



BUSITEMA UNIVERSITY

FACULTY OF NATURAL RESOURCES AND ENVIRONMENTAL SCIENCES

DEPARTMENT OF NATURAL RESOURCE ECONOMICS

**ASSESSMENT OF LAND DEGRADATION USING THE NORMALISED DIFFERENCE
VEGETATION INDEX (NDVI)
A CASE OF LUWERO DISTRICT**

By

SEMBATYA REAGAN

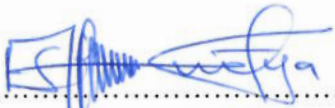
BU/UG/2015/2146

JUNE 2018

**RESEARCH THESIS SUBMITTED TO THE FACULTY OF NATURAL RESOURCES
AND ENVIRONMENTAL SCIENCES FOR PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE AWARD OF THE DEGREE OF BACHELOR OF
SCIENCE IN NATURAL RESOURCE ECONOMICS OF BUSITEMA UNIVERSITY**

DECLARATION

I hereby declare that the work presented in this research report is original and has not been submitted to any university or any other institution of higher learning for any academic award.

Signature.....

Date.....22nd / 07 / 2018

SEMBATYA REAGAN

APPROVAL

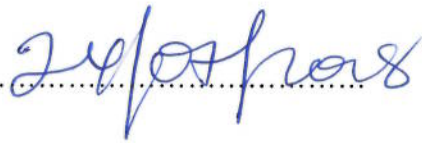
This is to certify that this research report submitted by Sembatya Reagan BU/UG/2015/2146 has been done and completed under my supervision. Therefore I recommend it for submission to the faculty of Natural Resources and Environmental Sciences, Department of Natural Resource Economics, Busitema University.

SUPERVISOR



.....
PROF. MOSES ISABIRYE (PhD)

DATE



DEDICATION

I dedicate this piece of work to my dear Father, Mum Mrs. Nabukeera Scovia, my brothers and sisters (Sekiganda Joas, Namwanga Marion, Nakato Miracle and Babirye Mercy), and my uncles Mr. Kamoga Daniel and all the family members who tirelessly provided me with financial and moral support just for the purpose of seeing me excel in life. Also to my dear friends Magoba Tracy Deborah and Tugabirwe sumaiya for the day to day support and to the rest of my classmates. May the almighty God bless you abundantly.

ACKNOWLEDGEMENT

I am delighted to extend my gratitude to the Almighty God for the gift of life, knowledge wisdom and for enabling me accomplish this work.

I greatly thank my dear Father, my loving Mum Mrs. Nabukeera Scovia, my brothers and sisters (Joas, Marion, Babirye and Nakato) and Uncles Mr. Kamoga Daniel, Mr. Galimaka Hosea for the courage and support in terms of finance and prayer you offered to me.

I also wish to acknowledge the contribution of my dear friends especially Magoba Tracy Deborah, Tugabirwe sumaiya and the rest of the entire students of Busitema University, Faculty of Natural Resource and Environmental Sciences.

Special thanks goes to my academic supervisor Professor Moses Isabirye for sacrificing his time just for me to have this work done successfully and for further guidance. May the God lord bless you so much.

LISTS OF ACRONYMS/ABBREVIATIONS

ERDAS	Earth Resource Data Analysis System
ETM+	Enhanced Thematic Mapper
FAO	Food and Agriculture Organization
GIS	Geographic Information System
GLASOD	Global Assessment of Human-induced Soil Degradation
GOU	Government of Uganda
GPS	Global Positioning System
Km ²	Square kilometer
NDVI	Normalized Differencing Vegetation Index
NEAP	National Environmental Action Plan
NEMA	National Environmental Management Authority
NIR	Near infrared
NMSA	National Meteorological System Agency
TIN	Triangulated Irregular Network
TM	Thematic Mapper
UNEP	United Nations Environmental Programme
UNESCO	United Nations Education, Science, Culture organization
USLE	Universal Soil Loss Equation
UTM	Universal Transverse Mercator
WGS	World Geodetic Survey
UNCCD	United Nations Convention to Combat Desertification

LIST OF FIGURES

Figure 1 : Conceptual framework	4
Figure 2 : Reflectance of different surface types as a function of wavelength bands	9
Figure 3 : A map of Uganda showing the location of Luwero district.	13
Figure 4 : A map of Luwero district showing its sub counties and parishes.	13
Figure 5 : Shows low degraded land (pure green)	21
Figure 6 : Shows highly degraded land (bare land)	21
Figure 7 : NDVI change due to change in land cover.....	25
Figure 8 : Comparison of Land cover change between 1995 and 2015.....	26
Figure 9 : summary of Land cover change and degradation between 1995 and 2015.....	27
Figure 10 : Land cover map, 2015	28
Figure 11 : Land cover change between 1995 and 2015.	29
Figure 12 : Summary of SDG 15.3.1 between 1995 and 2015	29

LIST OF TABLES

Table 1 : SO1-1 Trends in land cover.....	18
Table 2 : Land area by type of land cover transition (sq. km) between 1995 and 2015.....	22
Table 3 : Summary of SDG 15.3.1 Indicator.....	23
Table 4 : Land cover change by cover class between 1995 and 2015.....	23
Table 5 : Summary of change in land cover between 1995 and 2015.....	24

TABLE OF CONTENTS

DECLARATION	ii
APPROVAL.....	iii
DEDICATION	iv
ACKNOWLEDGEMENT	v
LISTS OF ACRONYMS/ABBREVIATIONS	vi
LIST OF FIGURES.....	vii
TABLE OF CONTENTS.....	ix
ABSTRACT	xii
CHAPTER ONE: GENERAL INTRODUCTION	1
1.0 Introduction	1
1.1 Background of the study	1
1.2 Problem statement.....	2
1.3 objectives of the study.....	3
1.3.1 General objective.....	3
1.3.2 Specific objectives.....	3
1.4 Research questions	3
1.5 Significance of the study.....	3
1.6 Justification of the study	4
1.7 Conceptual framework.....	4
1.8 Scope of the study	4
CHAPTER TWO: LITERATURE REVIEW	5
2.0 Introduction.....	5
2.1 Land degradation in perspective	5
2.2 Extent and causes of land degradation in Uganda.....	5
2.3 Land degradation in Luwero district.....	7
2.4 Land degradation and Land use/ land cover change	7
2.5 Remote Sensing (RS)	8
2.6 Geographic Information Systems (GIS).....	8
2.7 NDVI as an indicator of vegetation condition	8
2.8 Use of satellite remote sensing and GIS in Assessing Land Degradation	10

CHAPTER THREE: METHODOLOGY	12
3.0 Introduction	12
3.1 Description of the study area.....	12
3.1.1 Location	12
3.1.2 Size	12
3.1.3 Soils	12
3.1.4 Administrative Units.....	12
3.1.5 Climate.....	12
3.2 Research design.....	14
3.3 Types of Data	14
3.3.1 Primary data.....	14
3.3.2 Secondary Data.....	14
3.4 Target data.....	14
3.5 Study population	14
3.6 Sample size.....	15
3.7 Sampling strategies	15
3.8 Methods of data collection	15
3.8.1 Use of NDVI.....	15
3.8.2 Use of GIS	15
3.8.3 Interviews	15
3.8.4 Observation.....	16
3.8.5 Use of GPS	16
3.9 Data processing analysis	16
3.9.1 Processing.....	16
3.9.2 Data analysis.....	16
3.10 Ethical consideration	16
3.11 Constraints to Data Collection	17
3.12 Research tools	17
3.13 Reliability	17
CHAPTER FOUR; PRESENTATION OF RESULTS	18
4.0 Introduction.....	18

4.1 Land Use / Land Cover Changes.....	18
4.2 Land Cover Assessment.....	19
4.3 Extent of land degradation in Luwero District.....	20
4.4 Land cover and land use types in the area.....	22
4.5 Assessment of land cover degradation in the area	23
4.6 Comparison between the rate of NDVI change due to change in land cover	24
CHAPTER FIVE: DISCUSSION OF RESULTS	26
5.0 Introduction.....	26
5.1 comparison of Land cover change from 1995 to 2015.....	26
5.2 Land cover change and degradation.....	27
CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS.....	31
6.0 INTRODUCTION.....	31
6.1 CONCLUSION.....	31
6.2 RECOMMENDATIONS	32
BIBLIOGRAPHY	34
APPENDIX; FIELD PHOTOS.....	36

ABSTRACT

This study is aimed at assessment of land degradation using the normalized difference vegetation index (NDVI) a case of Luwero district.

Accordingly, classes classified as intensively cultivated and degraded / barren lands were expanding in a real coverage at the expense of others. However, moderately cultivated, wood and grazing lands of the study area became reduced in size in the time span of 2001 to 2015.

On the other hand, NDVI images analysis comparison also done to look into the vegetation/ land cover degradation or change between 1995 and 2017 images, its result implies a decline in land cover taking the standard deviation variation in to account.

CHAPTER ONE: GENERAL INTRODUCTION

1.0 Introduction

This chapter discusses the background to the study and the general situation of land degradation in Uganda, problem statement, research objectives, research questions and conceptual framework.

1.1 Background of the study

Land is a complex resource composed primarily of soil, water and biodiversity. The product of their interactions, ecosystem goods and services, is the foundation for sustainable livelihoods, social cohesion and economic growth. Communities and countries can no longer afford to waste this valuable resource.

Land degradation refers to any reduction or loss in the biological or economic productive capacity of the land resource base. It is generally caused by human activities, exacerbated by natural processes, often magnified by and closely intertwined with climate change and biodiversity loss. FAO defines Land degradation as the reduction in the capacity of the land to provide ecosystem goods and services and assure its functions over a period of time for its beneficiaries.

It is obvious that soils usually take a long time to form, perhaps up to 400 years for 10mm and under extreme conditions 100 years for 1mm. It can take 3000- 12000 years to produce a significant depth of mature soil for forming (Waugh, 1995). However, degradation of soil has been caused mainly by water logging and compaction, erosion, acidification, salinization and sodification and the accumulation of heavy metals and other inorganic contaminants would limit the productivity of the soil.

Land degradation has affected some 1900 million hectares of land world-wide. In Africa an estimated 500 million hectares of land have been affected by soil degradation, including 65% of the region's agricultural land. The rate at which arable land is being lost is increasing and is currently 30-35 times the historical rate. The loss of potential productivity due to soil erosion worldwide is estimated to be equivalent to some 20 million tons of grain per year. And this is happening worldwide, not just in Africa or Asia (UNEP, Global Environment Outlook - 2000. <http://www.unep.org/geo2000>, 1999)

BIBLIOGRAPHY

- Agarwal, C. G. (2002). A Review and Assessment of Land-Use Change Models: Dynamics of Space, Time, and Human Choice. General Technical Report NE-297. Newtown Square . U.S. Department of agriculture, Pennsylvania.
- Bachmann, M. M. (2005). Iterative maximum likelihood for fractional cover estimates - evaluating the portability. In Proceeding of the 4th Workshop on Imaging Spectroscopy: New Quality in Environmental Studies.
- Eklundh, O. L. (2003). Vegetation index trends for the African Sahel 1982–1999. *Geophys. Res. Lett.* 30, doi:10.1029/2002GL016772.
- Eswaran, H. R. (Retrieved 2012-02-05). "Land degradation (2001): proc. 2nd. International conference on land degradation and desertification. New Delhi, India: Oxford press.
- Evenson, R. E. (2003). Assessing the impact of the Green Revolution, 1930 to 2000. *science* 300 (5620).
- Gibson, J. P. (2000). *Introductory Remote Sensing*. Routledge. London, England.
- GLASOD. (1988).
- Hayes, D. J. (2001). Comparison of Change-Detection techniques for Monitoring Tropical Forest Clearing and Vegetation Regrowth in a Time Series.
- Herrmann, S.M.; Anyamba, A.; Tucker, C.J. (2005). Recent trends in vegetation dynamics in the African Sahel and their relationship to climate. *Glob. Environ. Change* 2005. (Vol. 15).
- Islam, K. a. (2000). Land use effects on soil quality in a tropical forest ecosystem of Bangladesh. *Agriculture, Ecosystems and Environment*.
- Jenson, J. R. (1996). *Introductory Digital Image Processing. In a remote sensing perspective (Second Edition ed.)*. Prentice Hall. New Jersey.
- Kramer. (2006). *How to write bibliographies*. Chicago: Adventure Works Press.
- Oumer, H. A. (august 2009). Land use and land cover change, drivers and its impact.
- Ringo, D. E. (1999). Assessment of erosion in the Turasha catchment in the lake Naivasha area, Kenya. Unpublished MSc Thesis, Enschede. The Netherlands.
- (2015). State of National Environment. Kampala: NEMA.
- Townshend, J. (1994). Global data sets for land applications from the Advanced Very High Resolution Radiometer: An introduction. *Int. J. Remote Sens.*

UNCCD. (2014). Land Degradation Neutrality.

UNEP. (1999). Global Environment Outlook - 2000. <http://www.unep.org/geo2000>. United Nations Environment Programme. London: Earthscan Publications.

UNEP. (2012). Sahel Atlas of Changing Landscapes . United Nations Environment Programme, Nairobi.

Yazidh, F. S. (1995). FAO production yearbook, B.2003 (Vol. 48 1994). Rome: Unpublished Msc thesis ITC, Enshede.

Yengoh, G. e. (2015). The Potential for Assessment of Land Degradation by Remote Sensing, in Use of the Normalized Difference Vegetation Index (NDVI) to Assess Land Degradation at Multiple Scales . Springer.

Yitafaru, B. (2007). Land Degradation and Options for Sustainable Land Management in the Lake Tana Basin (LTB), Amhara Region, Ethiopia.

Zubair, A. O. (2006). Change detection in land use and Land cover using remote sensing data and GIS. Msc Thesis, University of Ibadan, Nigeria.