FACULTY OF ENGINEERING

DEPARTMENT OF WATER RESOURCES

FINAL YEAR PROJECT REPORT

FLOOD RISK ASSESSMENT AND MITIGATION ALONG RIVER UNYAMA.

CASE STUDY: ELEGU FLOOD PLAIN, AMURU DISTRICT

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ABSTRACT

Unyama sub-catchment has an estimated drainage area of 1565 km^2 covering parts of Gulu and Amuru districts. The high stages of R. Unyama in Elegu flood plain are caused by heavy rains in Gulu and Amuru districts. This challenge has existed since 1960 but limited interventions have been done as businesses and other activities continue to be stifled. This research focused on flood risk assessment and mitigation along river Unyama in Elegu flood plain. Flood risk assessment was done through hydrologic and hydrodynamic modelling techniques. Since R. Unyama is not gauged, a rainfall-runoff model was developed using Arc-SWAT, Gumbel distribution method was used to analyze discharges for various return periods. Flood analysis was done using HEC-RAS software version 6.2, flood inundation maps corresponding to discharges of different return periods were developed and analyzed. A multi criteria approach was used to determine the most effective structural flood mitigation measure along river Unyama. Diversion and detention was found to be the most appropriate mitigation measure, Diversion channels were designed upstream of Elegu flood plain to divert the flood water before it reaches Elegu flood plain and store it in detention ponds such that it can be released at gradual and controlled intervals with an aim of attenuating the flood., the diversion and control structures were designed and simulated in HEC-RAS. Detention ponds were sized using hydrology studio, a flood routing-based software. The findings of the study were as follows; the discharges of 5, 7, 10, 25,100 and 200-year return periods were 200m^3/s, 233 m^3/s, 270 m^3/s, 360 m^3/s, 493 m^3/s, 558 m^3/s respectively. A 10-year return period discharge of 270 m^3/s was considered as the design discharge of the diversion structure. Three diversion channels were designed and simulated, diversion channels one, two and three diverted, 29.3%, 33.7% and 15.6% of the total peak flow respectively from the river to detention ponds while 21.5% of the total peak discharge continued to Elegu flood plain where very minimal flooding occurred with maximum flood depth of 0.009m. Some of the recommendations included; the MWE should consider installing a river gauging station on River Unyama to ensure availability of accurate and reliable data, research should be done on willingness to pay for project implementation by the local people, the scouring effect of water on the gates and the channels should also be investigated.

DECLARATION

We (Kia Esther and Namonye Sam) declare that this report is our own research and has not been either used nor submitted in any institution or university for any academic award.

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MR. NAMONYE SAM		
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APPROVAL

This research has been conducted and written under the supervision of;

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Mr. Oketcho Yoronimo		
Mr. Mugisha Moses		

DEDICATION

We dedicate this report to our lovely parents Mrs. Betty Neumbe, Mrs. Beatrice Nabonyo, Mr. Odit John and Mrs. Dorcus Odit.

We also dedicate it to all our siblings.

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HEC-RAS: Hydrologic Engineering Centre – River Analysis System

GIS: Geographic Information System

SWAT: Soil and Water Analysis Tool

WGS: World Geodetic System

DWRM: Directorate of Water Resource Management

UNMA: Uganda National Meteorological Authority

WMO: World Meteorological Organization

MWE: Ministry of Water and Environment

UTM: Universal Transverse Mercator

R. Unyama: River Unyama

FAO: Food and Agricultural Organization.

NSE: Nash-Sutcliffe Efficiency

WBG: World Bank Group

USGS: United States Geological Survey

USDA: United States Department of Agriculture

PF: Profile Flow

DEM: Digital Elevation

CBWRM: Catchment-Based Water Resource Management

CMP: Catchment Management Plan

m: meter

km: kilo-meter

m3/s: Cubic meter per second

m/s: meters per second

NDPs: National Development Goals

NWSC: National Water and Sewerage Cooperation

SDGs: Sustainable Development Goals

NGO: Non-Governmental Organizations

MTIC: Ministry of Trade, Industry and Cooperatives

NEMA: National Environmental Management Authority

UBOS: Uganda Bureau of Statistics

UNWMZ: Upper Nile Water Management Zone

WMZ: Water Management Zone

SPF: Standard Project Flood

MPF: Maximum Probable Flood

1.0 CHAPTER ONE

1.1.0 INTRODUCTION.

This chapter consists of; Background, problem statement, main objective, specific objectives, scope of the study and finally the justification.

1.2.0 BACKGROUND

Flooding is one of the major climatic calamities affecting the world socially, economically and politically. Some of the major floods which have occurred in the world include; 1931 China floods which claimed about 4 million lives, 1938 yellow river floods which claimed about 800,000 lives in China, Banqiao floods of 1975 which claimed about 230,000 lives in China. z(Rentschler & Salhab, 2020)

Globally, flooding is still a big challenge to even the first world countries like China, Japan and many others. Flooding remains the most significant natural hazard worldwide, in the period of 1985-2008 extreme rainfall events were responsible for destructions worth USD 700 billion. (Rentschler & Salhab, 2020)

In Africa, some of the countries which have been severely hit by floods include; Algeria, Ethiopia, south Africa, Uganda, Kenya and many others. (Lumbroso, 2020)

Uganda is at risk of natural disasters due to occurrence of extreme weather events which lead to mudslides, landslides and flooding. Increased intensity of heavy rainfall has led to greater impact of floods causing more damage due to expanded infrastructure, human settlement and general development of the country. (WBG, 2021)

In Uganda, Some of the major floods have occurred in districts like Kasese, Bundibugyo, Kampala, Bududa, Amuru, Gulu and many others. (WBG, 2021)

Worldwide, several mitigation measures have been employed to avert and reduce the effect of the floods. These mitigation measures are either structural or non-structural. Some of the structural methods which have been used include; construction of levees, flood ways, diversion channels, dredging, recession agriculture/spate irrigation and many others. Some of the non-structural methods employed in reducing the effects of flooding include; flood warning and detection systems, insurance and many others.

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