



**BUSITEMA
UNIVERSITY**
Pursuing Excellence

FACULTY OF ENGINEERING

DEPARTMENT OF WATER RESOURCES ENGINEERING

FINAL YEAR PROJECT

**INTEGRATED GIS-BASED APPROACH FOR MAPPING AND MODELING
GROUNDWATER RESOURCES.**

Case study: Kibalinga sub county, Mubende district.

By

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Abstract.

Due to effects of increasing demand on water, attributed to increasing population and increased industrialization, sustainable development in terms of water management has become a big challenge. Some boreholes in Kibalinga sub county are experiencing reduced water production and others complete drying, which is likely due to the over extraction of water from neighboring boreholes or natural causes. Sustainable groundwater management based on groundwater basin (GWB) must be equipped with comprehensive information including the characteristic of hydrogeology. This management method is very useful for governments to design some regulations concerning groundwater conservation. This study involved an integrated GIS-based approach for mapping and modeling groundwater resources in Kibalinga sub county, Mubende district. The project aimed to identify and map potential groundwater resources including the recharge and discharge zones using geological data and existing hydrogeological information, and develop a hydrological model to simulate groundwater using GIS tools and MODFLOW 6. Groundwater characteristics such as first water strike, main water strike, static water level, different characteristics of rock bearing structure were identified using maps and graphs. The project involved data collection, processing, and analysis using various GIS tools and techniques within a hydrological modeling framework. The proposed approach has the potential to provide valuable insights into the availability and distribution of groundwater resources in the study area, which can inform water resources management decisions. Furthermore, this study provided information about the changes in groundwater considering the different extractions and recharges over a period of ten years. The study has also identified the different aquifer characteristics that can help and guide on the location of groundwater extraction points. The sub county consists of the unconfined and confined aquifer of High Plain Aquifer, where the groundwater flows from north and east heading southward and westward. The methods applied to the study are mapping the geological and hydrogeological condition, reconstruction of subsurface stratigraphic condition, overlay of different maps of given parameters of the recharge-discharge zone, running models with different packages in MODFLOW. The groundwater yield potential from the results indicated that the yield ranges from 0.1007m³ /hr-10.008m³ /hr. therefore the total yield per hour is 66.71m³ /hr. therefore the annual water yield was 584,400m³ /hr. MODFLOW model calibration yielded an R² value of 0.78746.

DECLARATION.

I AYEBAZIBWE KENEDY declare that this report is a result of my own research and has never been submitted to any institution of higher learning for any academic award.

I stand to account for all this information contained in this report.

AYEBAZIBWE KENEDY

Signature

Date

APPROVAL.

This final year research project has been submitted to the Department of Water Resources Engineering of Busitema University under the supervision of the undersigned supervisor;

MR. BAAGALA BRIAN SEMPIIJA
SIGNATURE.....*Brian Sempiija*.....
DATE.....*20/11/2022*.....

ACKNOWLEDGEMENT.

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.

Many thanks to my cherished friends and family for their unending emotional support, encouragement, and prayers as well as for helping me with this effort.

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Without forgetting the 2019 class of water resources engineers for the great support.

DEDICATION.

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

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ACRONYMS

GIS	geographical information system
RS	Remote sensing
SDG	Sustainable Development Goals
GEC	Groundwater estimation committee
CGWB	Central Groundwater Board
ASCE	American Standard of Civil Engineers
MCDA	Multi Criteria Decision Analysis
AHP	Analytical Hierarchy Process
GPS	Global positioning system
DEM	Digital Elevation Model
UNMA	Uganda National Meteorological Authority
MWE	Ministry of Water and Environment
LG	Local Government
DWRM	Directorate of Water Resources Management
DGSM	Directorate of Geological survey and Mines
UNBS	Uganda National Bureau of Standards
USGS	United States Geological Survey
GW	Groundwater
MODFLOW	Modular flow
PEST	Parameter Estimation Tool.

CHAPTER ONE.

1.0 INTRODUCTION.

This chapter includes; back ground to the study, statement of the problem, justification, objectives of the study, the significance of the study, scope of the study, geographical scope, time scope and a brief description of Kibalinga sub county.

1.1 BACKGROUND.

Since 1997, Uganda has been implementing the Poverty Eradication Action Plan (PEAP). The PEAP is Uganda's national development framework and medium-term planning tool. It has been recognized under PEAP, that water resources have a significant contribution to make to poverty eradication through a number of programmes, in particular the provision of water and sanitation services. The success and sustainability of all the water related poverty eradication programmes depend on the availability of adequate water resources of the appropriate quality.

Water resources management is the responsibility of the Directorate of Water Resources Management (DWRM) within the Ministry of Water and Environment. The overall objective of the water resources management sector in Uganda is to manage and develop the water resources of the country in an integrated and sustainable manner, so as to secure and provide water of adequate quantity and quality for all social and economic needs of the present and future generations with the full participation of all stakeholders. Groundwater resources are particularly significant as over 80 % of the rural population depends on groundwater for clean water supplies. Safe water coverage in Uganda currently stands at 65 % for rural water supplies and 66 % for urban supplies (Water and Environment Sector Performance Report, 2009). Groundwater development has been identified as the most feasible source of water to develop in order to increase safe water coverage to over 95 %.

Groundwater is the water that is present below the Earth's surface in the spaces between soil particles, cracks, and pores in rocks, and in underground aquifers. It is an essential resource for human consumption, irrigation, industry, and ecosystems. However, over-extraction and contamination of groundwater have become significant challenges in many parts of the world (Mrs. L. Kannagi, Ramya. C, Shreya R 2018)

The natural recharge of groundwater occurs through precipitation, infiltration, and percolation, which replenish the water table. The amount and rate of recharge for groundwater depend on

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