

**HYDROGEOCHEMICAL ANALYSIS AND MODELING OF
GROUNDWATER IN SOUTH KINANGOP, NYANDARUA
COUNTY, KENYA**

Chege Robert Macharia (B.Ed. Sc)

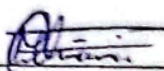
**A Thesis Submitted in Partial Fulfillment of the Requirements for
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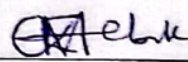
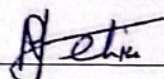
April, 2023

DECLARATION

This thesis is my original work and has not been presented for a degree or any other award in any other university or institution.


_____12/04/2023**Robert Macharia Chege****Date****I56/CE/28303/2013****Department of Chemistry****Kenyatta University****SUPERVISORS**

The work reported in this thesis was carried out by the student under our supervision


_____12th April 2023**Dr. G. Kibe Macharia****Date****Department of Chemistry****Kenyatta University**
_____12th APRIL 2023**Dr. Paul Njihia Gichuhi****Date****Department of Chemistry****Technical University of Mombasa**

ABSTRACT

The growing population South Kinangop sub County, Nyandarua County has led to increased competition for natural resources. Groundwater plays a critical role in agricultural production and remains the major source of domestic water in the study area. The quality of this water is thus of great concern but no significant work has been done to determine its chemical composition in the study area. The research aimed at assessing the physicochemical properties of ground water and related hydrogeochemical processes in the study area. This research was also to ascertain the quality of water compared to recommended World Health Organization (WHO) water standards for domestic uses. The water samples from 12 sampled wells were collected and analyzed using standard analytical procedures. Physical parameters were determined which included temperature, electric conductivity and pH. Their values ranged from 16 °C to 18 °C, $89.00 \pm 1.15 \mu\text{S/cm}$ to $422.00 \pm 1.53 \mu\text{S/cm}$ and 5.84 to 6.92 respectively. The concentrations of major cations (K^+ , Na^+ , Ca^{2+} and Mg^{2+}) and anions (Cl^- , SO_4^{2-} and NO_3^-) in groundwater were also determined. Major cations were determined using titrimetric methods and flame photometer while concentrations of major anions were determined using spectrophotometric and titrimetric methods. The dominance of cations in the study area was $Na^+ > Ca^{2+} > Mg^{2+} > K^+$ while that of anions was $SO_4^{2-} > CO_3^{2-} > Cl^- > NO_3^-$. The physical and chemical data obtained from experimental results were used as input data for modeling using PHREEQC and RockWare AQQA v1.50 computer software. They were used for determination of saturation indices, hydrochemical facies and processes. One third of the water samples exhibited *Ca-Mg-Cl* water type, 25% were *Na-Cl* and *Ca-Cl* water types. The remaining 16.7% were of *Ca-HCO₃* hydrochemical facies. *Ca-Na-HCO₃* and *Na-HCO₃* hydrochemical facies were absent in the water samples. The hydrochemical facies showed simple dissolution or mixing of water. This was attributed to absence of dominant major anion or cation in freshly recharged water which exhibited simple dissolution or mixing. All the water samples were undersaturated with anhydrites, gypsum, halite, aragonite, calcite and dolomite. The water parameters from all the wells were within the recommended values by World Health Organization (WHO) hence suitable for human consumption. However, water from Gichagi which had high sulphate content than the recommended values by WHO should be treated before use. From the results obtained, no serious cause of alarm, however monitoring of the analyte across various seasons is recommended.