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Physicochemical Analysis Of Bore Water Sample Of Traffic Area And Non Traffic Area In Coimbatore District: A Research

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Abstract: For domestic, agricultural, and industrial purposes, groundwater is an essential supply of fresh water in India, particularly in regions with inadequate surface water infrastructure. Groundwater quality in Coimbatore, Tamil Nadu, a fast-growing metropolis renowned for its textile industries, is being weakened by pollution from sewage, automobile emissions, industrial discharges, and agricultural runoff. The physicochemical properties of borewell water from western Coimbatore's non-traffic and traffic-congested areas are compared in this study. To evaluate water quality and comprehend the impact of human activity, parameters including pH, TDS, hardness, chloride, and microbiological content were examined. The study emphasises the influence of urbanisation and traffic-related pollution on groundwater, pointing out notable variations in water quality between the two zones.

KEYWORD- Groundwater quality, Borewell water, Physicochemical analysis, Urban pollution, Traffic areas, Coimbatore, Water contamination, Sustainable water management, Industrial effluents, Microbial content.

I. Introduction

Groundwater is an essential source of fresh water, particularly in developing countries like India, where it full fills domestic, agricultural, and industrial needs. In rural regions, around 88% of the safe drinking water supply is derived from groundwater due to limited water infrastructure (Suresh et al., 2021). Borewell water, as a primary source in both rural and urban settings, plays a vital role in meeting daily water demands (Chowdhury & Saha et al., 2019). However, its quality is under increasing threat from human activities, pollution, and overextraction. Groundwater is stored beneath the Earth's surface in aquifers and replenished through infiltration. But increased extraction and contamination hinder its natural recharge and deteriorate its quality. In urban areas, pollutants from industrial, vehicular, and domestic sources often reach groundwater, posing serious public health risks (Singh et al., 2018). Key water quality indicators such as pH, Total Dissolved Solids (TDS), hardness, chloride levels, and microbial content are critical for assessing groundwater's suitability for consumption and understanding its environmental and health implications.

Coimbatore, a rapidly urbanizing and industrializing city in Tamil Nadu, is known for its textile industries, silk weaving, and temples. While development has contributed to economic growth, it has also led to increased environmental degradation. Groundwater sources in the region are increasingly contaminated by municipal sewage, dyeing effluents, industrial discharges, and agricultural runoff (Kumar & Dahiya et al., 2017). The natural topography contributes to groundwater hardness, but anthropogenic activities further degrade water quality. In western Coimbatore, both traffic-congested and non-traffic areas are densely populated with small-scale and dyeing industries. Traffic areas suffer from high levels of pollution due to vehicular emissions, improper waste disposal, and runoff, all of which contribute to groundwater contamination (Mohan et al., 2020). Non-traffic areas, often rural or semi-urban, experience fewer pollutants and exhibit distinct water quality characteristics (Alappat et al., 2020). This study aims to compare the physicochemical characteristics of borewell water from traffic and non-traffic areas in Coimbatore, shedding light on the impact of urbanization, industrialization, and traffic on groundwater. By evaluating key water parameters and sanitary conditions, this research will offer insights into pollution sources and guide sustainable water management strategies in urban environments.

II. AIM

1. To compare and analyze the physicochemical properties of borewell water from traffic and non-traffic areas in Coimbatore District, assessing parameters like pH,
2. DO, TDS, chloride, heavy metals, and others to evaluate the impact of traffic pollution and determine water suitability for domestic use.

III. MATERIALS

Water Sampling Materials:

- Sampling Bottles (Glass or Plastic), Sterile Container, Cooler/Insulated Box, Gloves and Personal Protective Equipment (PPE)

Instruments used for analysis:

- pH Meter, Dissolved Oxygen Meter, TDS Meter, Chloride Test Kits, Heavy Metal Analysis, Atomic Absorption Spectrophotometer (AAS) or Inductively, Coupled Plasma Mass Spectrometry (ICP-MS), Hardness Test Kits.

IV. CHEMICALS AND REAGENTS

- pH Buffers, Chloride, Hydrochloric acid, Nitric acid, Glycerin, Sodium, Hydroxide, and Potassium Chromate

V.EXPERIMENTAL PROCEDURE

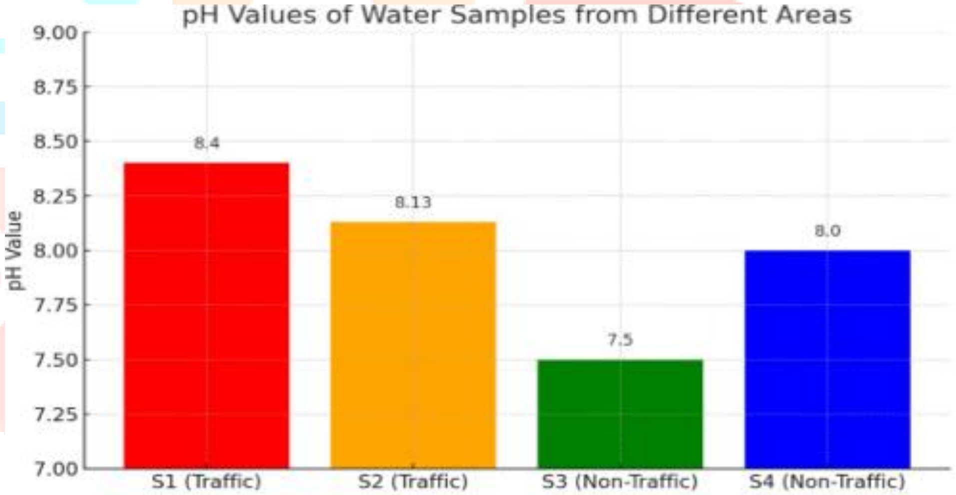
1. pH Test

Method: pH Meter

Procedure:

1. **Calibrate the pH meter**: Before measuring, you need to calibrate the pH meter with standard buffer solutions.
2. **Measure the sample**: Immerse the pH electrode into the water sample, ensuring the electrode is fully submerged. Stir the sample gently to ensure uniformity.
3. **Read the pH**: The pH value will be displayed on the meter. If the reading is below 7, the water is acidic; if above 7, it is alkaline.
4. **Clean the electrode** after each test to avoid cross-contamination.

- Considered a significant ecological element, pH offers a crucial component and piece of information in many kinds of geochemical equilibrium or solubility calculations. Since the majority of aquatic life is acclimated to an acidic environment, pH is a crucial parameter in water bodies. do not tolerate sudden changes and have an average pH. The pH scale has a range of 7.5 to 8.4. The pH range of 6.5 to 8.5 is the upper limit for drinking water. The pH indicates a mild alkalinity. In general, the geology of the catchment region and the water's buffering capability affect the pH of the water.



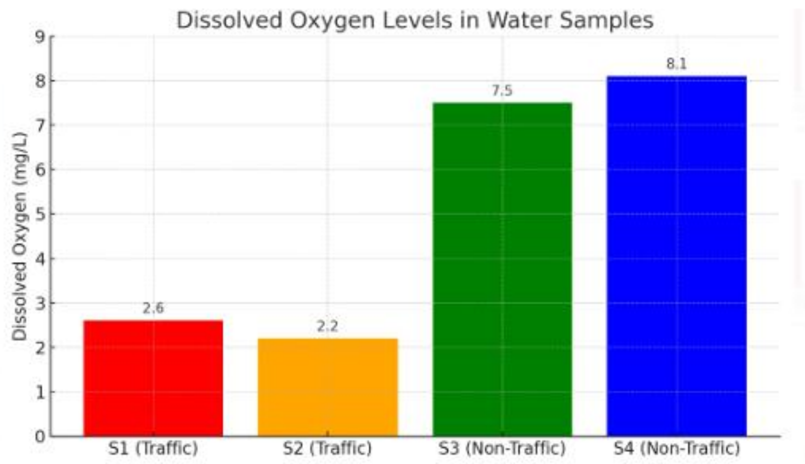
2. Dissolved Oxygen (DO) Test

Method: Winkler's Titration Method

Procedure:

1. **Prepare the sample**: Fill a BOD bottle completely with water, ensuring no air bubbles are trapped.
2. **Add reagents**: Add Manganese sulfate ($MnSO_4$) and alkali-iodide-azide reagent to the sample. The sample will turn brown due to the reaction between oxygen and manganese salts.
3. **Add sulfuric acid**: After mixing, add sulfuric acid to dissolve the precipitate, releasing iodine.
4. **Titrate**: Titrate the sample with a sodium thiosulfate solution, using starch as an indicator to detect the endpoint (when the sample turns colorless).
5. **Calculate DO**: The amount of sodium thiosulfate used corresponds to the amount of dissolved oxygen, which can be calculated using a known formula.

- The physical and biological activities that are present in the water are reflected in dissolved oxygen, a crucial criterion in the evaluation of water quality. The level of contamination in water bodies is indicated by the DO levels. The range of DO values was 2.2 to 8.1. The S1 and S2 sample points revealed low DO readings, suggesting significant organic matter pollution.



3. Total Dissolved Solids (TDS) Test:

Method: TDS Meter

Procedure:

1. **Calibrate the TDS meter**: Follow the manufacturer's instructions for calibration using standard solutions.
2. **Measure the sample**: Immerse the TDS meter probe into the water sample and stir gently.
3. **Read the TDS**: The meter will give the TDS value in parts per million (ppm). Higher TDS values indicate more dissolved solids, which may affect water taste and quality.

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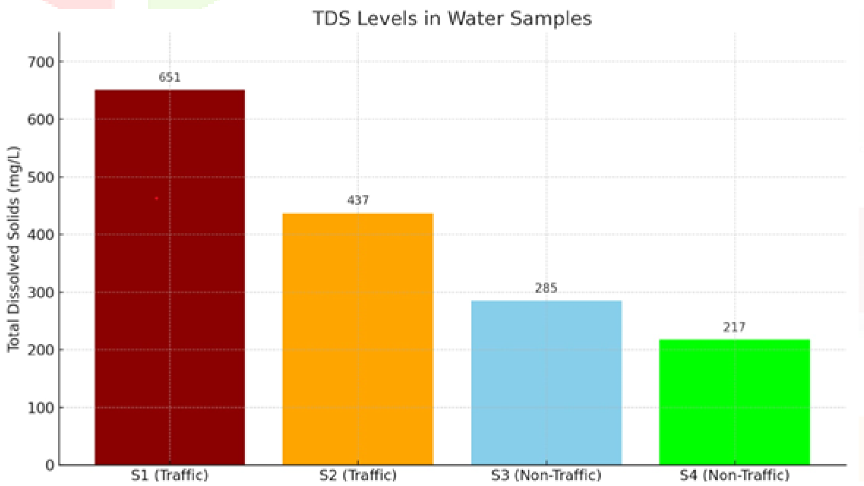


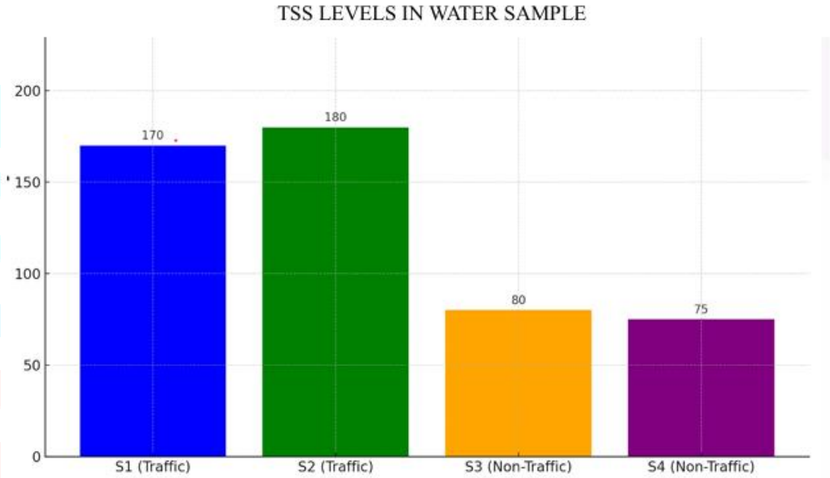
4. Total Suspended Solids (TSS) Test:

Method: Filtration Method

Procedure:

1. **Filter the sample**: Take a known volume of the water sample and filter it through a pre-weighed filter paper.
2. **Dry the filter**: Place the filter paper with the collected solids in an oven at 103–105°C for 1–2 hours to dry completely.
3. **Weigh the filter paper**: After drying, cool the filter in a desiccator and weigh it again.
4. **Calculate TSS**: The increase in mass of the filter paper represents the total suspended solids in the water. The TSS is expressed as mg/L (milligrams per liter) by dividing the increase in weight by the volume of water filtered.

- High TSS levels in S1 and S2 could be a sign of water contamination from industrial effluents, traffic carbon emissions, or other sources. The efficiency of water treatment procedures may also be impacted by high TSS. Low TSS levels are often regarded as good water in S3 and S4. quality, unchanged from the traffic area



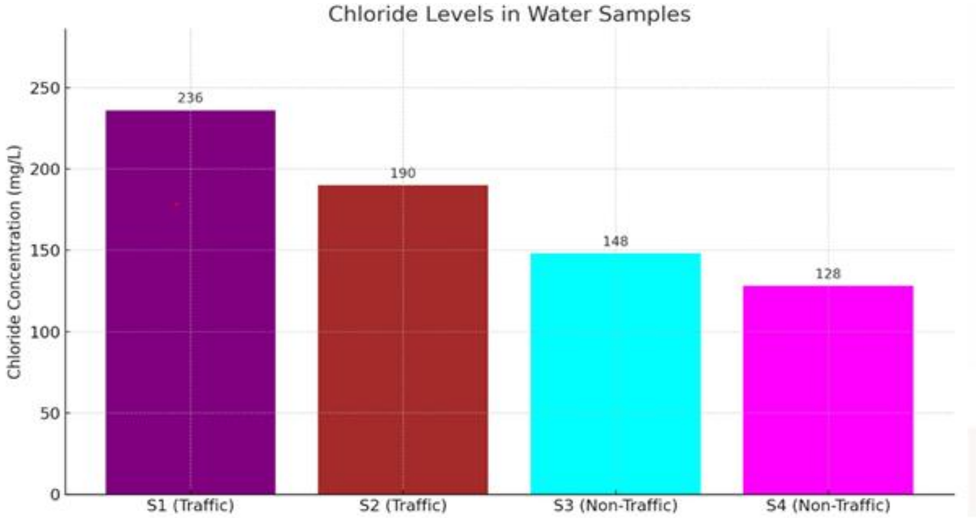
5. Chloride Test:

Method: Silver Nitrate Titration (Mohr's Method)

Procedure:

1. **Add reagents**: Take a known volume of water and add potassium chromate solution (which acts as an indicator).
2. **Titrate with silver nitrate**: Add silver nitrate solution drop by drop to the sample. Chloride ions will react with silver ions, forming silver chloride precipitate.
3. **Color change**: When all chloride has reacted, the addition of silver nitrate will cause the solution to turn red-brown, signaling the endpoint.
4. **Calculate chloride concentration**: The volume of silver nitrate used is used to calculate the chloride concentration.

- Areas with high traffic volumes had noticeably higher chloride concentrations. The widespread use of de-icing agents on roadways, industrial runoff, and other urban pollution sources could all be to blame for this rise. High levels of chloride are problematic because they can hasten the deterioration of water supply infrastructure and lower the quality of water suitable for household use. Non-traffic areas, on the other hand, showed relatively lower chloride concentrations, most likely as a result of fewer vehicle emissions, fewer industrial operations, and less urban runoff.



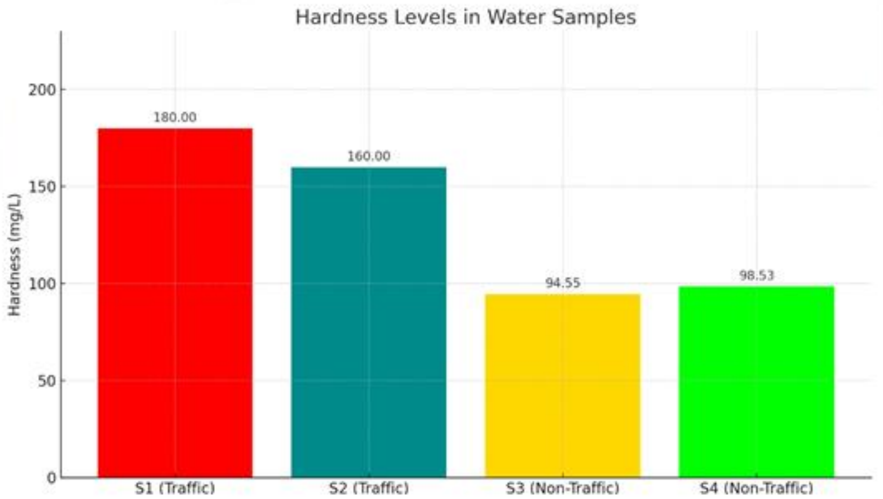
6. Hardness Test:

Method: EDTA Titration Method

Procedure:

1. **Prepare the sample**: Take a known volume of the water sample.
2. **Add buffer**: Add a buffer solution to maintain the pH at around 10.
3. **Add indicator**: Add Eriochrome Black T, which forms a red complex with calcium and magnesium ions.
4. **Titrate with EDTA**: Titrate the sample with a standard EDTA solution. The endpoint is reached when the red color changes to blue, indicating that all calcium and magnesium ions have reacted with EDTA.
5. **Calculate hardness**: The volume of EDTA used can be used to calculate hardness in mg/L as Ca CO_3 (calcium carbonate).

- According to ISI, the total hardness must not exceed 300 mg/L of $CaCO_3$. All four samples showed varying trends in the total hardness value. The total hardness values that were observed fell within the acceptable range. S1's TH value is 180 mg/L, which is higher than S3's (94.5 mg/L).



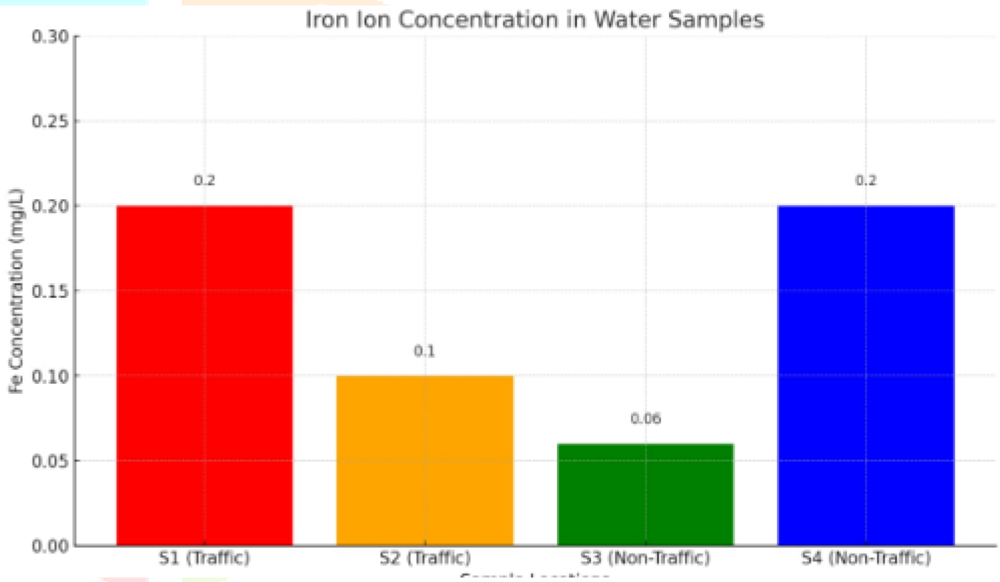
7. Iron Test:

Method: Phenanthroline Method

Procedure:

1. **Prepare the sample**: Take a known volume of the water sample.
2. **Reduce iron**: If the iron is in the ferric state, add a reducing agent like hydroxylamine hydrochloride to convert it to the ferrous form.
3. **Add phenanthroline**: Add phenanthroline reagent, which forms a red-colored complex with ferrous iron.
4. **Measure absorbance**: Use a spectrophotometer to measure the absorbance of the sample at 510 nm. The concentration of iron is proportional to the absorbance.
5. **Calculate iron concentration**: Use a standard calibration curve to determine the iron concentration in the sample.

- All tested samples had iron levels that were within permissible bounds. Iron testing is still necessary, though, especially in Coimbatore's industrially influenced areas, which include both traffic and non-traffic zones. Iron can be introduced into groundwater sources, and if the concentration is higher than allowed, it can cause a number of problems like bad taste, discolouration, fabric and utensil stains, and the growth of iron bacteria, which can clog water systems and degrade water quality.



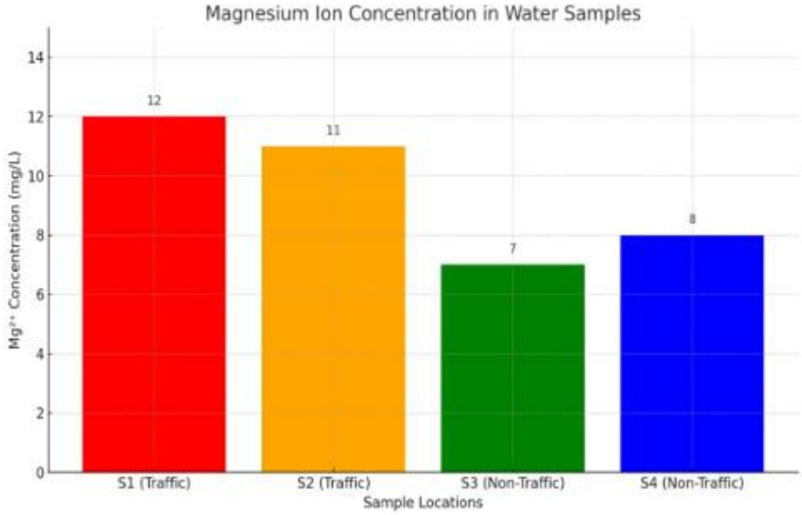
8. Magnesium Test:

Method: EDTA Titration Method

Procedure:

1. **Prepare the sample**: Take a known volume of water.
2. **Add buffer**: Add a buffer solution to keep the pH at around 10.
3. **Add indicator**: Use Eriochrome Black T as an indicator.
4. **Titrate with EDTA**: Titrate with EDTA, which will bind to the magnesium ions. The endpoint is marked by a color change from red to yellow.
5. **Calculate magnesium concentration**: The volume of EDTA used can be used to calculate magnesium concentration

- You can get a better idea of the hardness, potential health risks, and general suitability for consumption of magnesium water samples by testing them. Addressing regional water treatment methods is also crucial to guaranteeing that the water supplied is clean and complies with mandatory drinking and usage guidelines.



VI. CONCLUSION

Testing/sample	S1	S2	S3	S4
ph	8.4	8.13	7.5	8.0
DO	2.6mg/L	2.2 mg/L	8.3 mg/L	8.1 mg/L
TDS	651 mg/L	437 mg/L	285 mg/L	217 mg/L
TSS	170 mg/L	180 mg/L	80 mg/L	75 mg/L
Chloride	236 mg/L	190 mg/L	148 mg/L	128 mg/L
Hardeness	180 mg/L	160 mg/L	94.55 mg/L	98.53 mg/L
Iron	0.2 ppm	0.1 ppm	0.06 ppm	0.2 ppm
magnesium	12 ppm	11 ppm	7 ppm	8 ppm

pH:

- In general, the pH values of borewell water gathered from both non-traffic and traffic-congested areas stayed within the acceptable ranges established for potable water. Nonetheless, samples from areas with high traffic showed somewhat higher pH values, suggesting a slightly more alkaline environment. circumstances. Anthropogenic factors like pollution from industrial discharges, vehicle emissions, and surface runoff that contains acidic compounds—all of which have the potential to gradually seep into groundwater sources—are probably to blame for this deviation.

Dissolved oxygen (DO):

- In comparison to non-traffic areas, dissolved ion concentrations were lower in areas with high traffic. Frequent surface runoff and impervious surfaces like concrete and asphalt in traffic zones prevent mineral-rich water from penetrating the ground, lowering ion levels. accumulation. On the other hand, higher levels of dissolved ions are produced in non-traffic areas with more natural or permeable surfaces because more water can percolate through the rocks and soil. The mineral content of groundwater is increased by these high ion concentrations, which may affect its flavour and suitability for domestic use.

Total dissolved solids (TDS):

- Areas with a lot of traffic had higher levels of total dissolved solids than areas without. The accumulation of pollutants from road dust, industrial discharges, urban runoff, and vehicle emissions all of which contribute different dissolved substances is the cause of this increase. to the water. Additionally, the direct transport of pollutants into water bodies without natural filtration is made easier by the presence of impermeable surfaces in traffic areas. Lower TDS concentrations in non-traffic areas indicate relatively cleaner water because of less anthropogenic activity and improved natural filtration through the soil.

Total suspended solids:

- Compared to non-traffic areas, total suspended solids were substantially higher in traffic areas. This is brought on by an increase in surface runoff that carries solid pollutants that are frequently found in urban settings, such as dust, debris, tyre fragments, and construction waste. Constant vehicle Fine particulate matter is suspended in water sources due to movement and industrial activity. On the other hand, less erosion and sedimentation occur in non-traffic areas with less disturbance and better vegetation cover, which lowers the amount of suspended solids in the water.

Chloride:

- Areas with high traffic volumes had noticeably higher chloride concentrations. The widespread use of de-icing agents on roadways, industrial runoff, and other urban pollution sources could all be to blame for this rise. Concerns arise from elevated chloride levels because they can accelerate the deterioration of water supply infrastructure and jeopardise the quality of household water. Conversely, non-traffic areas had relatively lower chloride concentrations, most likely as a result of fewer automobile emissions, fewer industrial operations, and less urban runoff.

Hardness:

- Traffic-heavy areas had harder water than non-traffic areas. Road surfaces, building materials, and industrial operations all contribute to increased mineral runoff, which introduces calcium and magnesium ions into adjacent water sources. Higher hardness levels brought on by the buildup of these ions can result in plumbing system scaling, lower water heater efficiency, and higher maintenance expenses. The lack of these urban influences in non-traffic areas lowers mineral input and, consequently, water hardness.

Iron:

- Iron concentrations were high in both traffic and non-traffic areas, with the levels largely influenced by the presence of industrial activities rather than vehicular movement alone. Industries that utilize or discharge iron-containing materials contribute significantly to iron contamination in nearby water sources. Corrosion of pipelines and metal infrastructure further adds to iron content in water.

Regardless of traffic density, areas with industrial presence showed elevated iron levels, which can cause staining of surfaces, affect water taste, and increase water treatment requirements

Magnesium:

- Areas with a lot of traffic had higher magnesium concentrations than areas without. Urban runoff from roads and construction sites, which frequently contain materials high in magnesium, like cement, asphalt, and dust from concrete, is to blame for this increase. infrastructure. Furthermore, industrial operations that are frequently found in areas with high traffic volumes may be a factor in the release of magnesium into adjacent water sources. Lower magnesium levels are the result of less urbanisation and anthropogenic inputs in non-traffic areas.

The "Physicochemical Analysis of Borewell Water Samples of Traffic and Non-Traffic Areas in Coimbatore" project looks into how pollution from traffic and urbanisation affects the quality of groundwater. Both high and low traffic areas were used to gather borewell water samples, which were then examined for a number of physicochemical characteristics, including pH, dissolved oxygen (DO), total suspended solids (TSS), total dissolved solids (TDS), chlorides, iron, magnesium, and hardness. Traffic-heavy areas had significantly higher levels of TSS, TDS, chlorides, magnesium, and hardness, according to the results. This is probably because of road runoff, vehicle emissions, and other urban pollutants. It's interesting to note that iron concentrations affected both areas equally and were more closely associated with industrial discharges than traffic density.

The study comes to the conclusion that urbanisation and pollution from traffic significantly deteriorate Coimbatore's groundwater quality. It emphasises how urgently better wastewater treatment systems, more stringent traffic laws, and sustainable urban development are needed to lessen pollutant runoff. It's also advised to start a regular groundwater monitoring program and educate the public about the sources of contamination. In general, the results highlight the need for long-term environmental management and proactive pollution control to guarantee the sustainability and safety of groundwater resources in urban areas.

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