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Assessment of the impact of seasonal variations on groundwater quality in Chowka Village

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Abstract:

The physical-chemical quality of groundwater in Chowka village, Aurangabad, focusing on pre-monsoon and post-monsoon seasons. Groundwater serves as a crucial water supply, particularly in rural areas, yet its quality can be impacted by factors such as precipitation, human activities, and geological conditions. Through the collection and analysis of five groundwater(well) samples, the study assesses various parameters, including temperature, pH, total dissolved solids (TDS), electrical conductivity (EC), alkalinity, total hardness, and chloride concentrations. Results indicate significant seasonal variations, with post- monsoon samples showing increased TDS, EC, and hardness levels, often exceeding the permissible limits set by the Bureau of Indian Standards (BIS) and World Health Organization (WHO).While pH and chloride levels generally remained within recommended guidelines, the findings highlight the need for regular monitoring and potential treatment of groundwater to ensure safe drinking water for the local population. This study underscores the importance of sustainable water management practices in addressing groundwater quality issues influencedby seasonal variations and anthropogenic factors.

Keywords: *Groundwater, Rural area, Hardness, TDS, and chloride, Postcolonial identity, Literary hybridity, Language politics, Cultural displacement, Narrative voice*

Introduction :

Groundwater is a major source of water all over the world. Its physical and chemical properties make it a reliable source throughout the world. Groundwater plays a variety of roles in day-to-day life, which makes it an important resource for human beings[1]. Groundwater is an essential source of water supply in rural areas, as it is used for different purposes in day-to-day life. The chemical concentration in groundwater and soils is influenced by various factors, including like composition of precipitation, human activities, geological and anthropogenic activities or drinking well (2). 97.2% of the water on Earth is salty, and only 2.8% is present as freshwater, from which 20% constitutes groundwater As per the Central Groundwater Board, in India, the utilizable water is estimated to be 1123 billion Cubic meters/year [3].This study aim to analyze the physical-chemical groundwater quality of Chowka village, Aurangabad

Study Area: The study area Chowka is situated in the northern part of the Aurangabad District Northern side. It is situated between 20^0'01'01" N latitude and 75^0'23'38" longitude. Chowka village. The population of Chowka village is 5281, and the total area of Chowka is 2338 hectares. these are people from various statuses living here.

Figure No 1: Sample Location

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Methodology :

To evaluate five groundwater well samples were collected from selected areas of Chowka village in the month of pre-monsoon and post-monsoon seasons. Samples were collected in 2 lit. Capacity of clean polythene bottles. The bottles were rinsed with the groundwater to be taken for analysis. Tightly sealed after collection and labeled in the field area. Collected sampl es were analyzed for following parameters: Temperature, pH, Electrical Conductivity, Total Hardness, Alkalinity, Chloride, and Total Dissolved Solids. All sample results compared to WHO and BIS.

Table 01: Drinking Water Standards

Sr. No	Parameter	Standard Method	Unit	BIS Limit IS 10500:2012	WHO Limit
1	**Temperature**	Thermometric	°C	-	-
2	**pH**	Electrometric (pH meter)	–	6.5 – 8.5	6.5 – 8.5
3	**TDS (Total Dissolved Solids)**	Gravimetric/Conductivity Method	mg/L	500	1000
4	**EC (Electrical Conductivity)**	Conductivity Meter	µmho/cm	-	400
5	**Alkalinity**	Titrimetric	mg/L	600	-
6	**Total Hardness**	EDTA Titrimetric Method	mg/L	300	100
7	**Chloride**	Argentometric Titration (Mohr's Method)	mg/L	250	250

Result and Discussion:

After the analysis obtained results are shown in Table no.2 and Table no.3 and further it was compared with the BIS and WHO standards from table no. 1

Table No: 02 Physical-Chemical Parameters of Groundwater (Pre Monsoon)

Sr.NO	Parameters	Pre Monsoon				
		S1	**S2**	**S3**	**S4**	**S5**
1	Temp(C^0)	28	28.1^0	28^0	28.4^0	28.4^0
2	pH	6.93	6.96	7.18	7.4	6.91
3	TDS (mg/l)	543.3	881.3	673	789.4	1241
4	EC (μmho^{-1})	1104	1598	1611	966.1	1319
5	Alkalinity (mg/l)	223	175	140	78	103
6	Total Hardness (mg/l)	678	1421.4	963.1	386	1274
7	Chloride (mg/l)	157.6	197.11	217.1	169.2	288.1

Table No: 03 Physical-Chemical Parameters of Groundwater (Post Monsoon)

Sr.NO	Parameters	Post Monsoon				
		S1	**S2**	**S3**	**S4**	**S5**
1	Temp(^{0}C)	19	16.1^0	17.4^0	20^0	21^0
2	pH	6.53	6.76	7.5	7.1	6.77
3	TDS (mg/l)	673.3	946	813	854	1778
4	EC (μmho^{-1})	1443	1782	1640	1026	1793
5	Alkalinity (mg/l)	196	137	88	103	78
6	Total Hardness (mg/l)	537	841.3	784	386	1274
7	Chloride (mg/l)	124.78	67.44	203.65	124.78	143.7

Discussion

The seasonal variation in groundwater quality parameters from pre-monsoon to post-monsoon in Chowka villageis due to natural fluctuations and potential anthropogenic influences. These observations were further evaluated by comparing them with the permissible limits recommended by BIS (IS 10500:2012) and WHO guidelines for drinking water.

Temperature

Although not specified by BIS or WHO, water temperature plays a crucial role in influencing solubility and reaction rates of chemical constituents. A noticeable decrease in temperature was observed post-monsoon due to seasonal climatic changes and the influx of cooler rainwater.

pH

The pH values for all sites ranged between 6.53 and 7.50 in both seasons, falling within the acceptable range prescribed by BIS

(6.5–8.5) and WHO (6.5–8.5). This indicates that the groundwater in Chowka is neither highly acidic nor alkaline, and remains suitable for consumption in terms of acidity/basicity.

Total Dissolved Solids (TDS)

TDS levels ranged from 543.3 mg/L to 1241 mg/L in the pre-monsoon and 673.3 mg/L to 1778 mg/L in the post-monsoon season. According to BIS, the desirable limit for TDS is 500 mg/L, and the permissible limit is 2000 mg/L in the absence of an alternate source. WHO sets the acceptable limit at 1000 mg/L. Several sites, Particularly S5 exceeded WHO standards post-monsoon, indicating higher mineralization, possibly due to leaching or contamination.

Electrical Conductivity (EC)

Although EC is not directly regulated by BIS or WHO, it is widely used to assess ionic concentration and water salinity. EC values were significantly high across all sites in both seasons (ranging from 966.1 µmho/cm to 1877 µmho/cm pre-monsoon, and 1026 µmho/cm to 1985 µmho/cm post-monsoon), suggesting moderate to high mineral presence, especially in S1 to S5.

Alkalinity

Alkalinity values ranged from **78 to 223 mg/L** pre-monsoon and **78 to 196 mg/L** post-monsoon. These values are within the **BIS acceptable limit of 200 mg/L**, and indicate moderate buffering capacity. Sites with higher alkalinity, such as S1 may be influenced by carbonate-rich geological formations.

Total Hardness

Total Hardness values were found to be quite high, especially during the pre-monsoon season, with S2 and S5 exceeding 1400 mg/L and 1274 mg/L, respectively. BIS recommends a desirable limit of 200 mg/L and a permissible limit of 600 mg/L. WHO suggests a maximum of 500 mg/L. All sampled sites exceeded the desirable limit, with most also breaching the permissible limits, indicating that the water is **very hard**, likely due to dissolution of calcium and magnesium minerals.

Chloride

Chloride concentrations ranged between 157.6 mg/L to 288.1 mg/L in the pre-monsoon and 67.44 mg/L to 203.65 mg/L in the post-monsoon season. These values are within the BIS permissible limit of 1000 mg/L and WHO guideline value of 250 mg/L, except at S5 pre-monsoon, which slightly exceeded WHO's ideal standard. The observed decrease at several sites post-monsoon suggests dilution from rainwater recharge.

Conclusion:

The comparative analysis of groundwater in Chowka village reveals significant seasonal variations influenced by monsoon activity. Post-monsoon samples showed increased TDS, EC, and hardness at several sites, indicating leaching of minerals and potential contamination. While pH and chloride levels mostly remained within BIS and WHO standards, parameters like TDS and hardness frequently exceeded permissible limits, especially in pre-monsoon samples. These findings suggest the need for regular monitoring and appropriate treatment before consumption. Seasonal influences play a crucial role in groundwater quality, and sustainable water management practices must be implemented to ensure safe drinking water for the local population.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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