BUSITEMA UNIVERSITY
Pursuing Excellence

FACULTY OF ENGINEERING

DEPARTMENT OF MINING AND WATER RESOURCES ENGINEERING

ASSESSING THE IMPACT OF FUTURE WATER DEMAND ON RIVER RWIZI

BY

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ABSTRACT

Due to effects of increasing demand on water, attributed to increasing population and increased industrialization, sustainable development in terms of water management has become a big challenge. To meet the demands of the Mbarara municipality; proper planning for careful use of limited resources is essential. This research has been carried out to determine the availability of water in micro Mbarara municipality catchment. The analysis has been carried out by using ArcSWAT for time period of 21 years from 1993 to 2014. Integrated management planning network was also developed based on Water Evaluation and Planning (WEAP) to evaluate the impact of future water demand on the river under different scenarios. WEAP was used to investigate major stresses on demand and supply in terms of water availability in the river Rwizi. A customized WEAP model of Rwizi catchment was developed, taking into account the different water users in the municipality as demand points (municipal, rural and livestock). The model was calibrated for year 2014 using several quantitative statistics (coefficient of determination, R^2; Nash-Sutcliffe efficiency, NSE and Percent bias, PBIAS). Measured streamflow and simulated streamflow were used for calibration. The trend of supply and demand in the municipality was evaluated under four scenarios from year 2014 to year 2040, these include reference scenario, higher growth rates scenario, climate variation scenario (extended wet and seasons under reference scenario, extended wet and dry seasons under higher growth rates) and demand management options scenario. Demand management scenario was divided into reduction of non-revenue water (NRW) from 31.2% to 28% and demand management programs with a reduction of 20% of total annual water demand in the municipality. Results show that the available water in micro Mbarara municipality by 2014 was 1.74m^3/s. The water demand will continue to increase over the coming years which is majorly due to the urbanization of the municipality (municipal water use contributed 86.3% and 88.2% of the total water demanded by 2040 under reference scenario and higher growth rates scenario respectively) and the river will only be able to sustain the varying demand up to year 2029 under extended wet climate, up to year 2028 under extended dry climate and up to year 2033 under normal climate considering both demand management options of reduced NRW and demand management programs.

DECLARATION

I AYEBARE LUCKY do here by declare that this final year project report is my original work and to the best of my knowledge, it has never been published and submitted for the award of any academic qualification in any University before.

Signature..

AYEBARE LUCKY

BU/UG/2014/103

APPROVAL

This is to approve that this report has been fully and consistently worked on and submitted to the Department of Mining and Water Resources Engineering under the supervision of the undersigned supervisors;

………………………………………………… …………………………………………………

MR. MUGISHA MOSES

Main supervisor

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DEDICATION

I dedicate this report to my beloved mother Korubaro Enid who has tiresomely worked hard, provided the best for my wellbeing in all aspects of life may the Almighty God bless you and protect you always.

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First things first, I thank the ALMIGHTY GOD for enabling me among the many to be the channel through which his glory is manifested. Father thanks for being in me and guiding me through my studies and my entire life.

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LIST OF ACRONYMS

UBOS	Uganda Bureau of Statistics
DWRM	Directorate of Water Resources Management
FAO	Food and Agriculture Organization
UNMA	Uganda National Meteorological Authority
DEM	Digital Elevation Modal
HMS	Hydrological Modelling System
HEC	Hydrological Engineering Centre
GIS	Geographical Information System
WEAP	Water Evaluation and Planning Model
DSS	Decision Support System
DSM	Demand-side management
SWAT	Soil Water and Assessment Tool
HRU	Hydrological Response Units Distribution
MCM	Million Cubic Meters
CMS	Meters cubed per second

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CHAPTER ONE

1.1 Introduction

This chapter includes the background of the study, problem statement, objectives, justification and the scope of the study.

1.2 Background of the study

Water is an indispensable resource for agriculture, modern industrial production and much more. This indispensable quality makes the world's growing scarcity of fresh water a potential catastrophe for humanity. Almost three billion people (or 44% of the world's population) live in regions where fresh water resources are under severe stress. This troubling figure is set to rise to 3.9 billion by 2030(Lean & Editor, 2009).Today, the world's freshwater resources are under increasing pressure. Growth in population, increased economic activity from industry, urbanization, and improved standards of living have led to increased competition for and conflicts over the limited freshwater resource.

Water is not only crucial to life, without plentiful supplies of water the world's systems of modern agriculture and industrial production would collapse. Growing water scarcity demands new solutions, especially as the complexities of water management increase with population growth, increased urbanization and climate change(TAC, 2000). As according to research published in UN-Habitat's flagship report, The State of the World's Cities 2010-2011, all developing regions, including the African, Caribbean and Pacific states, will have more people living in urban than rural areas by the year 2030(Sengendo, Banduga, Obita, & Awuzu, 2012)

Between 2011 and 2050, the world population is expected to increase by 33%, growing from 7.0 billion to 9.3 billion (UNDESA, 2011)Population growth, urbanization, industrialization, and increases in production and consumption have all generated ever-increasing demands for freshwater resources(Growth, Global, & Demand, 2015)indicated that by 2030, the world is projected to face a 40% global water deficit under the business-as-usual climate scenario(Action, 2012).

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Nash, E., & Sutcliffe, V. (1970). PART I- A DISCUSSION OF PRINCIPLES * The problem of determining river flows from rainfall , evaporation , and other factors , occupies a central place in the technology of applied hydrology . It is not only the essential problem of flood forecasting but also arises , for example , in predicting the effects of proposed works on a catchment on the flow regime at the outfall . Most studies of representative and experimental basins and a large part of the effort of classical hydrology have been directed towards obtaining at least a partial solution of this problem . Routine flood forecasting requires , in addition to a model or estimate of the operation of transforming input data into discharge , a method of continuous correction of the forecast from the observed error of earlier forecasts . The two require- ments are separable and may be studied separately . The present study is confined to the development of an adequate model of the transformation of rainfall and other input data into discharge . Despite the attention which this problem has attracted over many years , the present position is far from satisfactory . Few hydrologists would confi- dently compute the discharge hydrograph from rainfall data and the physical description of the catchment . Nevertheless this is a practical problem which must often be faced by practising engineers . Although it would be extremely rash to think that a general answer is near or that techniques will soon be ready to produce accurate forecasts for specific catchments , recent experience, *10*, 282–290.

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