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GROUND WATER CHEMISTRY ANALYSIS AND QUALITY ASSESSMENT IN SANGANAR AREA, JAIPUR (RAJASTHAN), INDIA

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Abstract: *Groundwater serves as a primary source of drinking water in semi-arid regions of India, including the Sanganar area of Jaipur. This study evaluates the physicochemical characteristics of groundwater collected from ten sampling locations (W1–W10) between September and December 2023. The samples were analyzed for pH, electrical conductivity (EC), total dissolved solids (TDS), calcium, magnesium, potassium, chloride, nitrate, sulphate, and fluoride using standard analytical methods. The results indicate that pH values are within desirable limits, reflecting slightly alkaline conditions. However, EC and TDS exceed permissible limits at several locations, suggesting elevated ionic concentrations. Magnesium levels are significantly high in most samples, contributing to hardness. Nitrate and fluoride concentrations exceed permissible limits at site W1, posing potential health risks. The study highlights the need for continuous monitoring and effective groundwater management strategies to ensure safe drinking water quality.*

Keywords: -*Groundwater quality; Physicochemical parameters; TDS; EC; Fluoride; Nitrate; Jaipur*

1. Introduction

Groundwater is a crucial natural resource for drinking, agriculture, and industrial applications, particularly in semi-arid regions such as Rajasthan. Rapid urbanization, industrialization, and intensive agricultural practices have significantly influenced groundwater quality (Kumar et al., 2020). Monitoring physicochemical parameters is essential for assessing water suitability for human consumption (Singh et al., 2021).

Parameters such as pH, electrical conductivity (EC), total dissolved solids (TDS), and major ions (Ca^{2+}, Mg^{2+}, K^{+}, Cl^{-}, NO_3^{-}, SO_4^{2-}, F^{-}) are widely used indicators of water quality (WHO, 2017). Elevated nitrate and fluoride levels in groundwater are of particular concern due to their association with health risks such as methemoglobinemia and fluorosis (Sharma & Singh, 2022). Therefore, this study aims to evaluate groundwater quality in the Sanganer region using established standards and recent scientific approaches.

2. Materials and Methods:

2.1 Study Area

The study area, Sanganar in Jaipur (Rajasthan), is characterized by rapid urban expansion and textile industrial activities, which may influence groundwater chemistry.

2.2 Sample Collection

Ten groundwater samples (W1–W10) were collected from bore wells, hand pumps, and ponds during September–December 2023 using pre-cleaned glass bottles (2000 mL capacity)(Table -1). Standard sampling protocols were followed to avoid contamination.

2.3 Analytical Methods

Physicochemical parameters such as pH, EC, and TDS were measured using standard instruments. Major ions including calcium, magnesium, potassium, chloride, nitrate, sulphate, and fluoride were analyzed using standard procedures recommended by APHA (2017) and BIS (2012).

3. Results and Discussion:

The analytical results were compared with standard guidelines (BIS, 2012; WHO, 2017).

The pH of groundwater samples (Figure :1) ranged from 7.5 to 8.2, indicating slightly alkaline conditions. All values fall within the permissible range (6.5–8.5), suggesting suitability for drinking purposes (BIS, 2012).

Electrical conductivity (EC) varied (Figure :2) from 1038 µS/cm to 3750 µS/cm. Six samples exceeded the recommended limit of 1400 µS/cm, indicating high ionic concentration likely due to mineral dissolution and anthropogenic activities (Kumar et al., 2020). Total dissolved solids (TDS) ranged from 163 mg/L to 4250 mg/L (Figure :3). Several samples exceeded the permissible limit of 2000 mg/L, indicating deterioration of water quality in certain locations (Singh et al., 2021). Calcium concentrations (20.8–66.4 mg/L) were within acceptable limits, whereas magnesium concentrations (15.5–650.2 mg/L) exceeded permissible limits in most samples, significantly contributing to water hardness. Potassium concentrations (5.2–12.5 mg/L) remained within safe limits. Chloride levels (10.5–150.3 mg/L) were below the desirable limit, indicating no salinity or sewage contamination. (Figure :4)Nitrate concentrations ranged from 2.9 mg/L to 45.8 mg/L, with one sample slightly exceeding the permissible limit. Elevated nitrate levels may result from agricultural runoff and can pose health risks such as methemoglobinemia (Sharma & Singh, 2022).

Sulphate concentrations (10.5–107.5 mg/L) were within acceptable limits and do not pose health concerns. Fluoride concentrations ranged from 0.1 mg/L to 1.8 mg/L. One sample exceeded the permissible limit of 1.5 mg/L, which may lead to dental or skeletal fluorosis upon prolonged exposure (WHO, 2017). (Figure :5)

Table -1: Various ground water quality parameters of different sampling Areas of Sanganar, Jaipur (Rajasthan –India)

	GW 1	GW2	GW3	GW4	GW5	GW 6	GW 7	GW8	GW9	GW 10	Standard Drinking Water :Specification as per BIS 10500:2012	
											Desirable limit	Permissible limit
pH	7.5	7.8	7.6	7.7	7.6	7.8	7.9	8	7.9	8.2	6.5-8.5	---
EC (us/cm)	3750	3250	1641	1750	1177	1057	1089	1520	1058	3520	300 us/cm	----
TDS (mg/l)	650	780	163	988	748	598	707	4250	845	957	500 mg/l	2000 mg/l
Ca (mg/l)	28	32.5	25.6	44.5	38.6	60.5	48.7	20.8	60.5	66.4	75 mg/l	200 mg/l
Mg (mg/l)	124.5	120.2	650.2	29.5	32.5	45.6	38.5	15.5	17.5	65.2	30 mg/l	100 mg/l
K (mg/l)	7.5	6.6	5.6	12.5	6.8	7.5	10.9	5.2	8.2	6.4	----	----
Cl- (mg/l)	105.2	85.6	10.5	68.6	45.5	110.6	115.4	37.5	150.3	95.4	250 mg/l	1000 mg/l
SO_4^{2-} (mg/l)	35.5	45.5	107.5	38.5	25.5	39.5	37.8	10.5	30.5	60.5	200 mg/l	400 mg/l
NO_3^{-} (mg/l)	45.8	10.5	5.2	2.9	8.5	9.7	12.5	6.5	7.8	38.5	45 mg/l	No relaxation

F^- (mg/l)	1.8	0.56	0.1	1.2	1.1	0.85	0.68	0.72	0.56	0.78	1.1 mg/l	1.5 mg/l

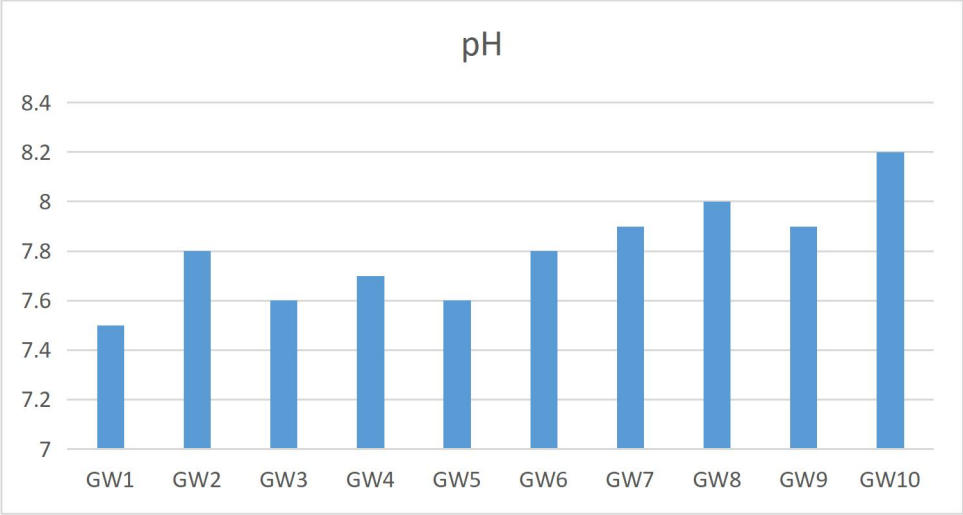


Figure: -1 Variation of pH in different ground water Samples of Sanganar, Jaipur

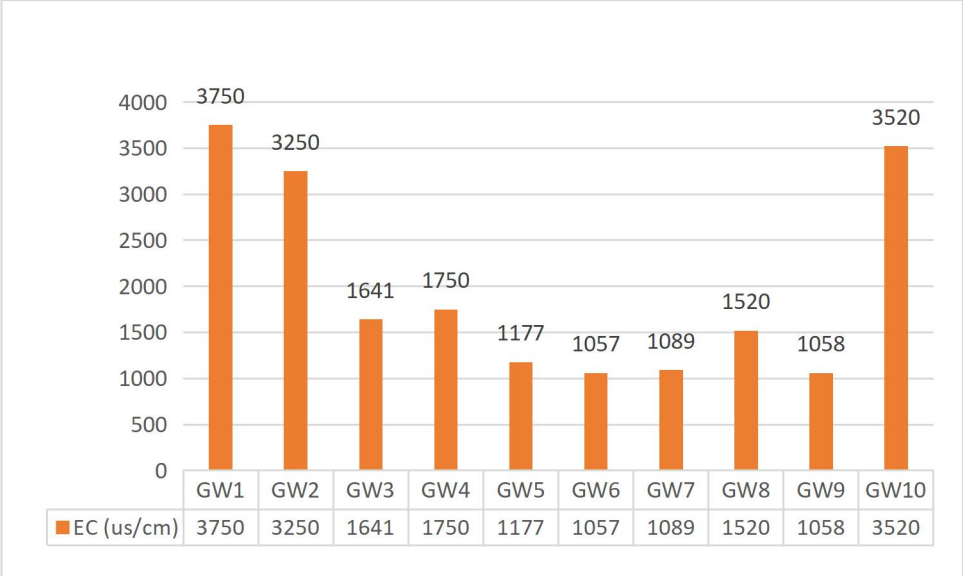


Figure: -2 Variation of EC in different ground water Samples of Sanganar, Jaipur

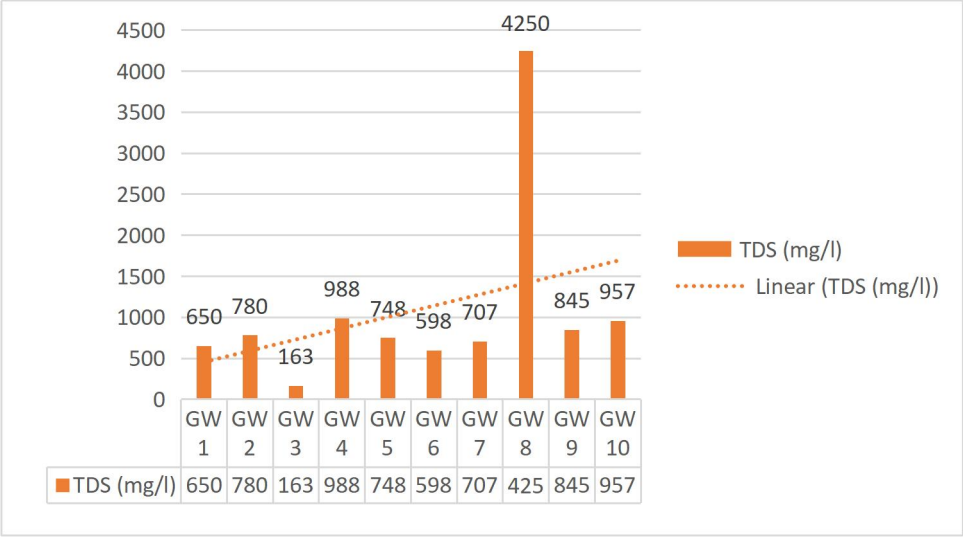
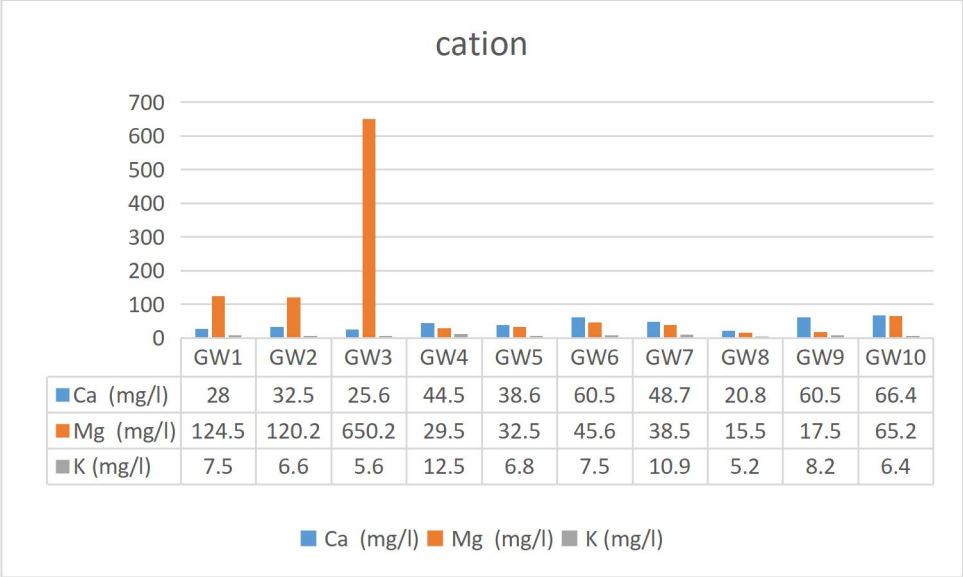
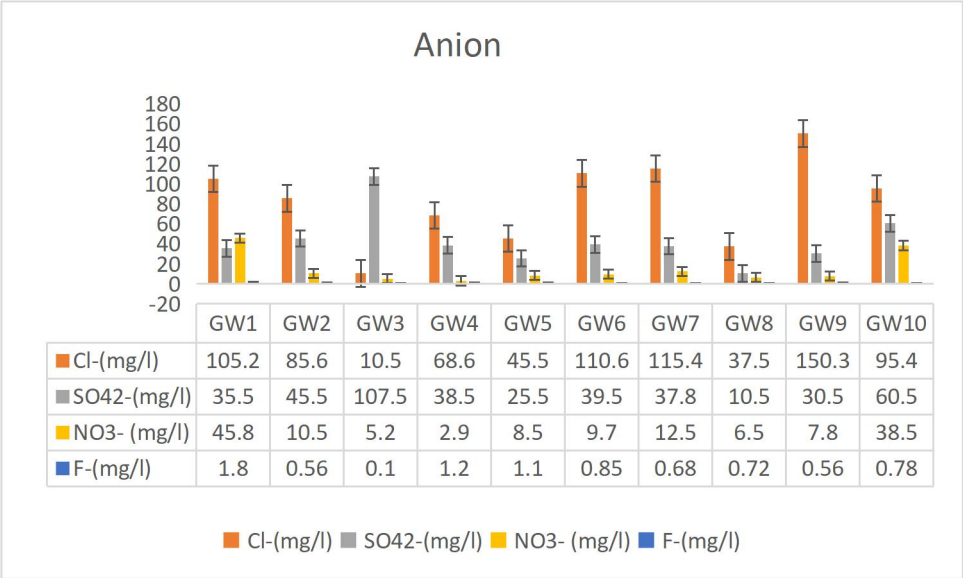


Figure: -3 Variation of TDS in different ground water Samples of Sanganar, Jaipur



	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	GW9	GW10
Ca (mg/l)	28	32.5	25.6	44.5	38.6	60.5	48.7	20.8	60.5	66.4
Mg (mg/l)	124.5	120.2	650.2	29.5	32.5	45.6	38.5	15.5	17.5	65.2
K (mg/l)	7.5	6.6	5.6	12.5	6.8	7.5	10.9	5.2	8.2	6.4

Figure: -4 Variation of Cations in different ground water Samples of Sanganar, Jaipur



	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	GW9	GW10
Cl-(mg/l)	105.2	85.6	10.5	68.6	45.5	110.6	115.4	37.5	150.3	95.4
SO42-(mg/l)	35.5	45.5	107.5	38.5	25.5	39.5	37.8	10.5	30.5	60.5
NO3- (mg/l)	45.8	10.5	5.2	2.9	8.5	9.7	12.5	6.5	7.8	38.5
F-(mg/l)	1.8	0.56	0.1	1.2	1.1	0.85	0.68	0.72	0.56	0.78

Figure: -5 Variation of Anions in different ground water Samples of Sanganar, Jaipur

4. Conclusion:

The study indicates that groundwater in the Sanganar area is generally suitable for drinking with respect to most physicochemical parameters. However, elevated levels of EC, TDS, magnesium, nitrate, and fluoride at certain locations indicate localized contamination. Regular monitoring, appropriate treatment methods, and sustainable groundwater management strategies are essential to ensure safe and potable water quality.

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