GIS-BASED SUSTAINABLE LAND-USE PLANNING: A CASE STUDY OF *BATTICALOA* MUNICIPAL COUNCIL

BY

IBRA LEBBE MOHAMED ZAHIR

PhD **2021**

GIS-BASED SUSTAINABLE LAND-USE PLANING: A CASE STUDY OF *BATTICALOA* MUNICIPAL COUNCIL

BY

IBAR LEBBE MOHAMED ZAHIR

THESIS SUBMITTED TO THE UNIVERSITY OF SRI JAYEWARDENEPURA FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY

AUTHOR DECLARATION

"The work described in this thesis was carried out by me under the supervision of Prof. T.M.S.P.K Thennakoon, Prof. Rev. P. Sangasumana Thero and Ms. H.M. Jayani Rupi Herath and a report on this has not been submitted in whole or in part to any university or any other institution for another Degree".

Date:…… ……..

I.L. Mohamed Zahir

CERTIFICATION OF SUPERVISORS

"We certify that the candidate has incoperated all corrections, additions and amendments recommended by the examinars to this version of the PhD thesis".

……

Prof. T.M.S.P.K Thennakoon

Department of Geography

Faculty of Humanities and Social Sciences

University of Sri Jayewardenepura, Sri Lanka

……

Prof. Ven. P. Sangasumana Thero

Department of Geography

Faculty of Humanities and Social Sciences

University of Sri Jayewardenepura, Sri Lanka

……

Ms. H.M. Jayani Rupi Herath

Department of Geography

Faculty of Humanities and Social Sciences

University of Sri Jayewardenepura, Sri Lanka

Table of Contents

List of Tables

List of Figures

Abbreviations

AHP	-	Analytic Hierarchy Process
ANOVA	-	Analysis of Variance
AOI	-	Area of Interest
CBD	-	Central Business District
CHIS	-	Critical Habitat Information System
DEM	-	Digital Elevation Model
DL	-	Dry Land
DMRT	-	Duncan Multiple Range Test
DSS	-	Decision Support System
DWT	-	Discrete Wavelet Transform
EC	-	Environmental Condition
ERDAS	-	Earth Resources Data Analysis System
ETM	-	Enhance Thematic Mapper
FAO	-	Food and Agriculture Organization
GAL	-	Gain and Loss
GIS	-	Geographic Information Systems
GND	-	Grama Niladharies Division
GPS	-	Global Position System
IDB	-	Inter-American Development Bank
kg/ac	-	Kilogram/Acre
LCM	-	Land Change Modeler
LS	-	Living Satisfaction
MC	-	Markov Chain

MCA	-	Multiple Criteria Analysis
MCDM	-	Multi-criteria Decision Making
MCSDSS	-	Multi-criteria Spatial Decision Support Systems
MLC	-	Maximum likelihood classifier
mm	-	Millimeter
MNDSD	-	Manmunai North Divisional Secretariat Division
MSL	-	Mean Sea Level
MSS	-	Multi-Spectral Scanner
OC	-	Organizational Commitments
OLI	-	Operational Land Imager
PI	-	Planning and Implementation
STD	-	Standard Deviation
SD	-	Sustainable Development
SDSS	-	Spatial Decision Support Systems
SPSS	-	Statistical Package for the Social Sciences
sq.km	-	Squire Kilometer
TIRS	-	Thermal Infrared Sensor
UC	-	Urban Council
UDA	-	Urban Development Authority
UE	-	Urban Expansion
UG	-	Urban Greenery
UNCED	-	United Nations Conference on Environment and Development
UNEP	-	United Nation Environment Programme
USGS	-	United State Geological Survey

WF	-	Wetland Filling
WLC	-	Weighted Linear Combination
WM	-	Waste Management
WP	-	Water Pollution
WWF	-	World Wildlife Fund

Acknowledgment

I would like to express my sincere gratitude to my supervisors Prof. T. M. S. P. K. Thennakoon, Prof. Ven. P. Sangasumana Thero and Ms. H. M. Jayani Rupi Herath helped and guided in making this research study a success.

I specially thank Prof. M. I. M. Kaleel, Department of Geography, South Eastern University of Sri Lanka for his timely and valuable suggestions throughout my research work.

I would also like to thank Mr. A. L. Iyoob, Development Officer and Land Use Policy Planning Department who gave his moral support throughout my research work.

I wish to thank my wife who encouraged and sacrificed her leisure time to help to carry out this study and my parents, other family members and relatives for their moral support and encouragement to complete this research study.

Finally, I wish to thank all who helped to carry out this research study successfully even though their names are not individually and severally mentioned.

GIS-based Sustainable Land-use Planning: A Case Study of *Batticaloa* Municipal Council

Ibra Lebbe Mohamed Zahir

ABSTRACT

Land has been defined as the frequently available natural resource on which man can rely to build their lives. Land-use planning is a planning technique to establish in advance the quality of life on the earth. The decision-making process is focused on facilitating the biophysical, socio-economic, environmental and public considerations which provide numerous benefits for the public. The land is frequently utilized improperly due to the 1978 cyclone, the 2004 tsunami and the civil war over 30 years. As a result, the natural environment has faced various challenges. Therefore, different spatial and temporal scales need to be considered to asses sustainable land-use plans for the future generation in *Batticaloa* Municipal Council.

The study aims to develop a GIS-based sustainable land-use plan for minimizing environmental issues in *Batticaloa* Municipal Council. To achieve the aim, a mixed method approach was used to make meaning of the sound effects of a sustainable land-use plan. The Landsat satellite images were used for temporal land-use analysis by maximum likelihood classifier in the supervised classification method to evaluate the existing land-use and land change modeler was used for the prediction of land change over the 40 years, whereas, the improper land-use was determined by GPS pinpoints, photographs and field observations. Furthermore, the questionnaire survey was evaluated the environmental issues regarding to the improper land use practices by the hypothesis test from urban dwellers and government officials.

The results revealed that the built-up land-use has remarkably extended by 34.1% while homegarden has minimal growth of 0.5%. But, agriculture, bare land, sandy and scrub have declined to 9.5%, 8.5%, 4.4% and 2.1% respectively. According to the loss and gain analysis, only built-up land-use has found that higher gain of 24.2% and wetland and homegaren least gain of 3.2% and 0.5% respectively while other land-use of agriculture, bare land, sandy and scrub loss of -9.7%, 8.2%, -6.7%, -3.5% respectively between 1980-2020. However, projected land-use from 2020-2030, built-up, homegarden and sandy would gain 3.2%, 1.9% and 0.1% respectively while loss of agriculture, wetland, scrub and bare land as -3.4%, -1.0%, -0.4% and -0.3% respectively. Furthermore, improper land-use of low productive agricultural land is identified at 23.7% and wetland at 2.6%. According to the suitability levels, 88.2% of land can recommend as suitable for sustainable land-use plans in future urban developments while 11.8% is recommended for conservation to urban ecological management in *Batticaloa* Municipal Council.

Keywords: land-use, sustainable, maximum likelihood, environment, supervised classification