P.O. Box 236, Tororo, Uganda
Gen: +256 - 45 444 8838
Fax: +256 - 45 4436517
Email: info@adm.busitema.ac.ug
www.busitema.ac.ug

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF WATER RESOURCES ENGINEERING

FINAL YEAR THESIS.

APPLICATION OF GIS AND REMOTELY SENSED DATA IN ASSESSING THE POTENTIAL FOR DAM SITE ZONATION.

Case study Area: Greater Soroti, Eastern block

BY

TIKOL JOSEPHINE

BU/UG/2019/0005

josephinetikol@gmail.com

0778517942/ 0740165447

SUPERVISOR: Mr. OKETCHO YORONIMO

Submission Date: 12th/ March/2024

"Submitted as a Final Year Thesis to the Department of Water Resources Engineering as a partial fulfillment for the award of a Bachelor's degree at Busitema University."

ABSTRACT.

Water scarcity coupled with food insecurity has been a major problem all over developing countries including Uganda; this is especially in rural areas where the citizenry is solely dependent on open water sources and rain-fed agriculture. This situation has been worsening with a constant negative change of climatic conditions. Dam site selection is a crucial task in the planning and development of water resource projects. Geographic Information Systems (GIS) have emerged as valuable tools for evaluating potential dam sites by incorporating various spatial data layers and analysis techniques.

This paper reviewed various case studies and methodologies employed in dam site selection using GIS. It discussed the key factors considered during the site selection process, including water availability, geological stability, environmental impacts, and socioeconomic considerations. Additionally, it explored the challenges and limitations associated with GISbased dam site selection, such as data availability, accuracy, and the need for expert knowledge in interpretation and analysis.

Chapter one included the background of the research, the problem statement, objectives, justification and scope of the project research.

Chapter two included the brief overview of dam development in Africa, Uganda in particular, the description of GIS and MCDA for land suitability analysis, as well as the Analytical Hierarchy Process.

Chapter three included the tools and the methods, and/ or activities used to generate the suitability model. The final output of this project was land suitability maps for dam sites. According to the study, **44%** of Greater Soroti was highly suitable for dam site location, **41%** was moderately suitable and the rest **14%** was completely not Suitable for dam site location.

Chapter four included the methods used to validate the generated suitability model by actual findings on the ground, and experimental analysis. The findings of this research should therefore be considered by several stakeholders in order to increase water accessibility in Greater Soroti, Uganda and East Africa at large.

ACKNOWLEDGEMENT.

I give thanks to the Lord for He is good and His love endures forever, the fear of the Lord, is the beginning of wisdom

I owe my utmost recognition to my supervisor, **Mr. OKETCHO YORONIMO,** who contributed towards my success and completion of this project. Without his unreserved help, valuable guidance, patience and dedication, this study would not be achieved.

Special thanks go to administration of Busitema University more especially the Department of Mining and water Resources engineering for providing a conducive learning environment, and for always being there for me when I needed help; thanks so much for always bridging a gap for me to learn. I just won't forget your efforts soon.

I would like to convey my sincere appreciation to **Mr. BENEDICTO MASERUKA** for his meticulous guidance throughout the project period.

I indeed can't forget to appreciate my colleagues, the Collaborative BSc. Water Resources Engineering class of the year 2019, Busitema University, who were often there for me whenever I needed any help. I really thank you from the bottom of my heart.

Lastly, my sincere appreciation goes to my mother and brother for their friendship, generosity, love and kindness. I thank God for all the countless blessings that he has given me through them in every step of life.

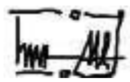
Above all, Almighty God, you are the master of everything, may you continue blessing us.

DEDICATION.

I dedicate this report to my supervisor, Mr. Oketcho Yoronimo and to the beloved Busitema University community and more specifically to my beloved daughter, Kemanzi M. Joseline. May the almighty God bless and reward them abundantly**.**

DECLARATION

I **TIKOL JOSEPHINE** of **REG No. BU/UG/2019/0005**, declare to the best of my knowledge that this thesis is as result of my research and efforts.

Student's signature:  --

Date: **11th September, 2023**

APPROVAL

This thesis has been submitted to the department of Mining and Water Resources Engineering of Busitema University with approval of the following University Supervisor.

Mr. OKETCHO YORONIMO

Signature:

Date:

Contents

LIST OF TABLES

LIST OF FIGURES

1.0 CHAPTER ONE: INTRODUCTION

In the year 2012, the United Nations held a conference on sustainable development in Rio de Janeiro. The objective was to produce a set of universal goals that meet the urgent environmental, political and economic challenges facing our world. In the year 2015, the 17 Sustainable Development Goals of the 2030 agenda were adopted by the world leaders and officially came into force (Bai et al., 2023). On 1st, January 2016, the United Nations via its Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs) stressed universal and provincial collaboration to ascertain water concerns then resolve them cooperatively (Whittingham et al., 2023). This was due to realization of the increasing universal water utilization in domestic, industrial and agricultural areas that posed a probable risk to the future generation.

1.1 Background

Several government bodies and countries met in 2015 to implement the seventeen sustainable development goals (Bai et al., 2023). Among the goals, end poverty in all its forms everywhere and end hunger, achieve food security, and improved nutrition and promote sustainable agriculture were obtained as SDGs one and two respectively. This was due to the realization that food insecurity and malnutrition consigns large portions of the population to poverty, scarcity, vulnerability, hunger, low prospects of human development and even death.

The African continent is amongst the fastest developing continents on the globe. Its population hopped steeply from 0.927 billion in 2005 to 1.427 billion in 2022 (Ibrahim et al., 2023). With this fast growing population, it is estimated that by 2030, an approximate population of 150 million persons in Africa are likely to encounter a serious water hassle, agricultural production would be strictly reduced and production from rain-fed farming would possibly diminish by about 50% in various areas (Gambe et al., 2023). It is estimated by the United Nations Environment Program that above 2 billion people will live under conditions of nonstandard water hassle by 2050 (Dafevwakpo et al., 2023).

Uganda currently has a population of 49.38 million people, growing at a rate of 3.32% annually (Kawuki et al., 2023); agriculture is a crucial sector accounting for only 23.84% of the country's GDP. This low level of agriculture contribution to GDP is due to unreliable rainfall that can hardly sustain several agricultural activities. In addition, approximately 19% of Ugandans only

REFERENCES

Ajibade, T. F., Nwogwu, N. A., Ajibade, F. O., Adelodun, B., & Idowu, T. E. (2020). *Potential dam sites selection using integrated techniques of remote sensing and GIS in Imo State , Southeastern , Nigeria*. *5*, 1–16.

Akumu, G. (2023). *https://doi.org/10.18697/ajfand.117.22345*. *23*(2), 22328–22353.

Al-ruzouq, R., Shanableh, A., Yilmaz, A. G., & Idris, A. (2019). *Dam Site Suitability Mapping and Analysis Using an Integrated GIS and Machine Learning Approach*.

Alatawi, S. (2015). *Dam Site Selection Using Remote Sensing Techniques and Geographical Dam Site Selection Using Remote Sensing Techniques and Geographical Information System to Control Flood Events in Tabuk City*. *January*. https://doi.org/10.4172/21577587.1000189

Arquero, A., Álvarez, M., & Martínez, E. (2009). *Decision Management Making by AHP (Analytical Hierarchy Process) trought GIS data*. *7*(1), 101–106.

Asala, L. (2017). *Site Suitability Mapping of Water Harvesting Structures Using GIS and Remote Sensing. Case Study: Machakos County*. http://geology.uonbi.ac.ke/node/1109

Bai, C., Zhou, H., & Sarkis, J. (2023). *Evaluating Industry 4 . 0 technology and sustainable development goals – a social perspective*. 0–21. https://doi.org/10.1080/00207543.2022.2164375

Basin, K. R., Khadka, J., & Bhaukajee, J. (n.d.). *Rainfall-Runoff Simulation and Modelling Using HEC-HMS and HEC-RAS Models : Case Studies from Nepal and Sweden*.

Bayazıt, Y., Bakış, R., & Koç, C. (2021). A study on transformation of multi-purpose dams into pumped storage hydroelectric power plants by using GIS model. *International Journal of Green Energy*, *18*(3), 308–318. https://doi.org/10.1080/15435075.2020.1865362

Browning, M. (2017). *Within What Distance Does ― Greenness ‖ Best Predict Physical Health ? A Systematic Review of Articles with GIS Buffer Analyses across the Lifespan*. 1–21. https://doi.org/10.3390/ijerph14070675

Collignon, B., & Collignon, B. (2000). *Region*. *June*. https://doi.org/10.13140/RG.2.2.27473.81761

Constantin, R., Guy, G., Vincent, C., Peters, V., & Dassargues, A. (n.d.). *GIS-based hydrogeological databases and groundwater modelling*. https://doi.org/10.1007/s10040-001-0167-3

Croke, K. (2023). Comparative Politics, Political Settlements, and the Political Economy of Health Financing Reform Comment on "Health Coverage and Financial Protection in Uganda: A Political Economy Perspective." *Kerman University of Medical Sciences*, *12*, 7630. https://doi.org/10.34172/ijhpm.2023.7630

Dafevwakpo, O. J., Hope Amadi, A., & Bello Anka, R. (2023). Realization of United Nations' Sustainable Development Goals (SDGs): The Project Manager's role. *International Journal of Social Science And Human Research*, *06*(01), 661–666. https://doi.org/10.47191/ijsshr/v6-i1-86

Dai, X. (2016). *Dam site selection using an integrated method of AHP and GIS for decision making support in Dam site selection using an integrated method of AHP and GIS for decision making support in Bortala , Northwest China By*. *14*.

Ding, L., & Kinnucan, H. W. (2011). This document is discoverable and free to researchers across the globe due to the work of AgEcon Search . Help ensure our sustainability . *Journal of Gender, Agriculture and Food Security*, *1*(3), 1–22.

Gambe, T. R., Turok, I., & Visagie, J. (2023). The trajectories of urbanisation in Southern Africa: A comparative analysis. *Habitat International*, *132*(December 2022). https://doi.org/10.1016/j.habitatint.2023.102747

Gebre, S. L. (2015). *Hydrology : Current Research Application of the HEC-HMS Model for Runoff Simulation of Upper Blue Nile River Basin*. *6*(2). https://doi.org/10.4172/21577587.1000199

Güven, A. B. (2019). Political economy. *The Routledge Handbook of Turkish Politics*, *554*, 151–162. https://doi.org/10.4324/9781315143842

Ibrahim, R. L., Al-Mulali, U., Ajide, K. B., Mohammed, A., & Al-Faryan, M. A. S. (2023). The Implications of Food Security on Sustainability: Do Trade Facilitation, Population Growth, and Institutional Quality Make or Mar the Target for SSA? *Sustainability (Switzerland)*, *15*(3). https://doi.org/10.3390/su15032089

Kawuki, J., Nambooze, J., Chan, P. S. fong, Chen, S., Liang, X., Mo, P. K. H., & Wang, Z. (2023). Differential COVID-19 Vaccination Uptake and Associated Factors among the Slum and Estate Communities in Uganda: A Cross-Sectional Population-Based Survey. *Vaccines*, *11*(2), 1–17. https://doi.org/10.3390/vaccines11020440 Kemunto,

N. (2016). *the University of Nairobi*. *November*, 1–3.

Lecturer, E., Neki, P., Sharma, R., & College, G. (2017). *Historical Development of Dams in India*. *22*(8), 16–18. https://doi.org/10.9790/0837-2208071618

Mugerwa, S., Stephen, K., & Anthony, E. (2014). *Status of Livestock Water Sources in Karamoja*. *4*(1), 58–66. https://doi.org/10.5923/j.re.20140401.07

Mutengu, A. K. J. (2011). *Evaluation of Community Resilience in Teso , Uganda*. *December*.

Natarajan, S., & Medium-sized, H. Á. H. Á. (2020). An Integrated Hydrologic and Hydraulic Flood Modeling Study for a Medium-Sized Ungauged Urban Catchment Area : A Case Study of Tiruchirappalli City Using HEC-HMS and HEC-RAS. *Journal of The Institution of Engineers (India): Series A*. https://doi.org/10.1007/s40030-019-00427-2 Njiru, F. M. (2017). *University of Nairobi*. *August*.

O'Brien, M. J., & Escudero, A. (2022). Topography in tropical forests enhances growth and survival differences within and among species via water availability and biotic interactions. *Functional Ecology*, *36*(3), 686–698. https://doi.org/10.1111/1365-2435.13977

Okello, D. K., Biruma, M., & Deom, C. M. (2010). *Overview of groundnuts research in Uganda : Past , present and future*. *9*(39), 6448–6459.

Oleyiblo, J. O., & Li, Z. (2010). Application of HEC-HMS for flood forecasting in Misai and Wan ' an catchments in China. *Water Science and Engineering*, *3*(1), 14–22. https://doi.org/10.3882/j.issn.1674-2370.2010.01.002

Othman, A. A., Al-maamar, A. F., Ali, D., Amin, M., Liesenberg, V., Hasan, S. E., Obaid, A. K., & Al-quraishi, A. M. F. (2020). *GIS-Based Modeling for Selection of Dam Sites in the Kurdistan Region , Iraq*.

Panagopoulos, T., Jesus, J., Antunes, M. D. C., & Beltr, J. (2006). *Analysis of spatial interpolation for optimising management of a salinized field cultivated with lettuce*. *24*, 1–10. https://doi.org/10.1016/j.eja.2005.03.001

Rienye, M. N. (2022). *University of Nairobi*. *June*.

Riley, L., & Crush, J. (2023). Transforming Urban Food Systems in Secondary Cities in Africa. In *Transforming Urban Food Systems in Secondary Cities in Africa*. https://doi.org/10.1007/978-3-030-93072-1

Rojanamon, P., Chaisomphob, T., & Bureekul, T. (2009). *Application of geographical information system to site selection of small run-of-river hydropower project by considering engineering*

/ economic / environmental criteria and social impact. *13*, 2336–2348. https://doi.org/10.1016/j.rser.2009.07.003

Romanescu, G., Romanescu, A., & Romanescu, G. (2014). *HISTORY OF BUILDING THE MAIN DAMS AND RESERVOIRS*. 485–492.

Roy, A., Mayega, W., Tumuhamye, N., Atuyambe, L., Bua, G., Ssentongo, J., & Bazeyo, W. (2015). *Qualitative Assessment of Resilience to the Effects of Climate Variability in the Three Communities in Uganda*. *July*.

Roy, D., Begam, S., Ghosh, S., & Jana, S. (2013). *CALIBRATION AND VALIDATION OF HECHMS MODEL FOR A RIVER BASIN IN EASTERN INDIA*. *8*(1), 40–56.

Taylor, R. G., Koussis, A. D., & Tindimugaya, C. (2009). *Groundwater and climate in Africa — a review*. *6667*. https://doi.org/10.1623/hysj.54.4.655

Whittingham, K. L., Earle, A. G., Hiz, D. I. L., & Argiolas, A. (2023). *The impact of the United Nations Sustainable Development Goals on corporate sustainability reporting*. https://doi.org/10.1177/23409444221085585

Yavuz, F. (2016). *AHP and GIS based land suitability analysis for Cihanbeyli (Turkey) County*. https://doi.org/10.1007/s12665-016-5558-9