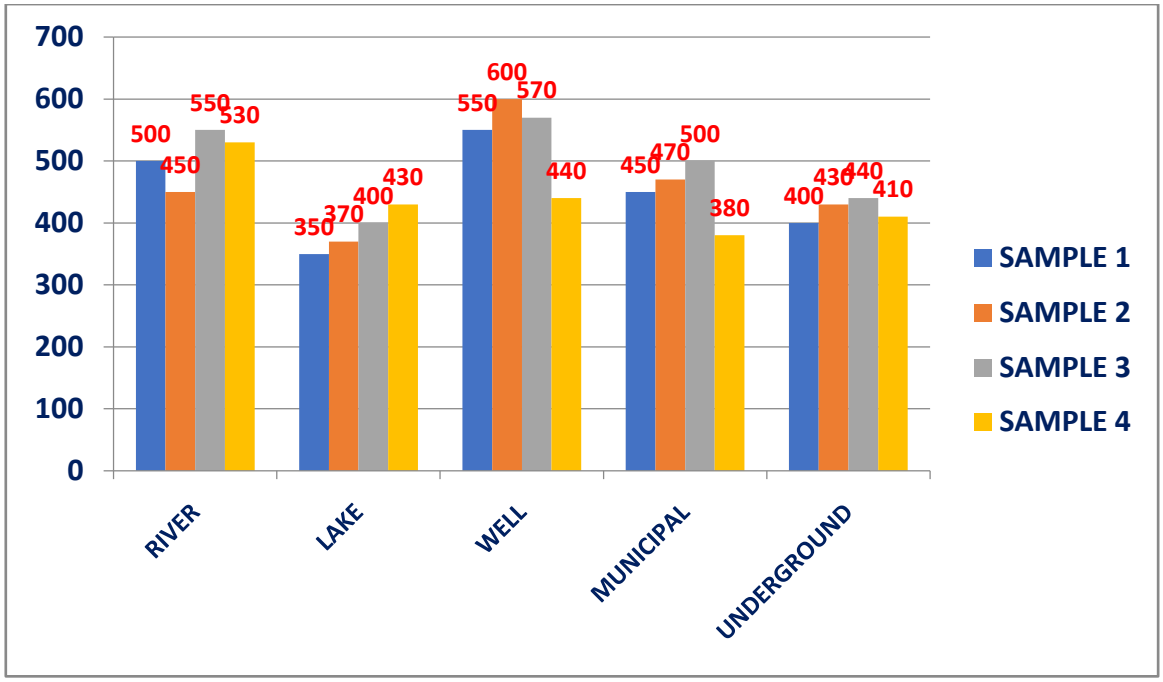
pH value (0-14)



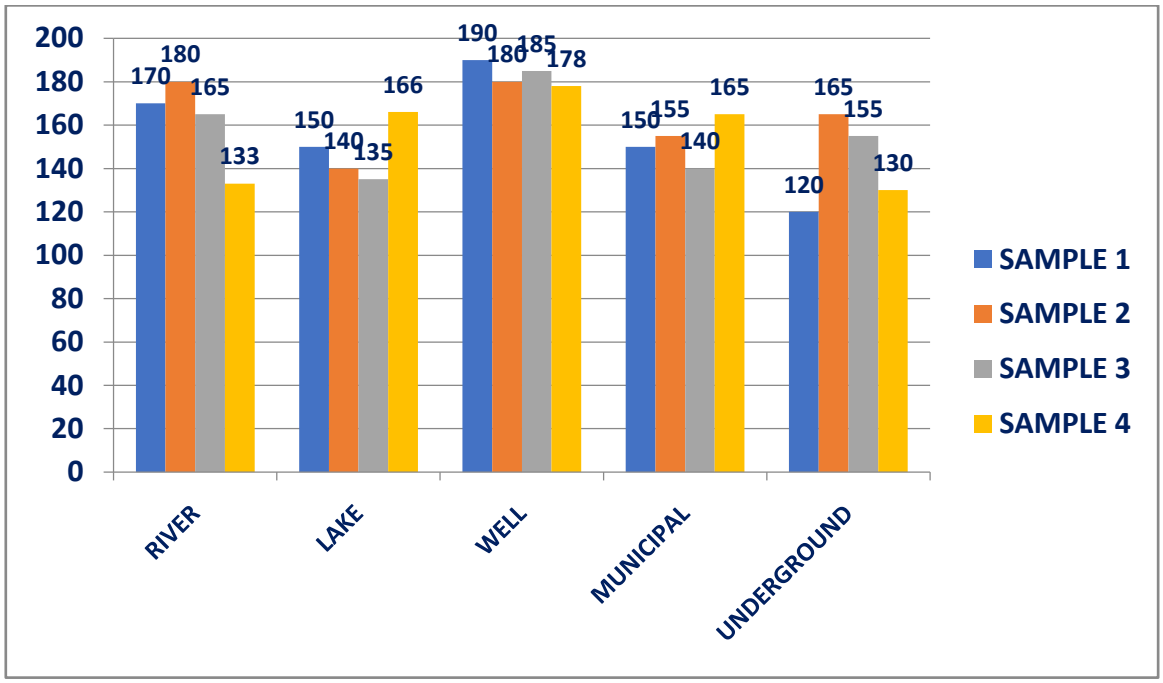
TEMPERATURE (DEGREE CELSIUS)



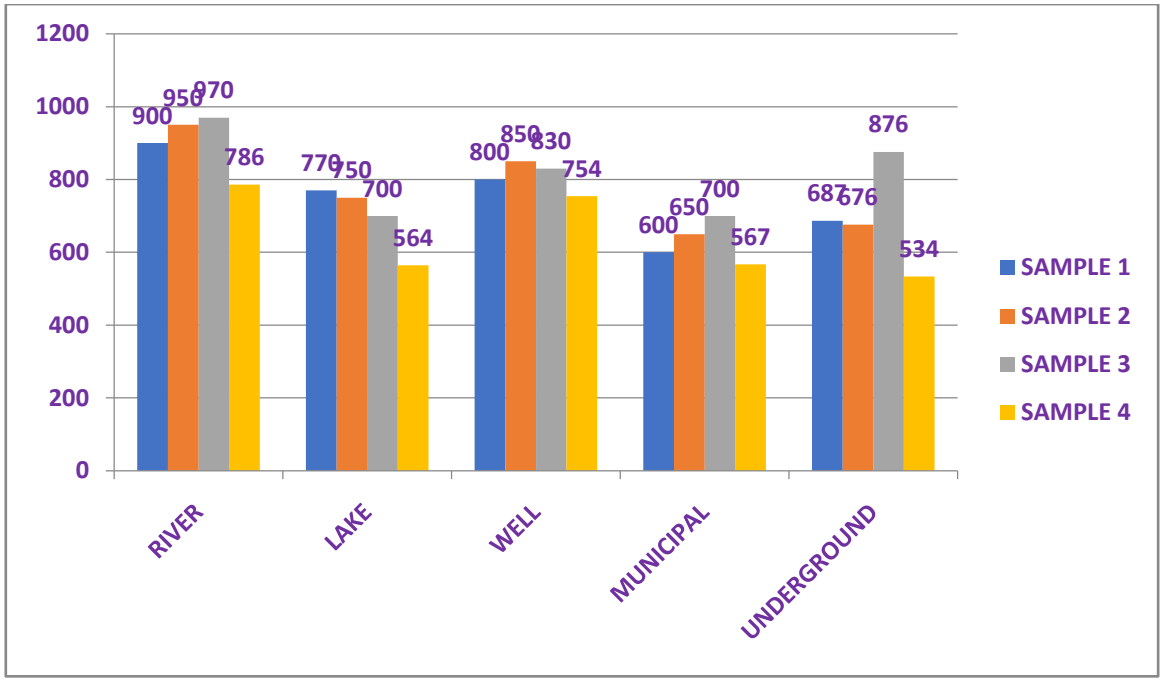
ALKANITY (mg/l or ppm)



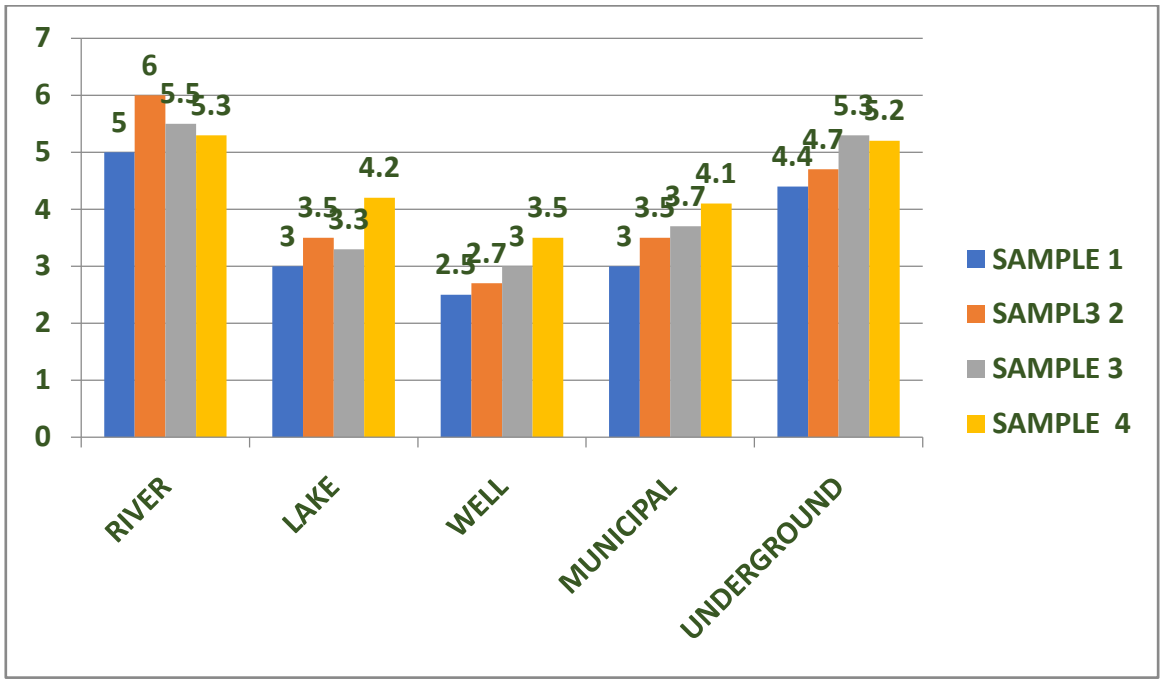
TOTAL HARDNESS (ppm or mg/l as CaCO3)



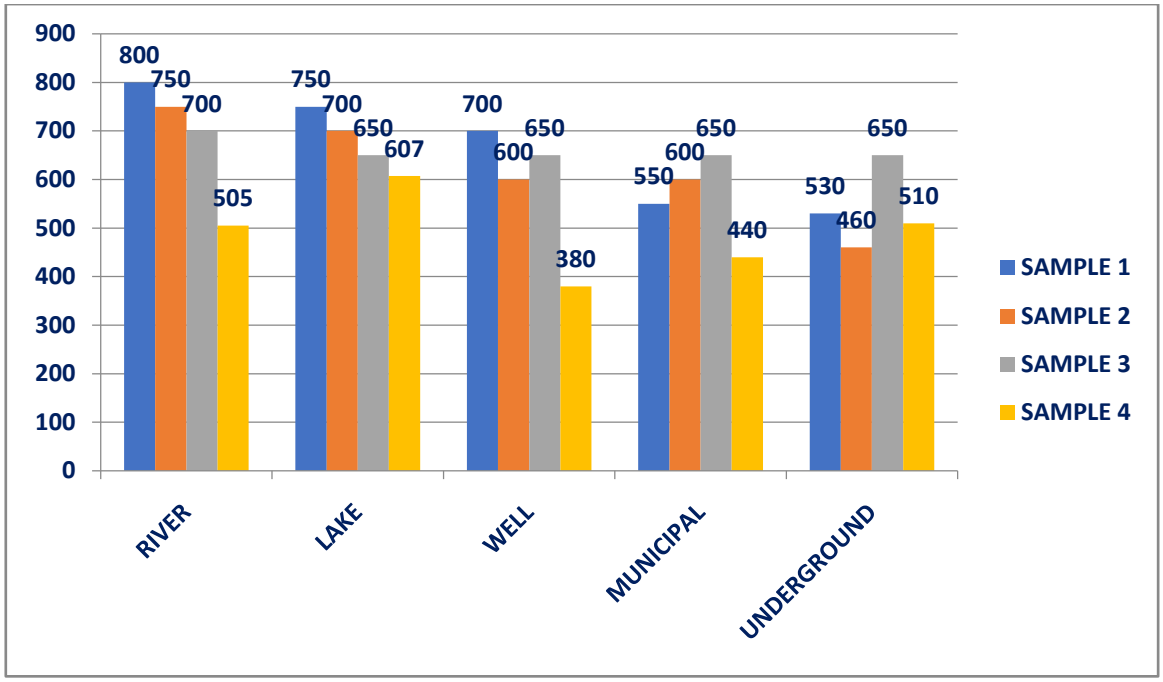
ELECTRICAL CONDUCTIVITY (micro S /CM)



TURBIDITY (NTU)

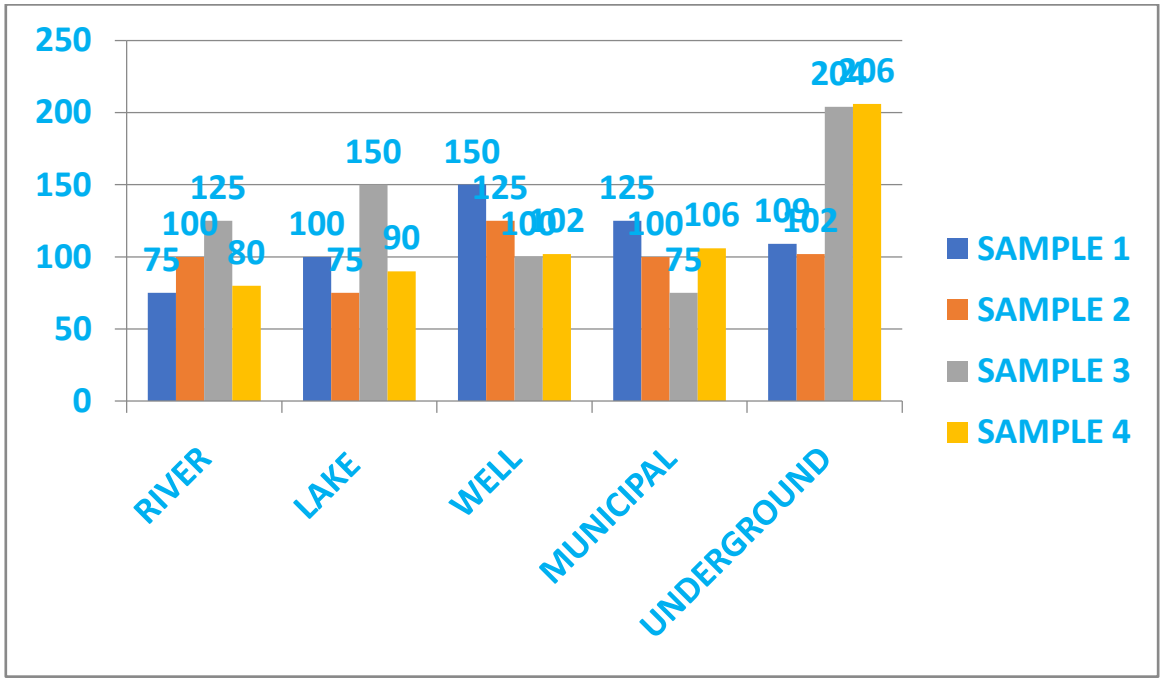


TOTAL DISSOLVED SOLIDS (TDS) in mg/l

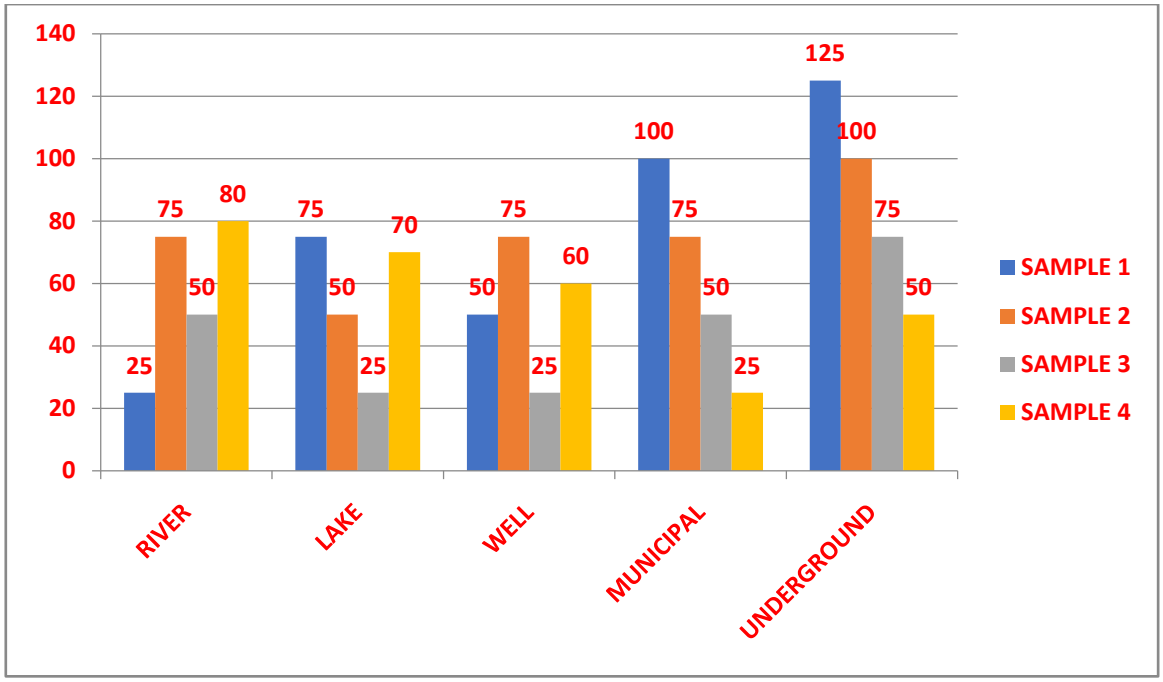


CHEMICAL PARAMETERS

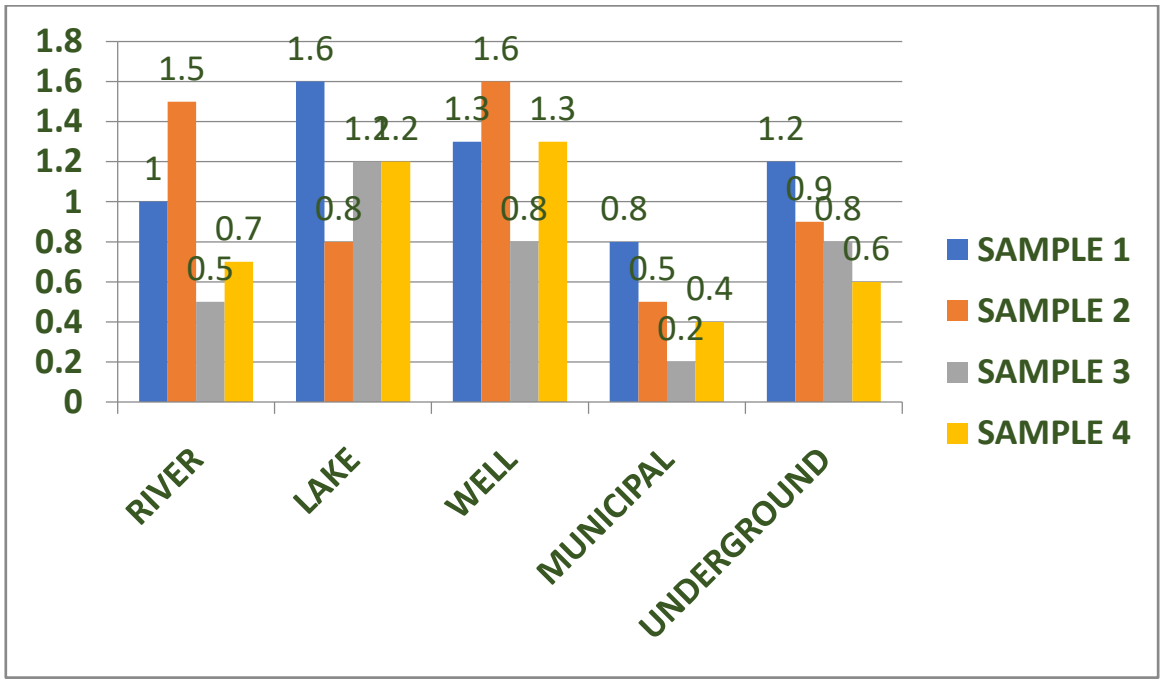
HARDNESS in (mg/l or ppm) as CaCO3



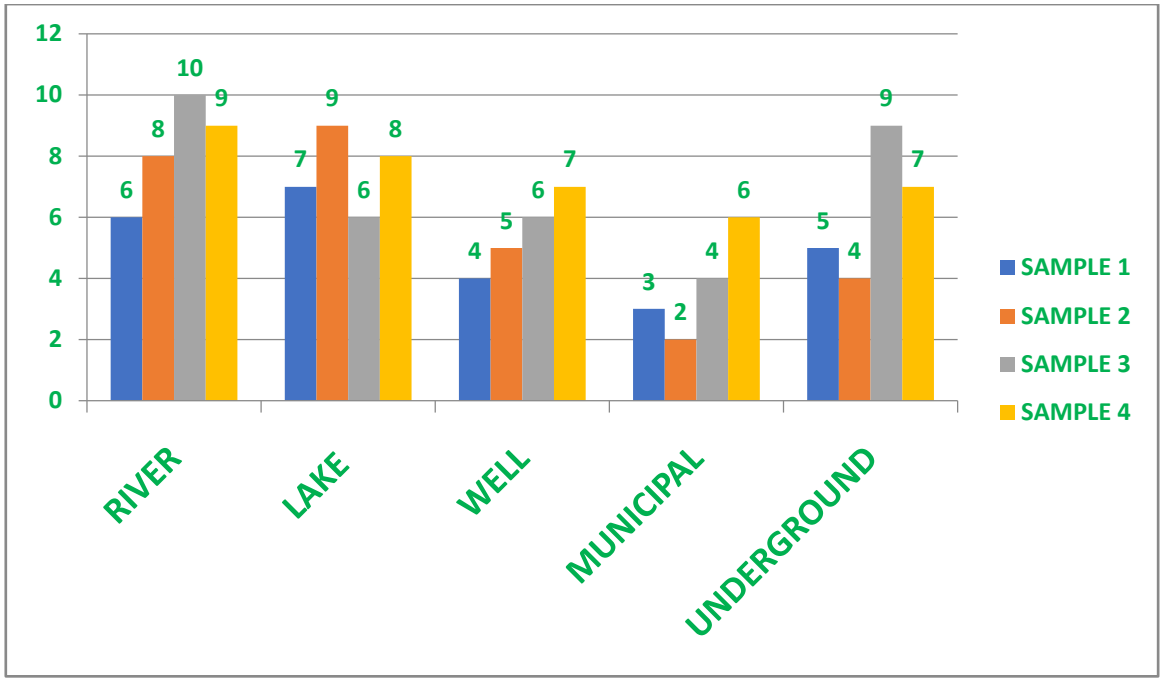
CHLORINE (Cl) in mg/l



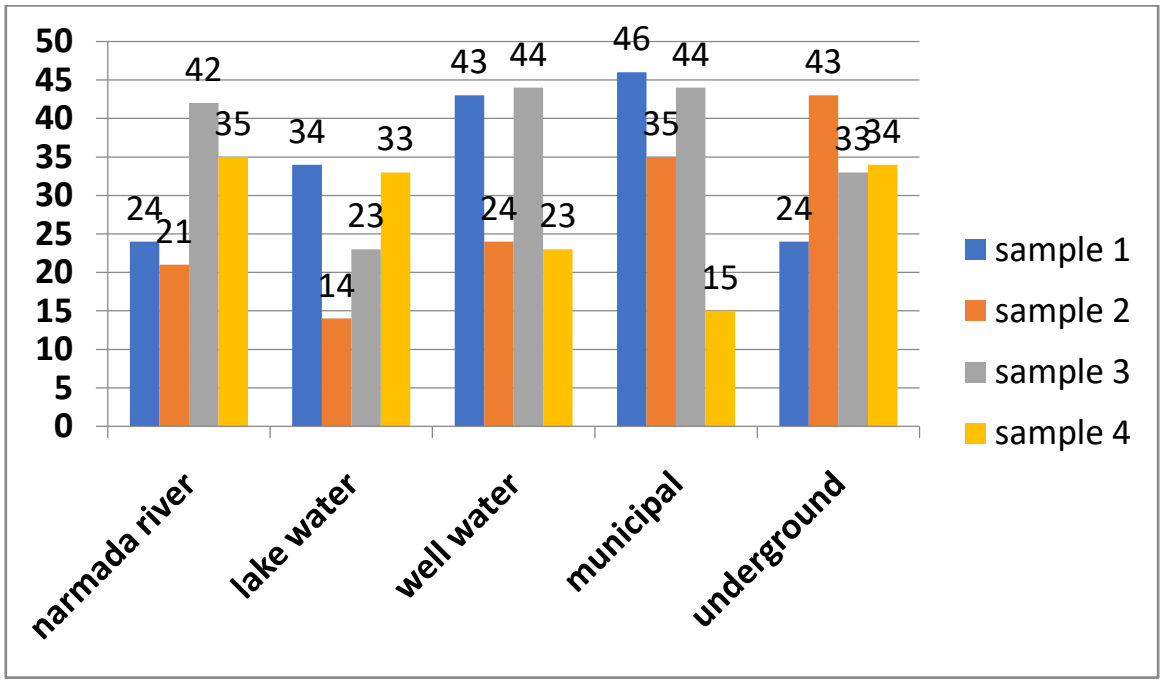
FLUORINE (F) in mg/l



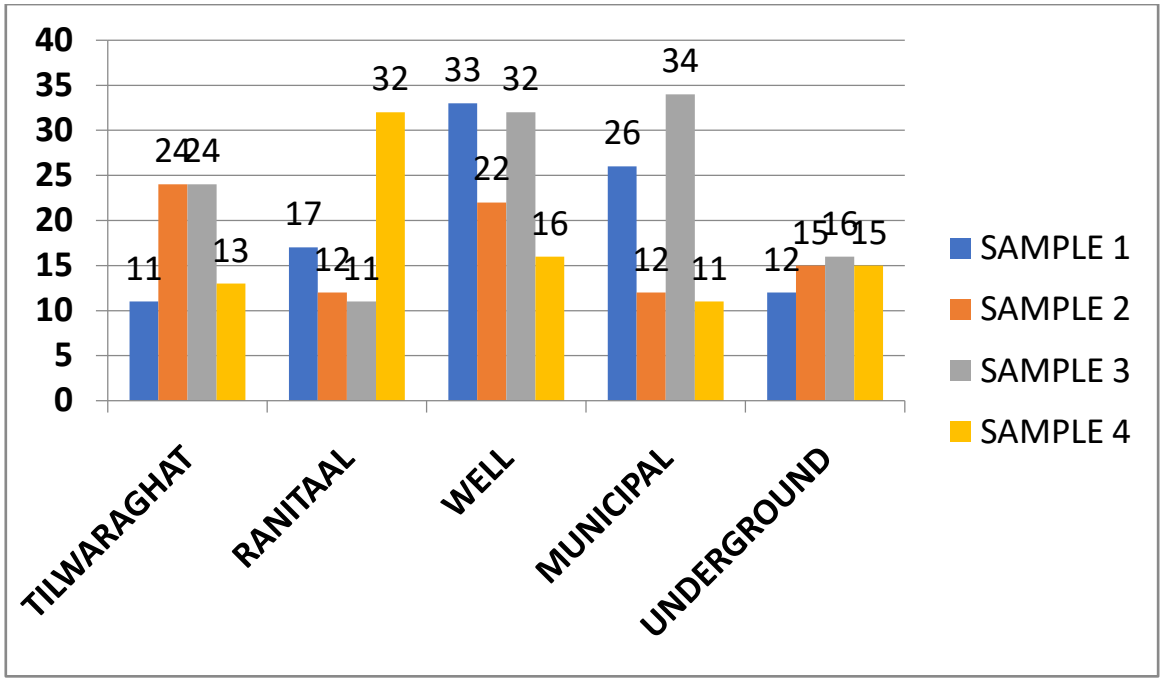
NITRATE (NO3) in mg/l



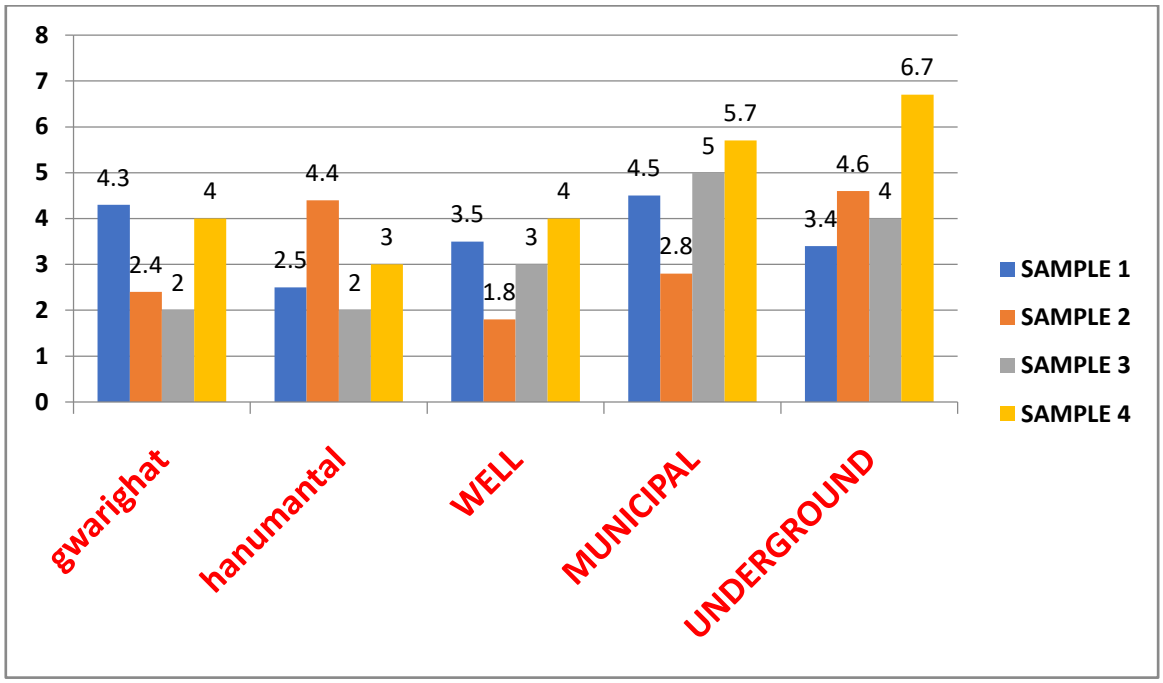
SULPHATE (SO4) in mg/l



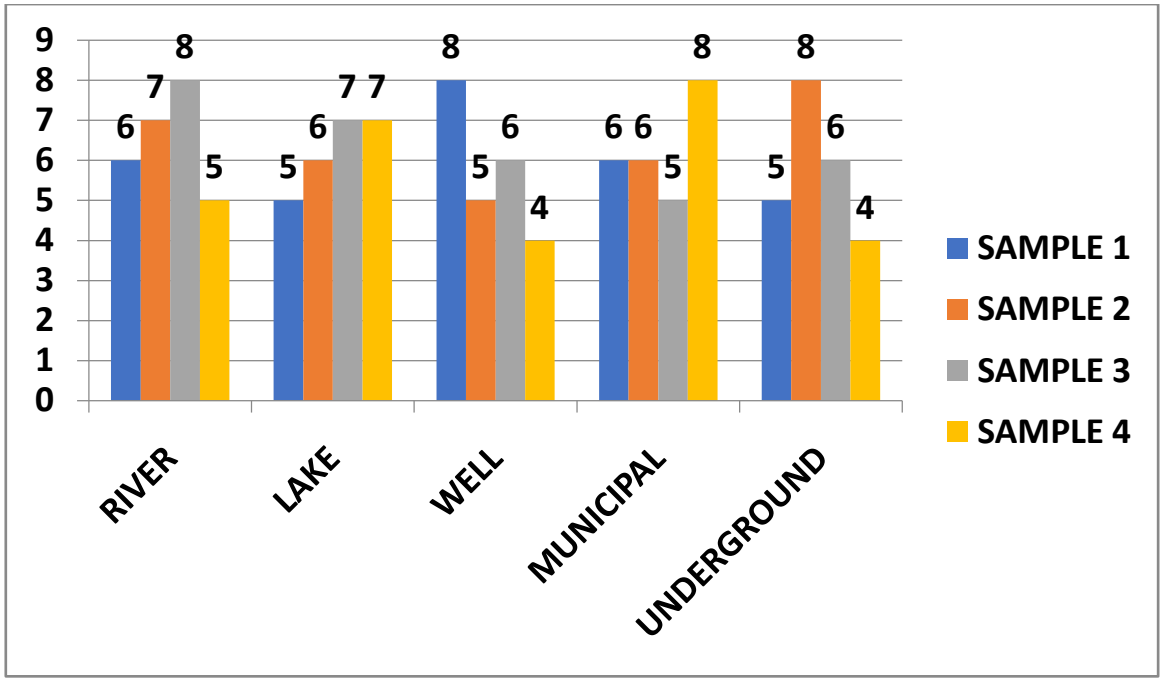
MAGNESIUM (Mg) in mg/l



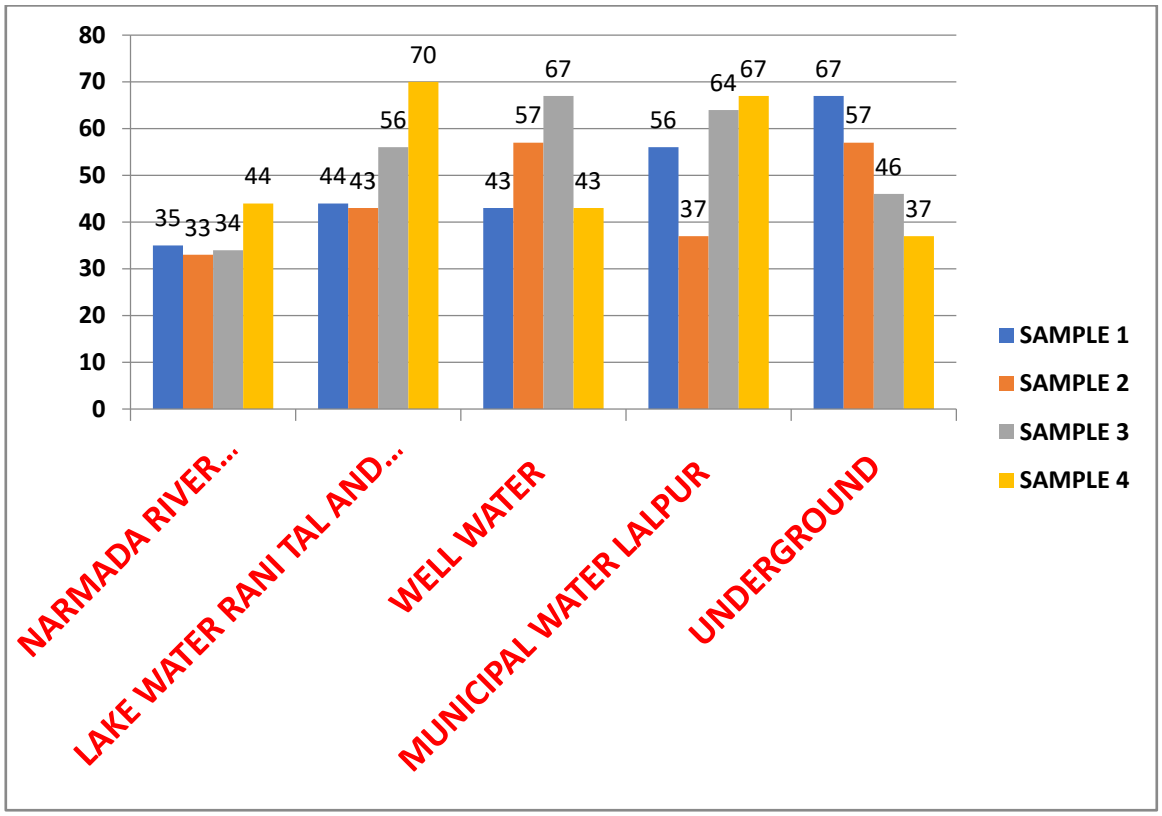
IRON (FE) in mg/l



DISSOLVED OXYGEN (DO) in mg/l



CALCIUM (Ca) in mg/l



: The results indicate that the water quality is generally safe for human health, with minimal risk of waterborne diseases. Here are some key interpretations:

Absence of harmful bacteria: The low levels of total coliform and fecal coliform bacteria indicate a low risk of waterborne illnesses like cholera, dysentery, and typhoid fever.

Safe pH levels: The pH range (7.2-8.5) is within the acceptable limits, ensuring that the water is not too acidic or basic, which can be harmful to human health.

Adequate mineral content: The levels of calcium, magnesium, and potassium are within recommended ranges, indicating that the water provides essential minerals for human health.

Low risk of nutrient-related illnesses: The low levels of nutrients like nitrogen and phosphorus reduce the risk of algal blooms, which can produce toxins harmful to humans.

No significant organic pollution: The low levels of total organic carbon (TOC) and ultraviolet absorbance (UV Abs) indicate minimal organic pollution, reducing the risk of waterborne diseases.

Regular monitoring is crucial to ensure continued water quality and safety.

Vulnerable populations (e.g., pregnant women, young children, and immune compromised individuals) may still be at risk from even low levels of contaminants.

Aesthetic parameters like taste, odor, and color may still be affected by naturally occurring substances or treatment processes.

Overall, the results suggest that the water is safe for human consumption, but ongoing monitoring and testing are necessary to ensure continued water quality and public health.

Identification of Sources of Pollution:

Agricultural runoff: Nutrient-rich fertilizers and pesticides from nearby farms are entering the water supply, contributing to elevated nutrient levels.

Urban runoff: Stormwater from urban areas is carrying pollutants like heavy metals, bacteria, and trash into the water supply.

Industrial activities: Nearby industrial sites are releasing chemicals and heavy metals into the water supply.

Wastewater treatment plant effluent: The wastewater treatment plant is not effectively removing contaminants, leading to their presence in the water supply.

Key findings:

Nutrient levels are elevated, posing a risk of algal blooms and waterborne illnesses.

Bacterial contamination is present, highlighting the need for improved wastewater treatment and sanitation.

Heavy metals are detected, necessitating industrial pollution control and monitoring.

Recommendations:

Implement agricultural best management practices and urban runoff management systems.

Upgrade wastewater treatment infrastructure and enforce industrial regulations. -

Enhance public education and outreach programs.

Regularly monitor water quality and adjust strategies as needed.

Outcomes

Identification of water quality trends and patterns in Jabalpur district, highlighting areas of concern and potential health risks.

Determination of the most critical physical and chemical parameters affecting water quality in the region.

Evaluation of the effectiveness of current water treatment processes and infrastructure in removing contaminants and improving water quality.

Development of recommendations for improving water quality management practices, including potential treatment technologies and monitoring strategies.

Contribution to the development of evidence-based policies and guidelines for drinking water quality management in India, with potential implications for national and international water quality standards.

Enhanced understanding of the relationships between water quality, public health, and sustainable development, informing future research and interventions in the field