



GLOBAL LESSONS FROM PERI URBAN GHANA: HYDROGEOCHEMICAL ASSESSMENT OF GROUNDWATER IN BEREKUM WEST DISTRICT, BONO REGION, GHANA

6th Commonwealth Chemistry Posters

Building Networks to Address the Goals
1-2 October 2025

Dora Hannah Damoah, Godfred Darko, Micheal K. Laryea, Lawrence S. Borquaye

Department of Chemistry, Kwame Nkrumah University of Science and Technology, Kumasi
E-mail: dhannahdora@yahoo.com



Introduction

Results & Discussion

Results & Discussion

- Earth's total volume of water is 1.4 billion km³ (United Nations, 2022)
- 3% out of this is classified as freshwater, with only 30% trapped beneath the earth as groundwater
- Increase in global water demand by 1 % every year in the last four decades (UNESCO, 2018)
- Groundwater quality has been studied extensively in Ghana (Tabi et al., 2024)
- That notwithstanding, groundwater in Berekum West District remains uncharacterized
- Located in the Bono Region of Ghana, the district is a growing agro-ecological hub with significant agricultural activities (Berekum West District Assembly, 2025) and predominantly underlain by rocks of the Birimian Supergroup (Berekum West District Assembly, 2021)
- These factors, combined with the strong reliance on groundwater, heighten the risk of contamination; yet, water quality assessment is lacking

- Groundwater samples were moderately to strongly acidic, as it ranged from 3.5 to 6.2, with a mean and standard deviation of 5.057 ± 0.779 pH units
- Bicarbonates and Carbonates levels were found below detection limits, indicating low alkalinity

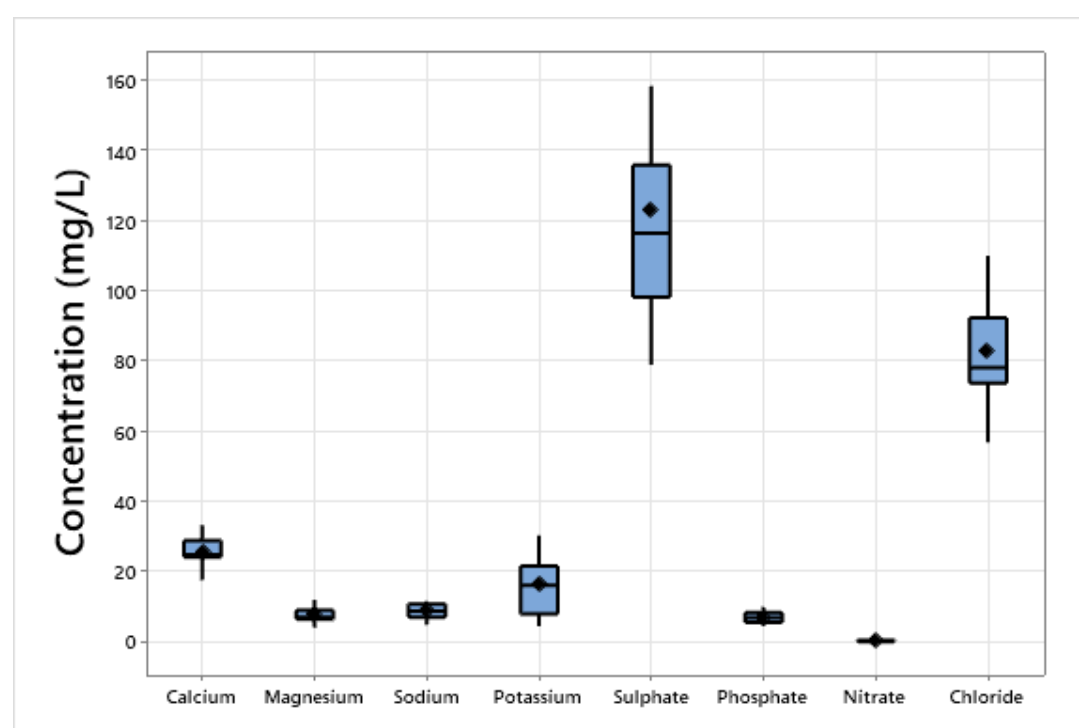


Fig. 2: box-whisker plot of major ions in groundwater samples

Relative abundance of cations and anions in groundwater within the district is in the order of: K⁺ > Ca²⁺ > Na⁺ > Mg²⁺ and SO₄²⁻ > Cl⁻ > PO₄³⁻ > NO₃⁻ respectively

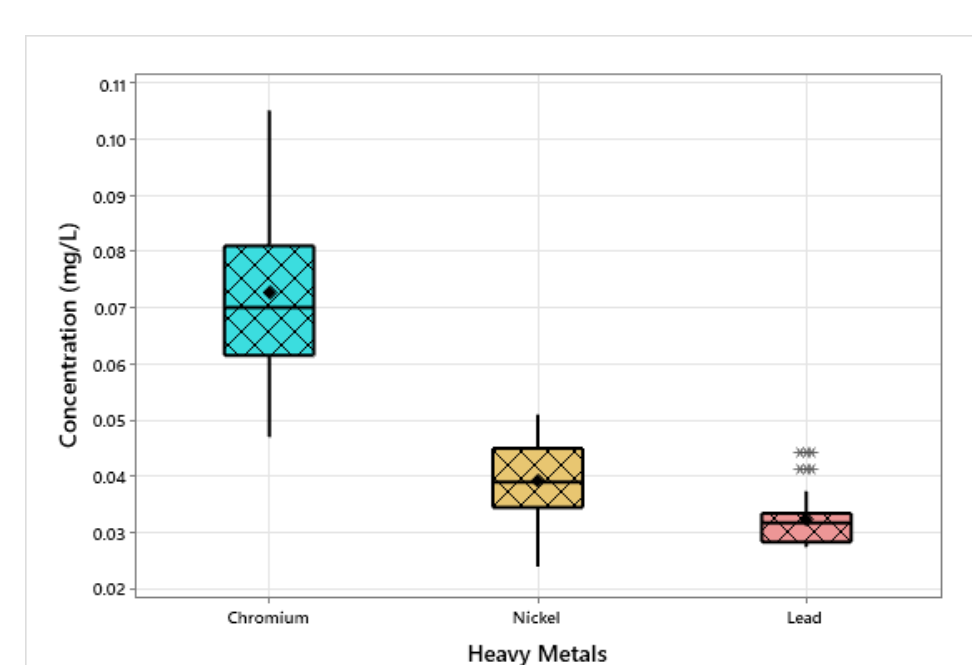


Figure 3: Box-whisker plot of heavy metals in groundwater samples

Weighted Arithmetic Water Quality Index

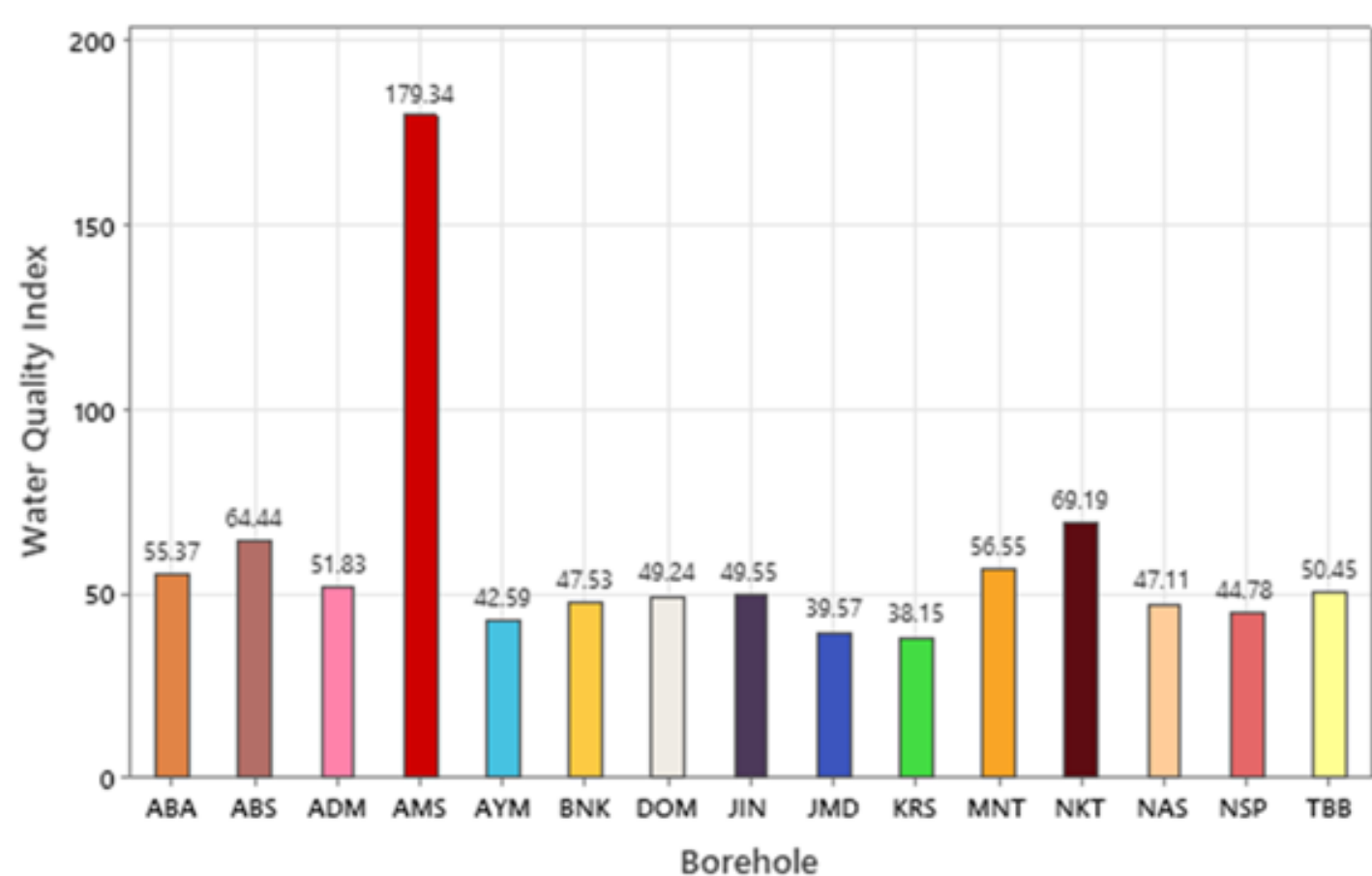


Fig. 4: bar chart of water quality index verses boreholes

WQI Range	CATEGORY
<50	Excellent water
50-100	Good water
100-200	Poor water
200-300	Very poor water
>300	Unsuitable water

- 53% (8 samples) - excellent quality
- 40% (6 samples) - good quality
- 7% (1 sample) - poor quality

- Eleven water quality parameters of each borehole was used to ascertain its suitability for domestic applications

Correlation Matrix Analysis

- Correlation coefficient is a tool for measuring the connection between two variables.
- It demonstrate the degree to which one variable is dependent on another
- Pearson correlation was used to identify factors that contributed to the dispersion and transportation of pollutants in groundwater (Chen et al., 2012)

Table 1: Pearson's correlation matrix of physicochemical and heavy metal parameters in groundwater samples

Variable	Temperature	pH	EC	TDS	Salinity	Total Hardness	Turbidity	Calcium	Magnesium	Sodium	Potassium	Sulphate	Phosphate	Nitrate	Chloride	Chromium	Nickel
Temperature	1																
pH	-0.187	1															
EC	0.342	-0.548	1														
TDS	0.342	-0.545	0.992	1													
Salinity	0.292	-0.498	0.991	0.991	1												
Total Hardness	-0.083	0.259	-0.092	-0.092	-0.09	1											
Turbidity	0.487	-0.059	-0.06	-0.06	-0.122	-0.117	1										
Calcium	-0.018	0.248	-0.085	-0.086	-0.095	0.56	-0.072	1									
Magnesium	-0.221	0.242	-0.093	-0.093	-0.066	0.891	-0.202	0.764	1								
Sodium	-0.2	0.038	-0.014	-0.014	-0.022	0.579	-0.303	0.605	0.431	1							
Potassium	0.291	0.209	-0.051	-0.051	-0.012	0.303	-0.358	0.326	0.204	0.339	1						
Sulphate	0.179	-0.39	0.941	0.941	-0.047	0.189	0.153	0.221	0.087	-0.175	-0.3	1					
Phosphate	0.171	-0.115	0.022	0.022	0.001	-0.39	0.072	-0.336	-0.453	-0.221	-0.404	-0.059	1				
Nitrate	-0.286	0.016	-0.35	-0.35	-0.323	0.185	-0.053	0.181	0.166	-0.052	0.123	0.222	0.114	1			
Chloride	0.432	-0.41	0.758	0.757	0.766	0.224	-0.202	0.193	0.261	0.017	0.226	0.367	-0.366	-0.138	1		
Chromium	-0.216	0.167	0.079	0.079	0.155	0.183	-0.447	0.13	0.276	0.278	0.514	-0.48	-0.228	0.131	0.2	1	
Nickel	-0.298	0.172	0.052	0.052	0.104	0.407	-0.644	0.358	0.454	0.311	0.443	-0.072	-0.577	0.092	0.329	0.284	1
Lead	0.043	-0.158	-0.231	-0.231	-0.264	-0.334	0.534	-0.37	-0.199	-0.43	-0.599	0.113	0.238	-0.262	-0.327	-0.346	-0.364

Aim & Objectives

Aim

- To assess and characterise the water quality in the Berekum West district using hydrogeochemical and statistical tools

Specific Objective

- To analyze physicochemical parameters and heavy metals
- To determine the quality of the samples for drinking purposes
- To investigate the underlying patterns and interrelationships in groundwater chemistry
- To assess the hydrochemical facies of the groundwater samples

Methodology

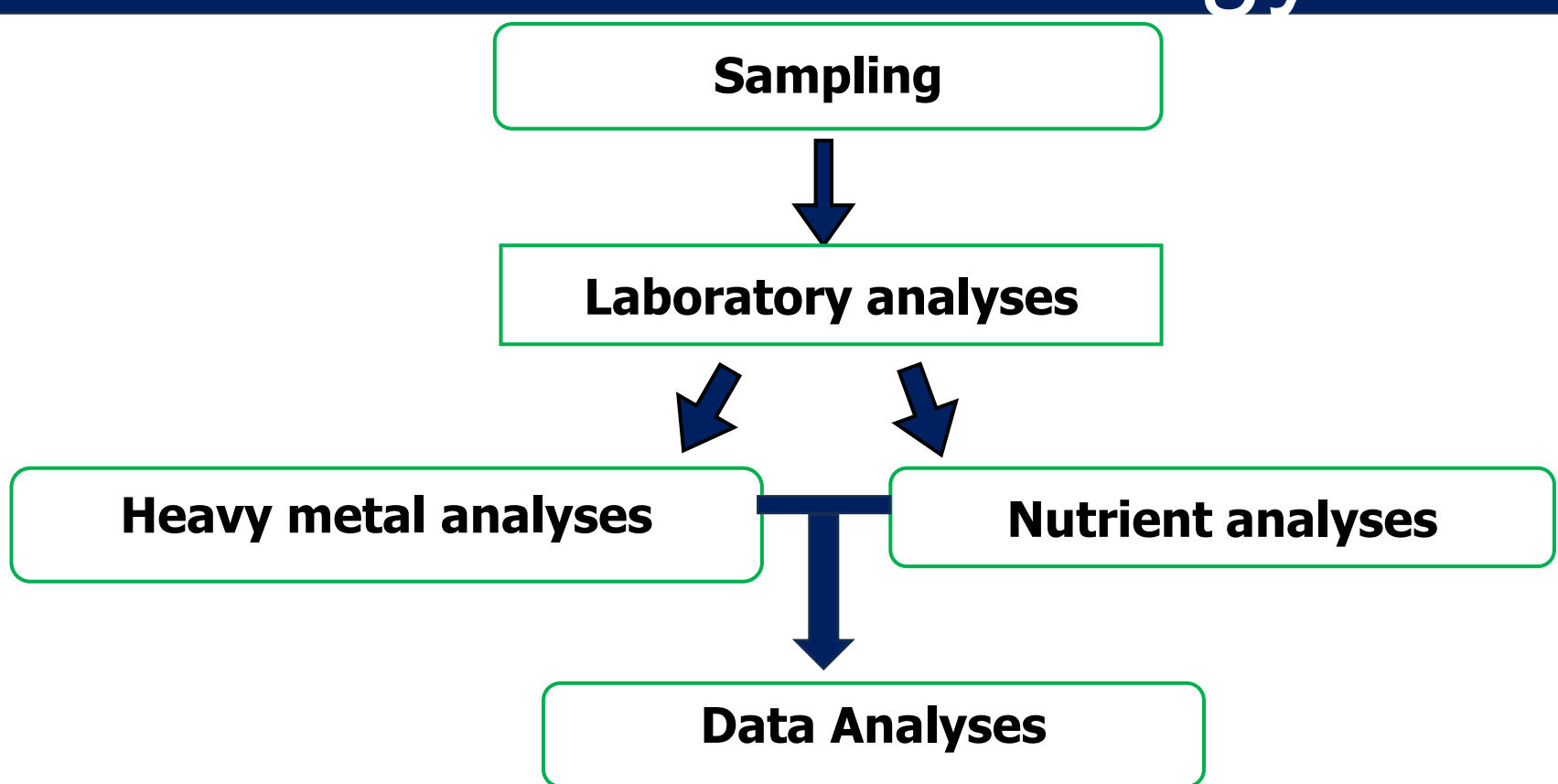


Fig. 1: flow chart of experimental design

Conclusion & Recommendation

- Geogenic influences and anthropogenic activities contributed to acidity in groundwater samples
- Groundwater is predominantly controlled by the dissolution of evaporite minerals, water-rock interaction and ion exchange
- Strong positive correlations among EC, TDS, salinity, sulphate, and chloride reflect high mineralization of groundwater samples
- The Community Water and Sanitation Agency should incorporate water quality into resource planning to balance abstraction with recharge
- The Environmental Protection Agency should establish routine groundwater quality monitoring programs to detect emerging contaminants early and take prompt action to mitigate risks
- The Ministry of Food and Agriculture should embark on community educational campaigns to inform residents about best practices in waste management, the reduction of agrochemical usage, and protective measures for groundwater resources

References

- Berekum West District Assembly. (2021). *Ministry of Local Government and Rural Development Berekum West District Assembly prepared under the agenda for jobs policy : Creating prosperity and equal opportunity for all.*
- Berekum West District Assembly. (2025). *Composite Budget for 2025-2028 Programme Based Budget.*
- Chen, B., Liang, X., Xu, W., Huang, X., Li, X.,(2012). The changes in trace metal contamination over the last decade in surface sediments of the Pearl River Estuary, South China. *Sci. Total Environ.* 439, 141–149
- Tabi, R. N., Gibrilla, A., Boakye, P., Agyemang, F. O., Foaah, A. A., & Oduro-Kwarteng, S. (2024). Appraisal of groundwater quality and hydrochemistry in three regions of Ghana: Implications for drinking purposes. *Groundwater for Sustainable Development*, 26(January), 101193. <https://doi.org/10.1016/j.gsd.2024.101193>
- UNESCO. (2018). *Nature-based Solutions for Water. In United Nations World Water Development Report.* <https://unesdoc.unesco.org/ark:/48223/pf0000261424>
- United Nations. (2022). Groundwater: Making the invisible visible. In *The United Nations World Water Development Report 2022*

Acknowledgement



- Sampling communities within the Berekum West District