



CRC Press
Taylor & Francis Group

Geoinformatics for Sustainable Urban Development



Edited by
Sulochana Shekhar
Deepak Kumar

Geoinformatics for Sustainable Urban Development

This book provides compelling new insights into how cities are attempting to address sustainability challenges via major applications of geospatial technology in an urban area. It elucidates the role of geospatial techniques such as GIS and GNSS, including remote sensing in urban management, and covers the theory and practice of urban sustainability transitions. It provides case studies and contextualised tools for the governance of urban transitions to present various applications of geospatial techniques in an urban environment.

Features:

- Covers hands-on approaches on quantitative measures of urban analytics
- Focuses on sustainability issues in urban planning and development
- Includes pertinent global case studies for implementation of urban planning practices
- Reviews the inter-relationship between smart cities and sustainable development

This book is aimed at graduate students, researchers, and professionals in GIS, urban sciences, and geography.

Geoinformatics for Sustainable Urban Development

Edited by
Sulochana Shekhar and Deepak Kumar



CRC Press is an imprint of the
Taylor & Francis Group, an **informa** business

First edition published 2024

by CRC Press

6000 Broken Sound Parkway NW, Suite 300, Boca Raton, FL 33487-2742

and by CRC Press

4 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN

CRC Press is an imprint of Taylor & Francis Group, LLC

© 2024 selection and editorial matter, Sulochana Shekhar and Deepak Kumar; individual chapters, the contributors

Reasonable efforts have been made to publish reliable data and information, but the authors and publishers cannot assume responsibility for the validity of all materials or the consequences of their use. The authors and publishers have attempted to trace the copyright holders of all material reproduced in this publication and apologize to copyright holders if permission to publish in this form has not been obtained. If any copyright material has not been acknowledged please write and let us know so we may rectify in any future reprint.

Except as permitted under U.S. Copyright Law, no part of this book may be reprinted, reproduced, transmitted, or utilized in any form by any electronic, mechanical, or other means, now known or hereafter invented, including photocopying, microfilming, and recording, or in any information storage or retrieval system, without written permission from the publishers.

For permission to photocopy or use material electronically from this work, access www.copyright.com or contact the Copyright Clearance Center, Inc. (CCC), 222 Rosewood Drive, Danvers, MA 01923, 978-750-8400. For works that are not available on CCC please contact mpkbookspermissions@tandf.co.uk

Trademark notice: Product or corporate names may be trademarks or registered trademarks and are used only for identification and explanation without intent to infringe.

ISBN: 9781032362564 (hbk)

ISBN: 9781032362571 (pbk)

ISBN: 9781003331001 (ebk)

DOI: 10.1201/9781003331001

Typeset in Times

by Newgen Publishing UK

Contents

Editor Biographies	ix
Contributors	xi
Chapter 1 Subaltern Urbanisation in the State of Haryana, India.....	1
<i>Meet Fatewar and Vinita Yadav</i>	
Chapter 2 Urban Sprawl Modelling Using the CA-MARKOV Model for Thoothukudi City.....	19
<i>C. Jeswin Titus and Colins Johnny Jesudhas</i>	
Chapter 3 Urban Site Suitability Mapping Using GIS-Based Multi-Criteria Decision Analysis in Pathankot City, Punjab	33
<i>Meghna Rout, Sumit Kumar, Reenu Sharma, Sanjay Kumar Ghosh, and Brijendra Pateriya</i>	
Chapter 4 Strengthening the Cities of Maharashtra State to Become Climate Smart to Achieve Sustainable Development Goals: A Nature-Based Solutions (NbS) and Climate Adaptation Approach.....	53
<i>Wasim Ayub Bagwan</i>	
Chapter 5 Urban Heat Island: A Review of Effects and Predictions with Deep and Machine Learning Technologies.....	71
<i>R. Pushpa Lakshmi</i>	
Chapter 6 Anatomisation of Land Use/Land Cover (LULC) Dynamics with a Focus on Land Surface Temperature in Lucknow City Using Geospatial Techniques	85
<i>Akanksha, Pranjal Pandey, and Ambrina Sardar Khan</i>	

- Chapter 7** Analysis of Urban Growth and Examination of a Master Plan through Geospatial Techniques: A Case Study of Ranchi, Jharkhand, India..... 105
Kamal Bisht, Shubham Kumar Sanu, Vishwa Raj Sharma, and Priya Sharma
- Chapter 8** A Multi-Criteria Evaluation of Urban Flood Vulnerability and Perception in Osun River Basin, Southwest Nigeria..... 117
Oladeji Quazeem Muhammed and Adebayo Oluwole Eludoyin
- Chapter 9** Site Suitability for an Information Technology Corridor in Tirunelveli District Using GIS: A Restriction Model Approach 145
Venkatesh Baskaran, M.A.M. Mannar Thippu Sulthan, E. Aswin Raj, and A. Krishna Kumar
- Chapter 10** Integrating Environmental Monitoring Techniques for an Effective Healthcare System..... 159
Nupur Joshi and Ambrina Sardar Khan
- Chapter 11** Advancing the Interventions of Nature-Based Solutions in Cities for Urban Climate Resilience..... 173
Harshita Jain, Renu Dhupper, and Deepak Kumar
- Chapter 12** Management of Flood Disasters in Peri-Urban Ecosystems of Noida Using Remote Sensing and Geographical Information Systems 189
Renu Dhupper, Harshita Jain, Anil K. Gupta, Pritha Acharya, and Deepak Kumar
- Chapter 13** Changing Demographic Contours of Hyderabad City211
Kalpana Markandey
- Chapter 14** Assessing Sprawl Characteristics in the Peri-Urban Regions of Indian Metropolises through Geospatial Studies with a Special Study of Southern Chennai229
A.R. Narayani and R. Nagalakshmi

Contents	vii
Chapter 15 Geospatial Technologies for Groundwater Sensitive Urban Planning: Exploring the Status in Smart Cities of Rajasthan, India.....	257
<i>Prerna Jasuja, Rina Surana, and Niruti Gupta</i>	
Chapter 16 Computing the Accessibility of the Settlements Using the Network Analysis of Indore City Region: A Regional Approach.....	279
<i>Aman Singh Rajput and Chetna Singh</i>	
Chapter 17 Smart Sensors for Peak Demand Reduction in Urban Buildings	291
<i>C. Rakesh, T. Vivek, and K. Balaji</i>	
Chapter 18 Assessment of Flood Susceptibility in Hare River Catchment, Rift Valley, Southern Ethiopia, Using Geospatial and Drainage Morphometric Analysis.....	303
<i>Muralitharan Jothimani, Jagadeshnan Gunalan, Ephrem Getahun, Abel Abebe, and Meseret Desalegn</i>	
Chapter 19 Assessment of COVID-19 Impact on the Vegetation and Urbanisation of Dehradun City Using Geospatial Techniques.....	317
<i>Ashish Mani, Deepali Bansal, Hanuth Saxena, Maya Kumari, Deepak Kumar, Dharmendra Kumar, and Sulochana Shekhar</i>	
Chapter 20 Framework for an Area-Based Development Approach for Predicted Urban Sprawl in Delhi City.....	339
<i>Gaurav Kumar Mishra and Amit M. Deshmukh</i>	
Index	361

6 Anatomisation of Land Use/Land Cover (LULC) Dynamics with a Focus on Land Surface Temperature in Lucknow City Using Geospatial Techniques

Akanksha, Pranjali Pandey, and Ambrina Sardar Khan

CONTENTS

6.1	Introduction	86
6.2	Area Used for the Study	87
6.3	Methodologies Adopted for Anatomisation of Land Use/Land Cover Dynamics (Figure 6.2)	88
6.3.1	Use of Satellite Data	88
6.3.2	Use of Image Processing	89
6.3.3	Use of LULC Pattern Change	90
6.3.4	Use of Urban Sprawl Measurement	90
6.3.5	Using LST Computations	91
6.3.6	Use of Brightness Temperature	91
6.3.7	Use of Emissivity of the Land Surface (LSE)	92
6.3.8	Use of Land Surface Temperature	92
6.3.9	Use of Spatial Indices Calculation (Spectral Image Enhancement)	92
6.4	Statistical Analyses and Correlation between LST and Indices	92
6.5	LULC Analyses and Outcome	93
6.5.1	Shannon Entropy	94
6.5.2	LST	95
6.5.3	Variation of LST with LULC	96

6.6	Analyses of Spatial Indices NDVI, NDBI, and MNDWI.....	98
6.6.1	LST Change Relation with NDVI	99
6.6.2	LST Change Relation with NDBI	99
6.6.3	LST Change Relation with MNDWI.....	99
6.7	Conclusions	99
	References.....	101

6.1 INTRODUCTION

Urbanisation is an adjustable, global cycle that transforms a rural territory into a metropolitan zone. The UN research into the worldwide population forecasts that by 2050 the majority the population of India will reside in urban areas (UN 2014). Urban development can be defined as the structural improvement of paved surfaces brought about by the migration or convergence of rural areas into urban areas or settlements, as well as the addition of financial pressures (Mumford 1961). Population growth involves the intentional construction of new housing, commercial, administrative, and transportation infrastructure. These commonly permit vegetation habitats and open fields to be changed, creating an increment in land pattern transformation and urban growth. When large systematic and non-systematic modifications are made to the land, a city tends to progress even if the city itself remains constant. Excessive and unexpected urban sprawl beyond its most significant level causes a reduction in the quality of the environment. A well-planned and composed urban development is required for the progress of a statistically, financially, and environment-friendly society (Cabral et al. 2013, Somvanshi et al. 2018). Fast development in peri-urban areas prompts an expansion of the metropolitan region and a decrease in horticultural land availability (Census 2011). This, thus, prompts huge changes in the trends of rural land development, the advancement of farming, and employment opportunities. The greater part of Indian cities is currently confronting this transition situation, which shifts the economic balance between rural and urban areas in individual provinces (Arif and Gupta 2018, Bharath et al. 2019, Munda 2006). Rapid urbanisation in India may also be linked to communities' migration from rural areas to larger settlement areas for upgradation and better socioeconomic opportunities, etc. The government of India has begun the hi-tech city mission for housing for everyone by 2022, the 'Atal mission' for urban transformation and rejuvenation, the 'Jawaharlal Nehru national urban renewal mission (JNNURAM)', and the 'national heritage city development and augmentation yojana (HRIDAY)' (Rojas 2013). This highlighted the need of recognising the recent patterns of increasing Indian urban settlements and visualising these trends in altering the pattern of land use as it relates to sustainable urban planning. An important factor contributing to the rapid growth of metropolitan communities' industries and businesses. Population expansion is resulting in a gradual increase in the demand for natural resources, which looks to be exerting increasing strain on natural land (FAO 1997). Augmentations of the land use pattern should be regarded as the most essential information on land development and effective management (Census 1991). Such variations are the result of the fast expansion of vast territories (Rembold et al. 2000). This facilitates strategy and decision-makers to