APPLICATION OF REMOTESENSING & GIS FOR LAND USE PLANNING IN AMPARA DISTRICT

by

Uthpala Madhavi Panditharathna

M.Sc. **2014**

APPLICATION OF REMOTE SENSING & GIS FOR LAND USE PLANNING IN AMPARA DISTRICT

By

Uthpala Madhavi Panditharathn

Reg. Number - 5998MD2012032

Index Number - MSC/GR/2012040

Thesis Submitted to the University of Sri Jayewardenepura for award of the Degree of Master of Science in Geographic Information Systems and Remote Sensing on 15.06.2014.

DECLARATION OF THE CANDIDATE

The work described in this thesis was carried out by me under the supervision of Ven. Dr. Pinnawala Sangasumana and Mr. Shivanandaraja and a report on this not been submitted in whole or in part to any university or any other institution for anther Degree/Diploma.

.....

Signature of the Candidate

01/08/2014

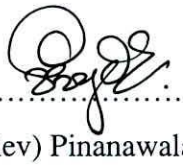
Date

DECLARATION OF THE SUPERVISORS

We certify that the above statement made by the candidate is true and that this thesis is suitable for submission to the University for the purpose of evaluation.

Certified by:

Supervisors:



.....

Dr. (Rev) Pinanawala Sangasumana
Head/Senior Lecturer
Department of Geography
University of Sri Jayewardenepura
Nugegoda
Sri Lanka.

.....

Date

.....

Mr. S. Sivanantharajah
Senior Superintendent of Surveys,
Survey Department of Sri Lanka
Colombo.

.....

Date

Ven. Dr. Pinnawala Sangasumana
Head /Department of Geography
University of Sri Jayewardenepura
Gangodawila, Nugegoda.
Sri Lanka.

TABLE OF CONTENTS

List of Tables vii
List of Figures ix
List of Maps xi
List of Abbreviations xii
Acknowledgement xiii
Abstract xiv

1 INTRODUCTION

1.1. Background of the study 1
1.2 GIS and Remote sensing approach for the Land use Planning 4
1.3 Study area 6
1.4 Rationale 7
1.5 Research Problem 8
1.6 Objectives 10
1.7 Limitations 10

2 LITERATURE REVIEW 11

2.1 Introduction 11
2.2 Land cover and Land Use changed 11
2.3 Neutralizing Remote sensing technologies 13
2.4 Different techniques 14
2.5 Electromagnetic Radiation 16
2.6 Methodology 17
2.7 Geometric correction 17
2.8 Classification 18

3 METHODOLOGY 19

3.1 Introduction 19

3.2 Data Organization of Methodology 19

3.2.1. Materials Used 19

3.2.2. Satellite Imagery 19

3.2.3. Satellite Image Acquisition and Pre-Processing 21

3.2.4. Classification of Normalized Difference Vegetation Index 21

3.3. Flow Chart of the Methodology 22

3.3.1. Methodology to find Land Use pattern 25

3.3.2 Land Use Pattern changing with Ground survey data 30

3.3.3 Flow chart of Land use change pattern (Topo) 31

3.3.4. Water body change pattern layer 33

3.3.5. Rain fall change pattern 37

3.3.6. Final Water layer 41

3.3.7. Soil Map 45

3.3.8. Land use change due to soil type 50

3.3.9. Slope Map 53

3.3.10. Population density change due to land use 56

3.3.11. Land use change pattern 59

3.4 Software Used 61

4 RESULTS AND DISCUSSION 62

4.1 Introduction 62

4.2 Results 62

4.2.1 Tanks and irrigation system 62

4.2.2 Urban or Built – up Land 75

4.2.3 Land suitability for Agriculture 79

4.3 Findings 80

4.3.1 Irrigation system and water supply projects 80

4.3.2 Chena cultivation 81

4.3.3 Paddy cultivation 86

4.3.4 Sugarcane cultivation..... 88
4.3.5 Build-up area and Population density..... 92
4.3.6 Misused Land and Deforestation..... 92

5 CONCLUTION AND RECOMMENDATION 94

5.1 Introduction.....94

5.2 Recommendation.....94

5.3 Further Works..... 99

6 REFERENCE..... 100

List of Table

Table 1 - Landsat Images Acquisition dates..... 21
Table 2 - Change Land Use pattern 2000 to 2014..... 30
Table 3 - Annual rain fall data..... 38
Table 4 - Annual rain fall data year 2000 - 2012..... 38
Table 5 - Each agro -Ecological zone..... 47
Table 7 - Population of Ampara District by religion..... 58
Table 8 - Number And Percentage of Population by DS Division -2012..... 58
Table 9 - Irrigation system and water supply projects.....80
Table 10 - Paddy cultivation.....86

List of Figures

Figure 1 – Flow Chart of the Methodology..... 23
Figure 2 – Flow charts for Land Use Pattern changing..... 25
Figure 3 – Flow charts for Land Use Pattern changing with Ground survey data..... 30
Figure 4 - Flow chart of Land use change pattern (Topo)..... 31
Figure 5 - water bodies changing pattern..... 33
Figure 6 – Rain fall changing pattern..... 37
Figure 7 - Final Water layer..... 41
Figure 8 - Methodology of Soil map..... 45
Figure 9 - Land use change due to soil type..... 50
Figure 10 - Slope map..... 53
Figure 11 - Population Density change due to land use..... 56
Figure 12 - Land use change pattern..... 59

List of Maps

Map 1 – Map of Sri Lanka..... 6
Map 2 - The visible changes in Ampara District..... 21
Map 3 - Ampara Area Land Use Classification..... 26
Map 4 - Land use pattern in 2000 to 2005..... 27
Map 5 - Display the final output of the land use pattern in 2000 to 2005..... 27
Map 6– Land Use Pattern 2000 - 2005..... 28
Map 7– Land Use Pattern 2005 – 2014..... 29
Map 8 - Ground Data updated map sheets in Ampara district..... 32
Map 9 - Land Use change pattern 2000-2005 and 2005-2014..... 32
Map-10 the surface water potentials of Sri Lanka..... 34
Map 11– Water bodies in Ampara district (2000 – 2005)..... 35
Map 12 – Water bodies in Ampara district (2005 – 2014)..... 36
Map 13 - IDW Rain fall data..... 40
Map 14 - Final Water layer..... 42
Map 15 - Final Water layer in Google map..... 43
Map 16 - Soil map of Sri Lanka..... 44
Map 17 - Agro Ecology area of Ampara District..... 46
Map 18 - Soil Type of Ampara District..... 48
Map 19 - Agriculture Land of Ampara District 2000 -2005..... 51
Map 20 - Agriculture Land of Ampara District 2005 -2014..... 52
Map 21 - Contour of Ampara District 54
Map 22 - Topographic Map of Ampara..... 55
Map 23 - Population Area map..... 57
Map 24 - Land Use change Pattern due to the soil, water and Population..... 60
Map 25 - Water tanks and Irrigation Channels..... 63
Map 26 - Namal Oya GN Division (2000-2005)..... 64
Map 27 - Namal Oya GN Division (2005-2008)..... 65
Map 28 - Namal oya GN Division (2008-2014)..... 66
Map 29 - Maha oya GN Division..... 67
Map 30 - Damana DS Division Forest Cover..... 68

Map 31 - Damana DS Division Chena Cultivation..... 69
Map 32 - Ampara DS Division unused Area..... 70
Map 33 - Malwatta and Walathpitti GN Division..... 71
Map 34 - Malwatta and Walathpitti GN Division..... 72
Map 35 - Uhana DS Division..... 73
Map 36 - Bandaragamduwa GN Division..... 74
Map 37 - NamalOya area..... 75
Map 38 - Madana GN Division..... 76
Map 39 - Bakmitiyava GN Division..... 77
Map 40 - Navagampura GN Division..... 78
Map 41 - Bakmitiyava GN Division..... 79
Map 42 - Irrigation Projects of Ampara District..... 81
Map 43 - Chena Cultivation of Ampara District 83
Map 44 - Chena Cultivation of Ampara District..... 84
Map 45 - Chena Cultivation spread in Forest Cover..... 85
Map 46 - Paddy Cultivation of Ampara District..... 87
Map 47 - Paddy Cultivation Type Of Ampara District..... 88
Map 48 - Zone of Sugarcane..... 89
Map 49 - Damana Land use 2000-2005..... 90
Map 50 - Damana Sugarcane..... 91
Map 51 - Forest Cover of Ampara District..... 93
Map 52 - Lahugala area..... 96
Map 53 - Lahugala Land Suitability..... 97
Map 54 - Mahaoya and Padiyatalava GN Division..... 98

List of Graph

Graph 1 - Rain fall data..... 39

Graph 2 - Population by Division 2012..... 59

List of Abbreviation

GIS	-	Geographic Information System
GPS	-	Global Position System
RS	-	Remote Sensing
IT	-	information technology
carto	-	Cartography
WWW	-	World Wide Web
QGIS	-	Quantum Gis
LOG	-	Logistic
NDVI	-	Normalized difference vegetation index
NDWI	-	Normalized Difference Water Index
TM	-	Thematic Mapper
UTM	-	Universal Transverse Mercator
NIR	-	Near Infrared
IDW	-	Inverse Distance Weighted

Acknowledgement

I would like to express my especial thanks and sincere gratitude to my supervisors, Dr. Pinnawala Sangasumana (Head/Geography,Coordinator- M.Sc. in GIS & RS), Academic staff of M.Sc. in GIS & RS and Mr S Shivanandaraja, Academic staff of M.Sc. in GIS & RS for their invaluable guidance, encouragements, patience and precious time that he offered to me. And, I was guided step by step from the beginning and I am deeply impressed with his wealth of knowledge and dedication to academic research.

I thank prof. Krishan Deheragoda who motivated me towards this endeavour by extending his valuable guidance during reviews from the inception.

ABSTRACT

The land accesses to Sri Lanka after the end of 30 years long civil war has increased the need of regularly update land cover/land use information for proper planning.

This research study was initiated with the main objectives of land use change past 35 years in Ampara district presenting a methodology though utilizing remote sensing imagery, GIS approach and social and environmental factors for simulating land use change. 13 year land sat imageries of Ampara District with 35 year time intervals and user social and environmental changes have been employed in order to simulate land use change. All images were rectified and registered to Sri Lanka grid system. Normalized vegetation index was used to classify the images to different land use categories. Seven classes were identified. GIS is used to model and monitor land use and perform spatial analysis on the results. This research adapts land use change model parameterized for Ampara district and explores how factors such as soil, rain fed, tanks and irrigation system can influence it. For each cell in the study area, the real change between two time steps is determined and analyzed compared with the provided variables in order to produce probability of land use change layer.

Those factors are acquired from remote sensing technologies and GIS analysis. Through remote sensing image impact factors (terrain) and socio-economic impact factors (town scale the distance from the town and main road) the population on the grid is discrete by spatial analysis functions of GIS. Through analyzing the various factors which impact on land suitability and the distribution of population, we determine the weight of the various factors which impact on the change land use pattern, evaluate the land use suitability to determine the direction of agriculture. These provide the scientific basis for planning.

Keywords GIS, internet technology, Land Use change pattern, Ampara, Gis Analysis, terrain Analysis, Land suitability