



**PREDICTING THE EFFECT OF LAND USE/LAND COVER CHANGE ON
CATCHMENT SOIL EROSION RISK USING SWAT MODEL
CASE STUDY OF MANAFWA SUB CATCHMENT, UGANDA**

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DECLARATION

I, the undersigned, certify that, with the exception of the places where proper credit has been given, this research report is all my own. I certify that neither this university nor any other institution has ever received this work for funding or partial fulfilment of any award.

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APPROVAL

This study titled “Predicting the effect of Land use/Land cover change on catchment Soil Erosion Risk using SWAT Model: case study of Manafwa Sub Catchment, Uganda”, has been submitted for examination in partial fulfillment for the award of Masters of Science in Irrigation and Drainage Engineering of Busitema University with the approval academic supervisor(s);

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DEDICATION

This research reports is dedicated to my beloved family.

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LIST OF ABBREVIATIONS AND ACRONYMS

AOI	Area of Interest
DEM	Digital Elevation Model
DV	Dependent Variable
EE	Earth Explorer
ETM	Energy Transition Mechanism
FAO	Food and Agricultural Organization
GDP	Gross Domestic Product
GIS	Geographical Information System
GLCF	Global Land Cover Facility
GLP	Global Land Programme
GWP	Global Water Partnership
IV	Independent Variable
IWRN	International Water Resources Network
KMs	Kilometers
KWMZ	Kyoga Water Management Zone
LUCC	Land use cover change
LULC	Land use and Land cover
MWE	Ministry of Water and Environment
NBO	Network of Basin Organization
NEMA	National Environmental Management Authority
NFA	National Forestry Authority
NSE	Nash Sitcliffe Efficiency
RGS	River Gauging Station
RS	Remote Sensing
RUSLE	Revised Universal Soil Loss Equilibrium
SRTM	Shuttle Radar Topography Mission
SSA	Sub-Saharan Africa
SWAT	Soil and Water Assessment Tool
UBOS	Uganda Bureau of Statistics
UNEP	United Nations Environmental Programme
UNESCO	United Nations Education Scientific and Cultural Organization
USA	United States of America
USGS	United Nations Geographical Survey
USLE	Universal Soil Loss Equilibrium

DEFINITION OF OPERATIONAL TERMS

Land cover: - refers to the natural biophysical characteristics found on land surfaces (Food and Agriculture Organisation, 2018). Land cover consists of plant, water, ice, bare rock, soil, and marshes (Majaliwa et al., 2018).

Land use/cover change: - is a human-induced modification of the earth's terrestrial surface (Sushanth et al., 2019). The rate at which one type of land use/cover gives way to another is referred to as land use/cover transition (Lü, Gao, Xiao & Fu., 2020).

Land use: - is a sequence of operations on land carried out by humans to get products and/or benefits through the use of land resources (Kiggundu et al., 2018; Obeidat et al., 2019); it is constituted of subsistence farming, commercial farming, and infrastructure (Bai, Sheng, Zhao & Zhang., 2020).

Sediment yield: - is the amount of sediment that reaches or passes through a site of interest in a given time period. It is estimated in tonnes per year, MCM per year, or millimetres per year. However, sediment yield from a watershed is estimated as the annual average sediment yield computed based on long-term historical data (Ellis, 2013).

Soil erosion: - Morgan (2015) describes soil erosion as the displacement and deposition of soil from its original location to another one, concluding that precipitation, runoff, wind, and gravitational forces are all involved for soil erosion, which is ideal in natural conditions.

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ABSTRACT

The Manafwa River sub-catchment in eastern Uganda has undergone significant changes in land use and land cover (LULC) over the past two decades, primarily driven by agricultural expansion. Such transformations have profound effects on hydrology, sediment dynamics, and flood risk. This study applied the Soil and Water Assessment Tool (SWAT) to evaluate the impacts of LULC changes on streamflow, soil erosion, and catchment hydrology from 2004 to 2024. LULC trends were first quantified, followed by SWAT calibration and validation using daily flow data, and scenario analyses to assess hydrological responses under varying land use scenarios. Results indicate that cropland expanded by 5%, while wetlands and forested areas declined by 5.5% and 2%, respectively. Flood hazard mapping revealed that built-up areas and commercial farmlands are highly vulnerable, whereas natural ecosystems exhibited low to moderate vulnerability. Hydrological simulations demonstrated strong model performance ($NSE = 0.86$ for calibration and 0.77 for validation), with LULC changes increasing streamflow (from 0.49 to 0.54), surface runoff (from 0.26 to 0.33), and reducing evapotranspiration (from 0.49 to 0.44). Scenario analyses revealed that low-flow conditions are more sensitive to land-use changes than high-flow events. The risk of soil erosion increased markedly in areas converted from grassland, forest, and wetland to subsistence farmland, particularly on steep slopes. The findings underscore the critical need for integrated land management strategies, including agroforestry, contour banding, and soil conservation measures, to mitigate runoff, enhance infiltration, and reduce erosion. This study demonstrates the utility of SWAT for predicting the hydrological and ecological consequences of LULC change and provides actionable insights for sustainable watershed management in tropical catchments.

Key words: Catchment, land use/cover, water resources, scenarios, hydrological modelling

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