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Basudeb Bhatta

# Urban Growth Analysis and Remote Sensing

A Case Study of  
Kolkata, India 1980–2010



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# Urban Growth Analysis and Remote Sensing

A Case Study of Kolkata, India 1980–2010

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*Dedicated to all my teachers*

# Preface

Study of urban growth is a branch of urban geography that concentrates on cities and towns in terms of their physical and demographic expansion. Understanding the urban patterns, dynamic processes, and their relationships is a primary objective in the urban research agenda with a wide consensus among scientists, resource managers, and planners; because future development and management of urban areas requires detailed information about ongoing processes and patterns. Analysis of urban patterns and processes, from remote sensing data, is a pertinent topic in the current urban research agenda. Detailed spatial and temporal information of urban morphology, infrastructure, population distributions, land-use/land-cover patterns and transitions among different land-uses/land covers are essential to be observed and understood. Urban remote sensing has attempted to provide such information. Determining the rate and the spatial configuration of urban growth from remote sensing data is not only a prevalent approach, rather it has a long history. However, the models and methods applied on remote sensing data, in terms of urban growth analysis, differ widely. Scientists and researchers hold different opinions. Many of them are still working to develop new methods and robust tools. This book is to document one such research.

This book aims to demonstrate some of the existing methods/models to test their fitness for the analysis of urban growth in the city of Kolkata, an important urban area from a developing country. In this study, four temporal satellite images of 10-yearly intervals (1980, 1990, 2000, and 2010) have been classified to determine the urban extent and built-up growth of Kolkata. These digitally classified imageries then have been used for the analysis. The analysis has been performed in consideration of jurisdictional boundary of Kolkata Municipal Corporation as well as the natural boundaries of the city. The main problem faced in this analysis was lack of temporal ancillary datasets that were essential for many of the widely practiced metrics. Therefore, the intention was to use some metrics that are less demanding in terms of data and computation. However, it has been found that most of these metrics are inferior in capturing insights into urban growth and sprawl. In this study, therefore, most of these metrics have been modified, either to overcome their limitations or to fit the study area.

Although the research documented in this book aims to analyze the urban growth of Kolkata, the book may be referred by urban researchers worldwide, especially those using remote sensing data for their analysis. They will benefit from the critical discussions and demonstrated methods/models.

This book comprises five chapters and three appendices. Each chapter starts with a brief of the topics to be covered within the chapter. [Chapter 1](#) provides an introduction and overview. It focuses on the background, significance, objectives, and methodological overview of the research. [Chapter 2](#) discusses the review of literature. This chapter briefly documents the patterns and processes of urban growth and sprawl, and application of remote sensing data in such analysis. It also critically reviews the analytical and quantification techniques of urban growth and sprawl from remote sensing data. Finally, it progresses toward the scope of the research. [Chapter 3](#) is intended to describe the data and methodology. It describes the data and software that have been used; how the remote sensing data have been rectified and classified; how the accuracy assessment has been performed; what were the steps involved in preparing the vector maps of Kolkata; how the census data have been encoded; and how the built-up data have been extracted. Analytical steps have also been explained in this chapter. Critical comments on the analytical techniques, their evaluations, and justifications on reliance have also been discussed. [Chapter 4](#) deals with the results obtained from the analysis. This chapter presents the built-up data in terms of classified images and also of matrices. It shows the status of urban growth and sprawl for the city of Kolkata. This chapter also aims to discuss the findings, make arguments on the methodology in terms of their merits and limitations, and construct logical statements. [Chapter 5](#) draws the conclusions and highlights the future scope of research and study. Appendix A briefly describes the study area, its geographical location and properties, administrative and urban structures. Appendix B furnishes the census data for each municipal ward and borough in Kolkata Municipal Corporation. Appendix C furnishes the derived built-up data for each borough of Kolkata Municipal Corporation, as well as for each natural boundary of the city.

# Acknowledgments

I am grateful to all the authors of the numerous books and research publications mentioned in the list of references of this book. These valuable literatures formed the basis of my knowledge required for conducting the research and writing this title. I express my gratitude to those teachers, researchers, and organizations for their contributions that reinforced my knowledge.

I would like to express my profound gratitude to Dr. Subhajit Saraswati, Professor, Department of Construction Engineering, Jadavpur University, and Dr. Debasish Bandyopadhyay, Associate Professor, Department of Construction Engineering, Jadavpur University, Kolkata. Their guidance was an invaluable resource for this research. I am much grateful to Prof. Rana Dattagupta, Director, CAD Centre, Jadavpur University, for providing all possible facilities to execute this research and prepare this title.

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Finally I express my gratitude to my parents who have been a perennial source of inspiration and hope for me. I also want to thank my wife Chandrani, for her understanding and full support, while I worked on this research. My little daughter, Bagmi, deserves a pat for bearing with me during this rigorous exercise.

Basudeb Bhatta



# Contents

<b>1</b>	<b>Introduction</b>	1
1.1	Background	1
1.2	Significance	3
1.3	Objectives	5
1.4	Research Questions	5
1.5	Methodological Overview	6
	References	6
<b>2</b>	<b>Review of Literature</b>	9
2.1	Urban Growth and Sprawl	9
2.2	Physical Patterns and Forms of Urban Growth and Sprawl	10
2.3	Temporal Process of Urban Growth and Sprawl	12
2.4	Remote Sensing for Analysis of Urban Growth and Sprawl	13
2.5	Measurement and Analysis of Urban Growth and Sprawl	14
2.6	Administrative Versus Natural Boundary for the Analysis	21
2.7	Determining the Natural Boundary of the City	21
2.8	Subdivision of Natural City Extent	22
2.9	Similar Studies in India	24
2.10	Similar Studies on Kolkata	26
2.11	Scope of the Research	26
	References	27
<b>3</b>	<b>Methodology</b>	33
3.1	Data	33
3.2	Software Used	35
3.3	Image Registration	35
3.4	Encoding Hardcopy Map	36
3.5	Encoding Vector Maps	37
3.6	Image Classification	38
3.7	Assessment of Classification Accuracy	39

- 3.8 Subsetting of Remote Sensing Data . . . . . 41
- 3.9 Determining the Natural Boundary of the City . . . . . 42
- 3.10 Subdivision of Natural City Extent . . . . . 42
- 3.11 Calculating the Built-up Area . . . . . 44
- 3.12 Generation of KMC Boundary . . . . . 45
- 3.13 Analysis Based on Administrative Boundary. . . . . 45
  - 3.13.1 Built-up Area and Urban Growth . . . . . 45
  - 3.13.2 Proportion of Population and Proportion of Built-up Area . . . . . 47
  - 3.13.3 Growth Rates of Population and Built-up Area. . . . . 48
  - 3.13.4 Households and Built-up Area . . . . . 49
- 3.14 Analysis Based on Natural Boundary. . . . . 50
  - 3.14.1 Area Index and Shape Index . . . . . 51
  - 3.14.2 City Extent and Built-up Area . . . . . 52
  - 3.14.3 Shannon’s Entropy and Built-up . . . . . 53
  - 3.14.4 Degree of Freedom in Urban Growth . . . . . 55
  - 3.14.5 Degree of Goodness in Urban Growth. . . . . 58
- References . . . . . 60
  
- 4 Results and Discussion . . . . . 63**
  - 4.1 Classified Imagery and Change Map . . . . . 63
  - 4.2 Results From Analysis: Based on Administrative Boundary . . . . . 64
    - 4.2.1 Built-up Area and Urban Growth . . . . . 65
    - 4.2.2 Proportion of Population and Proportion of Built-up Area . . . . . 69
    - 4.2.3 Growth Rates of Population and Built-up Area. . . . . 69
    - 4.2.4 Households and Built-up Area . . . . . 71
  - 4.3 Results From Analysis: Based on Natural Boundary . . . . . 72
    - 4.3.1 Area Index and Shape Index . . . . . 72
    - 4.3.2 City Extent and Built-up Area . . . . . 73
    - 4.3.3 Shannon’s Entropy and Built-up . . . . . 74
    - 4.3.4 Degree of Freedom in Urban Growth . . . . . 76
    - 4.3.5 Degree of Goodness in Urban Growth. . . . . 77
  - 4.4 Comparison of Sprawl Analysis . . . . . 78
  - 4.5 Degree of Freedom and Goodness . . . . . 79
  - 4.6 Boundary of the City . . . . . 80
  - 4.7 Application of the Results . . . . . 81
  - 4.8 Limitations of the Research . . . . . 82
  - References . . . . . 84
  
- 5 Conclusions . . . . . 85**
  - 5.1 Conclusions . . . . . 85
  - 5.2 Scope of Future Research. . . . . 87
  - References . . . . . 88

Contents	xiii
<b>Appendix A: The City of Kolkata</b> . . . . .	89
<b>Appendix B: Census Data</b> . . . . .	95
<b>Appendix C: Built-up Data</b> . . . . .	101
<b>Acronyms</b> . . . . .	103
<b>Index</b> . . . . .	105

# Chapter 1

## Introduction

**Abstract** This chapter introduces the study and research focused in this book. It aims to describe the background, significance, and objectives of the research; overview, questions that are to be answered in the research, and methodological overview. This chapter, as expected from any research-based book, acts as a prelude to all other chapters. The background section briefs the urban growth, sprawl, and the importance of remote sensing data and GIS techniques in urban growth analysis. The significance section documents the importance of current research. Other three sections (research objectives, research questions and methodological overview) will help to shape the readers' outlook on the research.

**Keywords** Urban growth • Sprawl growth • Kolkata • India • Remote sensing • GIS

### 1.1 Background

A spatial and demographic process that concentrates human population within a particular economy and society is generally regarded as urban growth. People move from villages to towns and cities in expectations of better life and economic opportunities. This movement is the primary cause of urban growth. A direct consequence of urban growth can be observed as increase in built areas.

Urban sprawl is an undesirable pattern as well as process of urban growth. This type of growth generally extends the core urban area to the outside rapidly in a dispersed manner. It occurs during the suburbanization process of residence, industry, and commerce. Sprawl encroach large amount of farmland, open space, and forest; may bring negative impacts on environment and may cause more traffic problems.