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FACULTY OF ENGINEERING

DEPARTMENT OF AGRICULTURAL MECHANIZATION AND IRRIGATION ENGINEERING

FINAL YEAR UNDERGRADUATE THESIS

IDENTIFICATION OF RAINWATER HARVESTING AREAS FOR DEVELOPMENT OF IRRIGATION WATER RESOURCES IN UGANDA

CASE STUDY: KARAMOJA REGION, NORTH-EASTERN UGANDA

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A final Year Undergraduate Thesis Submitted to the Department of Agricultural Mechanization and Irrigation Engineering as a Partial Fulfillment of the Requirements for the award of a Bachelor of Agricultural mechanization and Irrigation Engineering, Busitema University

DATE…………………………………………………………

ABSTRACT

Globally, the increasing water scarcity due to climate change is becoming a major threat for dry land irrigation agriculture development. This is a similar case with Karamoja, one of the poorest and most disadvantaged regions in Uganda facing a water crisis with only one crop season from April to November. Rainwater harvesting (RWH) is an emerging sustainable solution to mitigate water scarcity and enhance irrigation agriculture in such regions. However, identifying the suitable areas for RWH is quite difficult, time consuming and requires technical skills. This research aims to model and identify RWH areas using integrated multi-disciplinary approach of geographical information systems (GIS) and hydrological modeling techniques. Spatial data, including rainfall, topography, soil types, and land use, were analyzed to develop a comprehensive understanding of the region's hydrological characteristics. The crop water needs of two major crops; maize and sorghum were estimated using PM-FAO method in QGIS and Excel.

Soil conservation system curve number method was employed to estimate runoff, water availability and runoff capacity, considering different water demand scenarios for irrigation agriculture. The model considered factors such as catchment characteristics, water retention structures, and cropping patterns to assess the feasibility and potential impact of rainwater harvesting systems. The results show that 6.4%, 40%,2.9%, 52.9%, and 0.9% of land are not suitable, marginally suitable, moderately suitable, suitable and highly suitable respectively for RWH with 42% of areas ideal for irrigation agriculture development. Most of the area's slopes support RWH and irrigation agriculture, as confirmed by the validation test.

The study findings provide valuable insights into the suitability of different areas within the Karamoja region as catchments for RWH. The highlighted locations where RWH infrastructure can be implemented to support irrigation agriculture and agropastoralism thereby contributing to food security and improved livelihood in the region. Above all the research findings contribute to the scientific knowledge and understanding of RWH as a viable and climate solution for agricultural development in semi-arid regions.

DECLARATION

I AWINO SINDRELLA, with Registration number BU/UG/2019/0133, declare to the best of my knowledge that this project report is as result of my research and efforts and has never been presented to any institute of higher education for any award.

Students signature : ....

Date : 15/09/2023

APPROVAL

This Thesis has been submitted to the Department of Agricultural Mechanization and Irrigation Engineering of Busitema University with the approval of my project Supervisors and head of department.

MR. BWIRE DENIS

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GIS Geographic Information System

MCDA Multi-criteria Decision Analysis

LULC Land Use and Land Cover

FAO Food and Agricultural Organization

AHP Analytical Hierarchy Process

SCS Soil conservation service

CV Curve number

MCE Muti Criteria Evaluation

RWH Rainwater harvesting

1.0 CHAPTER ONE

1.1 Introduction

This chapter highlights the background related to water scarcity issues, the problems arising from water scarcity, the research that has been carried out and the innovations that have been used to mitigate water scarcity and its related problems, particularly in the Karamoja region using water harvesting.

1.2 BACKGROUND

Global concern on increasing water scarcity and food insecurity is fueled by the impacts of food demand and climate change (World Bank, 2016). Irrigation agriculture is the main consumer of water worldwide, accounting for approximately 70% of the total freshwater withdrawals from rivers, lakes , and aquifers (FAO, 2020). However, irrigation is increasingly being affected by climate change events more so drought, changing precipitation patterns, rising temperatures and more frequent extreme weather events, increasing the demand for water for irrigation in many regions. This calls on emphasizing the importance of efficient water management practices in agriculture to ensure sustainable use of this valuable resource. Additionally, as global demand for food continues to increase, more pressure on water resources for irrigation is expected to grow, requiring innovative solutions for water-efficient farming techniques.

Water harvesting is an innovation in the field of water management that involves the process of collecting and storing rainwater for future use. In many regions of the world, including Uganda in East Africa, water harvesting is essential for developing resources and irrigation agriculture, particularly in areas prone to droughts or where water resources are limited (Sharma &Sharma,2017). Climate change is expected to worsen water scarcity in many regions, including Uganda, making water harvesting even more critical(UNDP,2019).

According to the Uganda National Meteorological Authority, the country is already experiencing the impacts of climate change, including changes in rainfall patterns and increased frequency of extreme weather events such as droughts and floods(UNMA, 2021). As a result, there is a need to identify and model water harvesting areas that can help mitigate climate change’s impacts on water resources and agriculture in Uganda.

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