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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SUPERVISOR

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Final Year Project Report submitted to the Department of Water Resources Engineering in partial fulfilment for the award of a Bachelor of Science in Water Resources Engineering at Busitema University.

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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 MODFOW 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 0.1007%m3 /hr-10.008%m3 /hr. therefore the total yield per hour is 66.71m3 /hr. therefore the annual water yield was 584,400m3 /hr. MODFOW model calibration yielded an R^2 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.

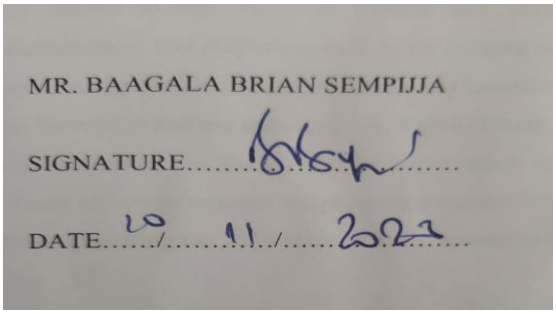
AYEBAZIBWE KENEDY

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;



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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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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.

Contents

List of figures and tables

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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