

LB/DON/64/02

TCP 04/75

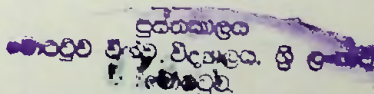
77

INTRODUCING SYSTEMATIC LAND
USE PLANNING IN THE UPPER
WATERSHED AREAS FOR THE
SUSTAINABLE DEVELOPMENT OF
LAND RESOURCE

E.L. CHANDRAWATHIE

711 "95"

711.14

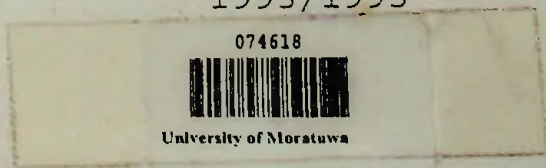


M.Sc. Degree for Land Use Planning
and Resource Management

TH

Department of Town and Country Planning
University of Moratuwa

1993/1995



74618

74618

DECLARATION

This dissertation has been written with the object of obtaining a diploma and I declare that it is my own work and is not the work of any other person.

Prof. A. S. Jayasinghe, Head of the Department of Town and Country Planning and Director, Post Graduate Studies, University of Moratuwa, Sri Lanka, has supervised and approved the work.

A dissertation presented to the Department of Town and Country Planning, University of Moratuwa, Sri Lanka, in fulfilment of the partial requirement for the Degree of Master of Science in Land Use Planning and Resources Management.

During the course of the study, I have received the assistance and advice of the following persons:

Senior Lecturer and Course Director, Dept. of Town and Country Planning, University of Moratuwa, Sri Lanka, who has supervised the progress of the study.

Mr. J. Jayasinghe, Director, Dept. of Town and Country Planning, University of Moratuwa, Sri Lanka, who has supervised the progress of the study.



ACKNOWLEDGEMENT

This dissertation has been written with the assistance obtaining from many persons and agencies. I thank them whole hearted^{ly} wish to record my special sincere thanks and gratitude to :

Prof. Ashley L.S. Perera, Head of the Department of Town and Country Planning and Director, Post Graduate Studies, University of Moratuwa for the directions and assistance provided.

Senior Prof. Willie Mendis, Department of Town and Country Planning, University of Moratuwa who supervised me the research.

Senior Lecturer Mr. Neal G. Karunaratna, Mr. K.D. Fernando, Mr. M.A.P. Senanayake and P.K.S. Mahanama who have advised me on various aspects of the study during the entire duration.

Senior Lecturer and Course Co-ordinator of the M.Sc. Degree Mr. S. Berugoda who has helped me in the different stages of the study.

Mr. J. Jayasinghe, Director, Land Use Policy Planning Division of the Ministry of Agriculture, Lands and Forestry for granting me two years study leave to follow the M.Sc. Degree.

Miss. Muthumala, Stenographer of Land Use Policy Planning Division, who handled the typing of the dissertation.

My Husband and Sisters who encourage me to make success of the study and my two little children Pabasara and Charith who tolerated me during this period.

E.L. Chandrawathie

1996.

S Y N O P S I S

The need for maintaining the land uses of the upper watersheds for the sustainable developments of entire river basis has been recognized and action towards this has been taken by several countries. The attention paid towards the proper maintenance of such watershed in Sri Lanka in the past does not appear to be sufficient. There are several statutory divisions administered by several government institutions dealing with the conservation and development of the areas covered by the upper watersheds as well as the downstream areas the downstream areas. However there dose'nt appear to be sufficient appreciation of the need for coordination of this activity. As a result of the developments have occurred in areas which are not suitable for such developments, resulting in retarding development of the entire river basins taken as a whole. This affects economy of the country.

This study is aimed at assessing the problem due to the present land use condition in the upper watershed and formulating principles for the preparation of land use plans for such upper watersheds which would benefits the developments of all land resources in such river basins.

A study area has been selected for an indepth study of the current problems and formulation of proposals to remedy any deficiencies. The principles of such proposals thus

formulated have a general applicability for all the upper watershed of the country.

The principle adopted in the entire study has been the optimal utilization of land resources for sustainable developments.

The study has been done in six Chapter. Chapter 1 has discussed the planning concepts and theories applicable for land use planning in the upper watersheds.

Chapter 2 has discussed the experience in watershed management in other countries to facilitate comparable understanding on this subject.

Chapter 3 has then analyzed the present situation in upper watershed areas in Sri Lanka.

Chapter 4 comprises the analysis and findings of the case study area selected for in-depth evaluation.

Chapter 5 has discussed the potentials and constrains for systematic land use planning in the upper watershed area for the sustainable development of its land resources.

Chapter 6 comprise the main conclusion and recommendation arising from the study.

CONTENTS

	PAGE NO.
Acknowledgement	i
Synopsis	iii
Contents	iv
List of Tables	x
List of Figures	xi
List of Maps	xii
Abbreviation	xiii
Introduction	xiv
CHAPTER 1 PLANNING CONCEPTS AND THEORIES APPLICABLE FOR LAND USE PLANNING IN THE UPPER WATERSHED	1 - 34
1.1 Definitions of Upper Watersheds	1
1.2 Importance of the Upper Watershed Areas	4
1.3 Basic Concepts	8
1.3.1 Concepts of Land Resource	8
1.3.2 Watershed Degradation	8
1.3.3 Soil Erosion	9
1.3.4 Sedimentation	10
1.3.5 Landslides	10
1.3.6 Floods	12
1.4 Planning Concepts Applicable for Watershed Area	13
1.4.1 Systems Approach	13
1.4.2 Integrated Planning Approach	15
1.4.3 Comprehensive Planning Approach	17
1.4.4 Multiple Use Concept	18
1.4.5 Concept of Sustainable Development	19

1.5	Components of Planning	21
1.5.1	Physical Planning	21
1.5.2	Economic Planning	21
1.5.3	Social Planning	22
1.5.4	Environmental Planning	22
1.6	Levels of Planning	23
1.7	Concepts of Watershed Management	25

**CHAPTER 2 PAST EXPERIENCE OF UPPER WATERSHED MANAGEMENT IN
THE GLOBAL SCENE 35 - 56**

2.1	India	35
2.2	Nepal	38
2.3	Indonesia	40
2.4	United States of America	42
2.5	Relevant of watershed management schemes of other countries to the Sri Lanka situation	44

**CHAPTER 3 PRESENT SITUATION IN THE UPPER WATERSHED AREAS IN
SRI LANKA 57 - 96**

3.1	Physical Characteristics in the Upper Watershed	57
3.1.1	Topography	57
3.1.2	Soils	59
3.1.3	Rainfall	61
3.1.4	Natural Drainage Network	63
3.1.5	Geology	65
3.1.6	Agro Ecological Regions	66
3.1.7	Natural Vegetation	66
3.1.8	Land Use	69
3.2	Population and Settlements	73



3.3	Major Issue of Watershed Degradation in Sri Lanka	76
3.3.1	Deforestation	76
3.3.2	Expansion of Agricultural Land and Settlement	76
3.3.3	Soil Erosion	77
3.3.4	Sedimentation	81
3.3.5	Landslide	81
3.3.6	Floods	83
3.4	Experience in Watershed Management in Sri Lanka	84
3.5	Existing Institutional Arrangement for Watershed Management	85
3.6	Existing policies on watershed management	87
3.7	Planning implications of the present developments in the Upper Watersheds	91
CHAPTER 4 CASE STUDY IN RAT GANGA UPPER WATERSHED AREA OF KALU GANGA BASIN RATNAPURA		97 - 137
4.1	Selection of Case Study Area	97
4.2	Methodology adopted for Case Study	99
4.3	Background	100
4.4	Physical aspects	103
4.4.1	Topography	103
4.4.2	Geology	104
4.4.3	Soils	104
4.4.4	Climate	106
4.4.5	Drainage	110
4.4.6	Natural Vegetation	110
4.4.7	Land Use	111
4.5	Social aspects	114

4.5.1	Population	114
4.5.2	Migration pattern	116
4.5.3	Educational Achievement	117
4.5.4	Employment	118
4.5.5	Housing and Settlement	119
4.5.6	Infrastructure facilities	122
4.6	Economic aspects	124
4.6.1	Income level	124
4.6.2	Relationship of income and land use	126
4.6.3	Land Tenure	127
4.7	Environmental Aspects	129
4.7.1	Peak wilderness sanctuary	129
4.7.2	Giliamale proposed reserve	130
4.7.3	Relationship between the land use and the environmental problem in the area	130
4.8	Planning implication of the present level of the Rat ganga	132
CHAPTER 5 POTENTIALS AND CONSTRAINTS		138 - 141
5.1	Potentials	139
5.2	Constraints	140
CHAPTER 6 CONCLUSIONS AND RECOMMENDATIONS		142 - 156
6.1	Conclusion	142
6.2	Specific Recommendations	145
6.2.1	Short Term Specific Recommendations	146
6.2.2	Long Term Specific Recommendations	149
6.3	General Recommendations	150
6.3.1	Short Term General Recommendations	150
6.3.2	Long Term General Recommendations	153

BIBLIOGRAPHY

155

ANNEXURE

I	River Flow data in Sri Lanka	100
II	Landslides Particulars in Sri Lanka	101
III	(A) National Level Institutional set up for Upper Watershed Area Management	102
	(B) Provincial Level Institutional Set up for Upper Watershed Area Management	103
	(C) Divisional Level Institutional set up for Upper Watershed Area Management	104
IV	Questionnaire	105
	1. Land Use Change	110
	2. Population structure by farm type age	111
	3. Migration pattern	112
	4. Educational Attainment	113
	5. Employment	114
	6. Income level	115
	7. Distribution of Operated Cropping Land by Size	116
	8. Land Ownership	117
	9. Land Management Level	118

LIST OF TABLES

	PAGE NO.
1 Degraded Land in Developing Countries	9
2 Causes of Degradation	50
3 Land Use Patterns in the Upper Watershed	71
4 Total Population of the Upper watershed areas	74
5 Urban Population of the Upper Watersheds	75
6 Encroachments in Sri Lanka (1979)	78
7 Annual Soil loss from cultivated lands	80
8 Annual Sediment Yield of Several locations	82
9 Major floods in Sri Lanka	84
10 Rainfall distribution in the Case Study Area	107
11 Land Use Changes	112
12 Population structure by five year age	115
13 Migration Pattern	117
14 Educational Attainment	118
15 Employment	119
16 Income Level	125
17 Distribution of Operation Owning Land by Size	128
18 Land Ownership	129
19 Land Management Level	131



LIST OF FIGURES

PAGE NO.

1	Biodiversity	5
2	Hydrological Cycle	7
3	Sediment and Soil Erosion Process	11
4	Level of Planning	26
5	Three Dimensional Frame Work for Watershed Management	28
6	Monthly Rainfall Pattern	108
7	Quality of Residential House	121
8	Available Facilities	123



LIST OF MAPS

	PAGE NO.
1 Annual precipitation of the representative countries	47
2 Natural vegetation of the representative countries	48
3 World population distribution	49
4 Upper Watershed Areas	58
5 Soil Distribution	60
6 Rainfall Distribution	62
7 River Basin in Sri Lanka	64
8 Agro Ecological Zones	67
9 Natural Vegetation	70
10 Land Use Map of the Upper watersheds	72
11 Settlements and Road Network	73
12 Location Map of the Study Area	101
13 Detailed Map of the Study Area	102
14 Slope Class	105
15 Agro Ecological Region and Drainage	109
16 Land Use	113
17 Settlements and Road Network	120
18 Recommendations Map	154



ABBREVIATION

D.S.D.	Divisional Secretary Division
F.A.O.	Food and Agricultural organization
G.N.D.	Grama Niladhari Division
I.B.L.	Immature Brown Lomes
L.U.P.P.D.	Land Use Policy Planning Division
N.B.R.O.	National Building Research Organization
R.Y.P.	Red Yellow Podzolic
R.B.L.	Red Brown Latzolic
T.V.A.	Tennessy Valley Authority
U.M.W.M.P.	Upper Mahaweli Watershed Management Project
U.N.O.	United Nation Organization

