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ORIGINAL ARTICLE

Principal component analysis of groundwater sources pollution in Omu-Aran Community, Nigeria

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Abstract

Most developing countries rely on water sources that are usually not protected making them unsafe for drinking. It is imperative to ensure regular assessment and proper monitoring to evaluate their quality and ensure they meet standards before use. This study was aimed at identifying pollution sources of groundwater in the study area of Omu-Aran and assessing the wáter quality under varying temporal conditions. Ninety-six groundwater samples were collected from eight locations during the dry and wet seasons of 2019–2020. These samples were examined for water quality parameters ($n = 10$) using standard methods. The study adopted the use of principal component analysis (PCA), water quality index (WQI) and independent sample t test to analyze water pollution sources, fully assess water quality and examine temporal variations in the sampling stations respectively. The mean values for measured parameters all fall within the Nigerian Standard Drinking Water Quality guideline values with the exception of pH, nitrite, dissolved oxygen and T. coliform. This pollution was attributed to sewage pollution arising from anthropogenic sources. Water quality decreased during rainy season as compared to the dry season with significant differences ($P < 0.05$) between these periods except for pH, total hardness and fluoride. WQI ranged from 28.17 to 108.15 which lies on the "*good*" to *"unsuitable for drinking"* spectrum. Three latent factors were extracted for both the wet and dry seasons from measured parameters by means of PCA. They explain natural pollution and soil erosion phenomenom due to seasonal changes while organic matter oxidation and mineral dissolution are also identified as factors that affect the water quality in the study area. In conclusion, the study has been able to integrate the use of PCA and WQI to analyse recorded data for pollution source identification and water quality interpretation in the study area. Regular assessment and proper monitoring to evaluate the quality of these sources should be done in order to ensure they meet standards before use. Users should be encouraged to carry out disinfection and ensure their water sources are protected and not left exposed.

Keywords Water quality index (WQI) · Contamination · Groundwater · Principal component analysis (PCA) · Omu-Aran · *t* test

Abbreviations

APHA	American public health association
Chloride	Chloride
DO	Dissolved oxygen
E	East
EC	Electrical conductivity
k	Constant of proportionality
L	Liter
Mg	Milligram
MLR	Multiple linear regression
NSDWQ	Nigerian drinking standard water quality
N	North
NTU	Nephleometric turbidity unit
PCA	Principal component analysis
PC1	The first rotated component
PC2	The second rotated component
PC3	The third rotated component
PC4	The fourth rotated component
PCs	Principal components
pH	PH (Hydrogen potential)
Si	Standardized maximum concentration
Std. dev	Standard deviation
T. coliform	Total coliform

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