



FACULTY OF ENGINEERING

DEPARTMENT OF WATER RESOURCES ENGINEERING

FINAL YEAR PROJECT

ASSESSING GROUNDWATER VULNERABILITY TO SALINITY
USING MODIFIED DRASTIC MODEL AND MACHINE
LEARNING

CASE STUDY: BUSIRE, BUSITEMA SUB-COUNTRY (BUSIA
DISTRICT)

By

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Abstract

Groundwater vulnerability to salinity assessment serves as a measure of potential groundwater salinity pollution in a target area. The study focused on modified DRASTIC model to assess groundwater vulnerability to salinity, with machine learning (random forest) to successfully predict groundwater saline sensitive zones. However, research to predict groundwater salinity risk using machine learning was limited. The aims of the study, to assess inherent sensitivity of groundwater to pollution, determine spatial variations in vulnerability due to additional factor of land use, to develop ground water salinity map based on saline concentration and to predict potential ground water saline zones using machine learning. The methods employed on the objectives, were the DRASTIC, DRASTIC-LU incorporating the impact of anthropogenic influences, validation of the DRASTIC-LU with groundwater quality data (EC as an indicator of salinity levels) and implementation in machine learning model with the threshold value of EC as the predictor class value. Groundwater salinity was increasingly recognized as a significant environmental hazard, particularly in areas highly influenced by the impact of anthropogenic activities such as mining, agricultural practices, and different land use changes. Random forest classifier models were developed, using depth to water (D), recharge (R), aquifer media (A), soil media (S), topography (T), vadose zone (I) and hydraulic conductivity (C), on the basis of EC class. To assess the performance of groundwater salinity risk model, training and validation datasets were evaluated using the ROC curve and gained accuracy of 94%. The results revealed that approximately 20% of the study area fell within the high salinity potential, and around 50% exhibited moderate salinity risk while 30% very low to salinity risk concentration. Random forest algorithm could serve as efficient technique for evaluating and managing groundwater resources. The findings underscored relatively poor groundwater quality in the Busire, with excessive aquifer exploitation by the agricultural sector and infiltration of urban sewage and industrial waste identified as the primary causes of groundwater salinity. The implications of these findings were crucial for devising strategies and implementing preventive measures to mitigate water resource vulnerability and

associated health risks in Busitema Subcounty.

Declaration

I OTHIENO TIMOTHY, declare that the work presented in this final report is my original work except where due references has been made. I declare that this work has never been submitted to this university or any other institute for finding /partial fulfillment for any award.

SIGNATURE C.H.H.

DATE 20th - May - 2025

Approval

I certify that the work reported in this research has been written under the supervision of;

Name: Mr. OKETCHO YORONIMO

Signature

Date

24-MAY-2024

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I express my sincere gratitude to the Almighty GOD, who gave me life and made it possible for me to achieve this academic level by providing for all my needs.

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I would on special note want to express my heartfelt appreciation to my supervisor, Mr. OKETCHO YORONIMO and my lecturers for their constant supervision during the project. Their suggestions and tenacious efforts to monitor the project's progress were very helpful in ensuring its success.

Dedication

I dedicate this final year project report to everyone who contributed to my success and making it possible for me to come up with such an amazing piece of work. GOD bless you abundantly.

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Abbreviations or Acronyms

DVI	DRASTIC Vulnerability Index
EC	Electrical Conductivity
GIS	Geographical information system
GWVZ	Groundwater Vulnerability Zones
IDW	Inverse Distance Weighting
KDE	Kernel Density Estimation
LU	Land use
RF	Random Forest
ROC	Receiver Operating Characteristics
SDG	Sustainable Development Goals

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