
FACULTY OF ENGINEERING
DEPARTMENT OF WATER RESOURCES
AND MINING ENGINEERING
A SOCIO-HYDROLOGICAL APPROACH TO
SEDIMENTATION CONTROL IN
IRRIGATION VALLEY DAMS: CASE STUDY
OF APUWAI RESERVOIR

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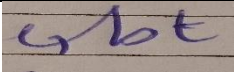
First, we would like to thank the almighty God for keeping us in good health and offering us the opportunity to undertake this project.

I express my gratitude to my supervisors Mr. Kajubi Enock and Mr. Kimbowa George for their guidance, supervision, and support throughout this entire work. Their kindness and patience enabled me to enjoy the process and conclusion of this project.

DECLARATION

I, NIWANDINDA GILBERT declare that this report is my research and has not been submitted before to any university or institution of higher learning for any academic award, except where due acknowledgment has been made in the text and reference list.

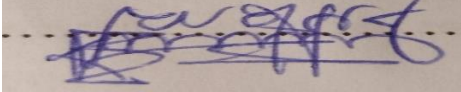
I stand to defend all this information contained in this report and regret any queries that may arise out of it if there are any.

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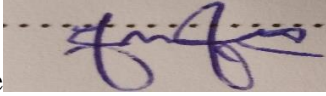
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DEDICATION

I dedicate this report to my late mummy MARIA RWOMUSHANA. May your soul continue to Rest in Peace.

ABSTRACT

Sedimentation of reservoirs continues to be a significant problem for reservoir operations all over the world. The reservoirs' storage capacity and useful life are decreased by sediment accumulation. Many Ugandan reservoirs and rivers, including the Apuwai Dam, have sediment-related problems such as decreased water quality and quantity for domestic use and irrigation, flooding, and damage to structures. The rate of sedimentation in the Apuwai reservoir catchment is accelerated by deforestation, overgrazing, and poor land management, among other factors. The study's objectives included finding out the watershed's sediment yield, pinpointing the worst-affected areas with the aid of the RUSLE model and SMCE analysis in a GIS framework for better decision support, and determining the community's WTP for sedimentation mitigation measures using the Dichotomous Choice-Contingent Valuation Method. The research established that the annual soil loss was $572tha^{-1}yr^{-1}$, the SDR ranged from 0 to 0.7469, and the estimated average annual sediment yield in the dam watershed in $13.955tha^{-1}yr^{-1}$. The trap efficiency of the reservoir was estimated to be 79.7% with an annual sedimentation rate of $4,893.730m^3yr^{-1}$. The sediment yield based on catchment characterization was $11.3109tha^{-1}yr^{-1}$. The study found that WTP for sedimentation measures of Yes reduces as the price of the offer increase and that 19.3 percent of the total respondents showed WTP while 80.7 percent did not.

Keywords: Reservoir sedimentation, Revised Universal Soil Loss Equation, Spatial Multi-Criteria Evaluation, Sediment Delivery Ratio, Trap efficiency, Willingness to pay, DC-CVM

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LIST OF ACRONYMS

MWE - Ministry of Water and Environment

SDG – Sustainable Development Goals

GIS – Graphic Interface System

DEM – Digital Elevation Model

AHP – Analytical Hierarchy Process

RUSLE – Revised Universal Soil Loss Equation

MCDA – Multi-Criteria Decision Analysis

CVM – Contingent Valuation Method

WTP -Willingness to Pay

CWP -Community Willingness to Pay

SMCE – Spatial Multi-Criteria Evaluation

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1 INTRODUCTION

This chapter includes the following; background to the study, statement of the problem, the purpose of the study, objectives of the study, scope of the study, and finally the significance of the study.

1.1 Background

The issue of food insecurity continues to be a serious worry due to the growing population in many developing nations(Karunaratne et al., 2021). Over-reliance on rain-based agriculture and the failure to maximize irrigation capacity are the main causes of food poverty. However, non-governmental organizations and governmental organizations have constructed hundreds of valley dams in regions with insufficient groundwater or surface water to store water for irrigation, domestic water supply, hydropower generation, flood control, and recreational activities to improve agriculture for the growing population. (MAAIF & MWE, 2017). Small-scale irrigation systems based on valley dams are being encouraged since they require less maintenance, are less complicated to operate, and are environmentally beneficial(Kizza et al., 2017).

However, due to insufficient sediment management strategies, such as dam sediment routing, periodic sediment desilting, and catchment management to reduce soil erosion, the useful life of many of these dams is drastically reduced to the point that some are filled with sediments after a few years of their establishment and become useless. (Andredaki et al,2015).

Around the world, reservoir sedimentation is still a major concern considering reservoirs lose 0.5% to 1% of the total stored volume of water each year (Ali & Shakir, 2018). For the entire continent of Africa, it is estimated that soil erosion decreases production by 8.2% on average, and that reservoir storage levels are silted by an average of 19%. Sediment accumulation usually requires mechanical removal, which is expensive. Rivers and reservoirs get filled with sediment, which lowers their capacity to hold back floodwaters. Sediment is regarded as a significant contaminant. It can restrict fish from spawning and impede plants from receiving essential sunlight.

Some valley dams in Uganda, like the Kisote dam and the Dana dam, have entirely silted up before their design life and are now useless. This is due to Uganda's vulnerability to soil erosion brought by inadequate land management practices, steep slopes, and excessive rainfall, there is a large amount of sedimentation (Iradukunda & Bwambale, 2021).

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