Seasonal and Source-Based Assessment of Physicochemical and Microbial Water Quality in Rocky-Hill Settlements of Southwestern Nigeria

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Kanayo Samuel Okonji
Department of Chemistry, Federal University Oye-Ekiti, Ekiti State, Nigeria. Email: kanayosamuelokonji63@gmail.com

Abstract

This study evaluated the physicochemical and microbial quality of borehole, well, and rainwater sources in selected rocky-hill settlements of Southwestern Nigeria during the dry and wet seasons. Standard analytical methods were used to assess key water quality parameters and indicator microorganisms. Significant seasonal and source-dependent variations were observed. Borehole water generally exhibited the most stable quality, while well water recorded the highest turbidity and microbial contamination, particularly during the wet season. Rainwater quality varied according to collection and storage conditions. The findings highlight the influence of seasonality and water source on drinking water safety and emphasize the need for improved water management and treatment strategies to support **SDG 6 (Clean Water and Sanitation)**.

Fig 1. Map of Ekiti State

Introduction

Access to safe drinking water remains a major public health challenge in many rural and semi-urban communities of sub-Saharan Africa. In rocky-hill environments, groundwater occurrence, recharge, and quality are strongly influenced by geology, seasonal rainfall, and human activities.

Residents of many Ekiti communities rely on:

- Boreholes
- Hand-dug wells
- Rainwater harvesting

Understanding how water source and season affect water quality is essential for sustainable water-resource management and protection of community health.

Study Area: Ilawe-ekiti; Aramoko-ekiti, Iyin-ekiti (Comparison Community)

Keywords: Water quality, seasonal variation, borehole, well water, rainwater, microbial contamination, **SDG 6**.

Fig 2. Physicochemical Characteristics of Drinking Water Sources Across Seasons

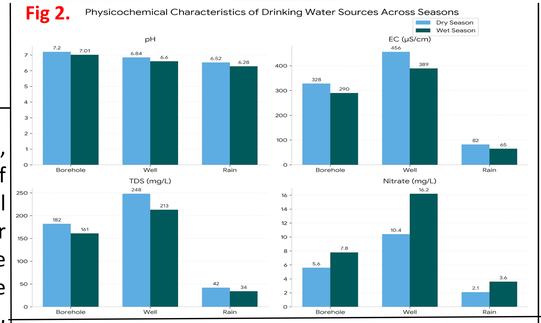


Fig 3. Seasonal Variation in Water Turbidity

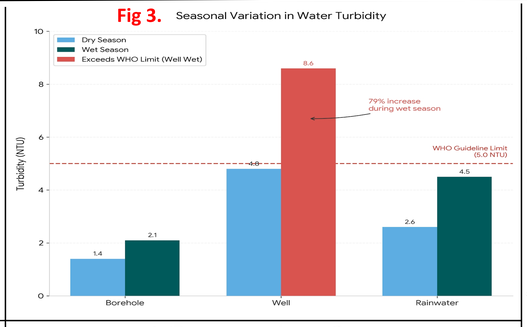


Fig 4. Microbial Quality of Drinking Water Sources

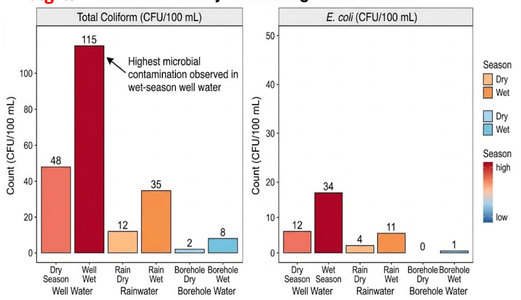


Fig 5. WHO Drinking Water Compliance Assessment

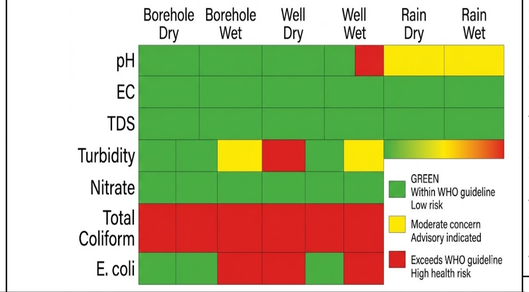
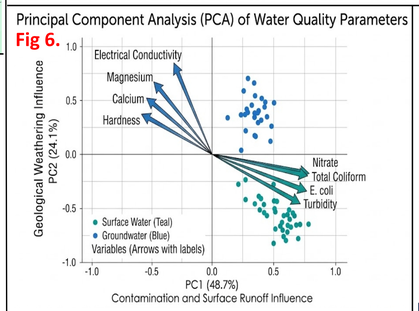
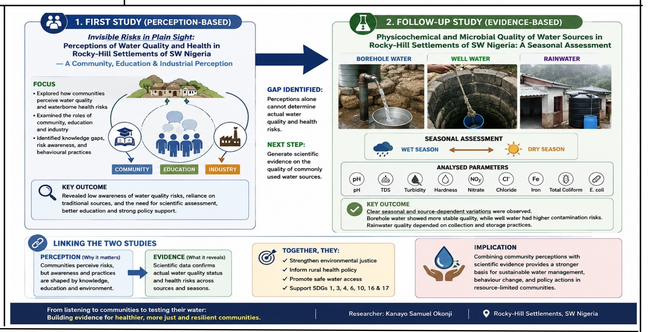


Fig 6. Principal Component Analysis (PCA) of Water Quality Parameters





Methods

Study Area

Water Quality Assessment Was Conducted In Three Communities In Ekiti State, Nigeria (Ilawe-ekiti, Aramoko-ekiti, And Iyin-ekiti), Representing Rocky-hill And Comparison Environments.

Sampling Design

Three Drinking Water Sources Were Investigated:

- Borehole Water
- Hand-dug Well Water
- Harvested Rainwater

A Total Of 36 Sampling Points Were Monitored During The Dry And Wet Seasons.

Water Quality Analysis

Physicochemical Parameters Measured Included:

- Ph • Electrical Conductivity (EC) • Total Dissolved Solids (TDS) • Turbidity
- Hardness • Calcium And Magnesium • Nitrate

N.B. Analyses Were Performed According To APHA Standard Methods.

Microbial Assessment

Total Coliforms And *Escherichia Coli* Were Determined Using Membrane Filtration And Expressed As CFU/100 Ml.

Quality Assurance & Statistics

Triplicate Analyses, Instrument Calibration, Blanks, And Duplicate Samples Were Employed For Quality Control. Data Were Analysed Using Descriptive Statistics, Two-way ANOVA ($P < 0.05$), And Principal Component Analysis (PCA).

Discussion of Findings (Fig 1-5)

Fig. 2 shows clear source- and season-dependent variations in physicochemical parameters, with well water exhibiting higher EC, TDS, and nitrate concentrations, while rainwater displayed the lowest mineral content and slightly acidic pH. **Fig. 3** reveals a marked increase in turbidity during the wet season, with well water exceeding the WHO limit (8.6 NTU), indicating enhanced runoff-driven contamination. **Fig. 4** demonstrates that microbial contamination was highest in well water and increased across all sources during the wet season. **Fig. 5** highlights that while most physicochemical parameters complied with WHO guidelines, turbidity and microbial indicators showed notable non-compliance, particularly in well water. **Fig. 6** further confirms that contamination-related variables (turbidity, nitrate, total coliforms, and *E. coli*) were primarily associated with surface runoff and anthropogenic influences, whereas hardness, major ions, and EC were controlled by geological weathering processes.

Conclusion & SDG Impact

Water quality in the studied rocky-hill communities was strongly influenced by both water source and seasonal variation. Borehole water generally exhibited the most stable physicochemical and microbial quality, while well water showed the highest vulnerability to contamination, particularly during the wet season. The findings highlight the need for improved water safety interventions to reduce exposure to waterborne health risks and support equitable access to safe drinking water, directly contributing to **Sustainable Development Goal 6 (*Clean Water and Sanitation*)**.

Recommendations

Regular water quality monitoring, protection of wellheads from surface runoff, household water treatment, and improved rainwater harvesting and storage practices are recommended to enhance drinking water safety and strengthen sustainable water resource management in rural communities.