

**Land-Use and  
Environmental Resources**  
*Methods and Management*

## EDITORS

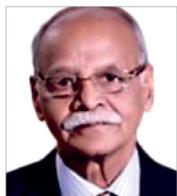
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**Dr. Anil K. Gupta** is Head of Policy Planning Division, Head of Training Cell and Coordinator of Technical Advisory Committee, at India's National Institute of Disaster Management, New Delhi. Previously he was Director of Bundelkhand University Institute of Environment and Development Studies, and head of its Environmental Science and NRM Departments, as founder. He also worked with DMI Bhopal, NEERI (CSIR) Nagpur, NDMC Ltd. and CICON Bhopal. He is Fellow of Earth Scientists Society and known for pioneering contributions on disaster management policy planning, climate change adaptation, ecosystem approach to disaster reduction, environmental law and risk/damage assessment. He steered making of India's National Plan for Disaster Management, National Human Resource Plan, and Perspective Plan of NIDM. He was honoured with Young Scientist Award of Government of Madhya Pradesh (2006) and Excellence Award of Indian Society of Occupational & Environmental Health (2012). He has more than 125 publications including 20 books and 46 research/policy papers. He has steered various projects supported by NORAD, World Bank, Govt. Ministries, Planning Board, ICSSR, GIZ Germany, CDKN (UK), and collaborated with UNDP, UNEP (Geneva), UNU-EHS, ITC Netherlands, ISET (USA), inWEnt Germany, Ifanos Germany, etc. and represented in international delegations.



**Sreeja S. Nair** is presently associated with UNHABITAT Myanmar as Coordinator of the Myanmar Consortium for Capacity Development on Disaster Management (MCCDDM). She is Assistant Professor at National Institute of Disaster Management since June 2007. She is a disaster management professional having more than 15 years of experience. Her areas of research, documentation and training activities at NIDM include Geoinformatics applications in Disaster Management, Environmental Law, Disaster Data and Information Management, Ecosystem Approach to Disaster Risk Reduction and Chemical Disaster Management. She has published 20 papers in national and international journals, authored 8 training modules and authored/ edited 4 books. She has coordinated the Indo German Cooperation on Environmental Knowledge for Disaster Risk Management and was the co-principal investigator of ICSSR research project on drought vulnerability and mitigation analysis.



**Prof. (Dr.) Mohammad Yunus** is presently Vice Chancellor of the Mohammad Ali Jauhar University of Uttar Pradesh in India, since 2012, after his tenure as Professor (position offered in absentia) and Head of Environmental Sciences, and Dean of Faculties of Environmental Sciences, Information Science & Technology and Biosciences & Biotechnology (as Founder Professor), at Babasaheb Bhimrao Ambedkar (Central) University at Lucknow. He also served as Registrar and as Vice Chancellor of the University. He was elected Fellow of Lineus Society of London (FLS) and has the credit of scientific association with Prof. T. A. Mansfield (FRS) at Lancaster University, UK. He also worked at University of Sussex at Brighton, UK. Prior to joining as Professor, he was Scientist, Head and Area Coordinator of Environmental Science Division at CSIR's National Botanical Research Institute, Lucknow. He was also Convenor of Environmental Cell (financial arm for providing consultancy). Prof. Yunus has guided several doctoral and post-graduate research treatise in area of phytoremediation, land restoration, EIA, disaster management, etc., and published more than 140 research papers including 84 in foreign journals with high impact factor and high citation.

# **Land-Use and Environmental Resources**

*Methods and Management*

*Editors*

**Anil K. Gupta**

**Sreeja S. Nair**

**M. Yunus**

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Mittal and Mr. Surya Mittal deserve special thanks. Last but not the least, family members of the Senior Editor (MY) and Co-editor (SSN), and of the undersigned (Dr. Alka Gupta, Ms. Vanya Badal Gupta and Mr. Vibhu Badal Gupta) are acknowledged for their cooperation without which this work would have not been possible.

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**Dr. Anil K. Gupta**  
**Principal Editor**

# Foreword

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Land is the foundation on which humanity has built civilisations and achieved progress. Land supports our forests and our agriculture. The quality of our urban and rural life is dependent on efficiency of our land use. It is also increasingly becoming clear that in appropriate land use planning can lead to disastrous consequences as evidenced by many recent disasters around the world.

The importance of land use planning for disaster risk reduction has been identified in a number of recent international documents. The IPCC Special Report on Extreme Events (2012) and the Sendai Framework on Disaster Risk Reduction (2015), both highlights the importance of land use planning for disaster risk reduction. The World Bank Report “Natural Hazards, Un-Natural Disasters”, demonstrate land use planning as the most cost effective way of achieving disaster risk reduction.

While the importance of appropriate planning of land is both self evident and well documented, it is also a fact that adequate attention from the policy makers has not been directed in this area. Historically, when land was plenty, efficient use or even well planned use was not as critical as it is today. Secondly, as land is one of the fundamental possessions of individuals, families and community, any attempt to regulate land use will be seen as an encroachment of their freedom and way of life. Land Use planning is thus a major challenge, especially in democratic societies.

It is, therefore, important that the benefits of planned land use is studied, documented and used for policy advocacy at national, state and local levels. This book volume entitled “Land-use and Environmental Resources: Methods and Management” is a praiseworthy effort of bringing strategic issues along practical examples of useful tools and case studies on various aspects, from various countries. I congratulate the editors, who are well known to me as noted authors of text books and guidance documents, for undertaking this task. The publication is very timely in

the light of global journey to Sustainable Development Goals. I am sure the book would be a significant reference for researchers, policy analysts, planning professionals, and post graduate students.

**Dr. Muralee Thummarkuddy**

Chief, Disaster Risk Reduction

**United Nations Environment Programme (UNEP)**

(Disaster Management and Post-Conflict Branch)

Geneva, Switzerland

# Introduction

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Land is the most limited resource as we have as yet only one earth known suitable for the human population which is ever growing and on a faster rate than the carrying capacity of the supporting systems. Land inhabits most life forms, holds water and water bodies, in-houses all the basic functions and precursors of climatic functions that take place in its near atmosphere. Changes in the land – landscape, land-use and quality, change the microclimatic settings and also modify regional and local influence on winds and precipitation.

Land is the house of all the economic developments – be it the housing, industry, power, agriculture, forestry, transport, or else, land is the basic requirement. Environmental resources are the systems and sub-systems of our environment (be it natural or human-made) that we look at for our services and supplies, also called as ‘ecosystem services’. These are, for example, climate regulation, water, food and fibre, recreation, health and medicines, industrial raw materials, etc.

Management of environmental resources in an approach that helps maintain the renewability and sustainability calls for the effective management of land – landscape, land-use and land-resources. More recently the ‘ecosystem approach to climate change adaptation’ and ‘disaster risk reduction’ has added refinement to our understanding of ‘environment-development’ relations as ‘human security and safety’ are significant aspects of ‘sustainability’. More so, the recent disasters of Uttarakhand (June 2013), Malingaon landslide (2013), Kashmir flood (2014), etc. have re-called an extension of the academic thought process to ‘environment-development-disaster’ inter-linkages.

In the modern times of growing urbanization, industrial agglomeration with urban peripheries and rural transitions in fast pace, defining natural and human environment separately would be inappropriate. However, land-use management holds the key and shall set the tone for management of environmental resources for human need and its generations. Case studies and experiences with examples from different parts of the world on different methods and management aspects of land and environmental resources are brought together in this edited volume with the aim of offering a holistic knowledge base covering all important aspects. The book comprises of three sections: Introduction and Overview, Methods & Case Studies and Management Strategies.

The Introduction and Overview section offers a broad understanding on land resources and land-use related current concerns of classification, land reforms and real estate, disaster risk reduction, and coastal specific issues. The section has 4 chapters contributed by practicing subject experts. First chapter of the book and of this section tries to relate the land and land-use functions with climate-change related issues and brings in the perspective of human security through land management. Land-cover modifications are more subtle changes that affect the character of the land cover without changing its overall classification. Sustainable land-use management provides a variety of cost-effective mechanisms for supporting both climate adaptation and mitigation. Ecosystem services represent the transformations of natural assets (soil, water, biota) into 'products' of value to humans. The context of land-use related researches offers emphasis on diverse range of studies on land-use which can be utilized for effective planning and management of ecosystem services with specific reference to climate-change adaptation.

Chapter 2 focused on the land capability classification as a tool for optimization and brings in the ground level research and extension experience of the authors. Six main uses of land have been defined; three related to ecological aspects, and three to human activities. The ecological uses, related to food security, compete with the human uses, related to urbanization, industrialization and recreation. Such competitions have had an adverse impact on this vital natural resource which is in fact the mother resource. The land-capability classification map is normally prepared by interpreting a standard soil-survey map. The land-suitability and its concerned capacity have been discussed in the chapter taking an example case study from Central India.

Sharing the accomplishments of a booming economy and healthy GDP growth, Indian real estate industry has been expanding at an exponential rate. Favorable demographics, rising purchasing power, availability of cheap finance, professionalism in real estate and reforms initiated by the government are the major drivers of this spectacular growth. Chapter 3 of the book presents a thorough analysis of land reform and environmental sustainability with special reference to real estate boom in India. Apart from economic development, employment generation and benefits of rural urban migration and number of other benefits can be counted of the real estate boom. But this reform encouraged environmental problem, social conflict and social imbalance in society. Land reform has widened the gap between rich and poor.

Land use planning in the coastal region through remote sensing based technique has been discussed in chapter 4 with a case study from Gujarat of India. Coastal areas are vulnerable in nature. At the same time they are also the growth engine of the region by attracting a variety of economic activities. Such a situation put lot of stress on the coastal areas for development. Gujarat example of coastal industrialization and land-change modifications in recent times is classic for study as it has multiple dimensions of benefits and losses to people and ecosystems, with warnings for the future. The change in land use pattern in the coastal region can provide an idea of utilization of land resources for development. The case study in the chapter also presents an analysis the quality of land in terms of salinity effects.

In the surroundings of Zaragoza (Spain), the quaternary alluvial terraces of the Ebro River deposited upon Tertiary gypsum formations. This covered karst area presents intense karstification processes and is an important source of sand and gravels deposits and groundwater. Negative interactions with the environment, as the destruction of infrastructure by land subsidence or groundwater contamination by industry, occurred in the last decades, due to the fast development of the city. Chapter 5 provides a case study of spatial decision support systems for sustainable land-use suitability analysis. The study the methodology was useful in classifying and identifying the land suitable for new industrial, agricultural and housing development.

Land cover and land use can be seen as the interface between natural conditions and human influence providing a sound framework for linking socio-economic development with some environmental impacts. Since independence, India has witnessed phenomenal educational development both in quantitative and qualitative terms. There has been a steady growth in school enrolment coupled with a decline in school dropout. Of all, land resource to house the educational buildings, playgrounds, hostels and residential quarters is the basic requirement. A study of land use for educational institutes, in a fast growing District of Uttar Pradesh in India, has been carried out and presented in chapter 6. Land under educational institutes, although occupies relatively small area (> 2% of the district) is important taking in consideration its potentiality of expansion in the crowded urban sprawling.

Chapter 7 provides an analysis of land use diversification in the Himalaya region, through a study of Shivaliks in India. The foothills of Shivaliks extending from Jammu and Kashmir to Uttarakhand states cover a total area of 3.10 mha. Rainfed areas face multifaceted problems of poor soil fertility, erratic rainfall, low soil moisture, poor economic condition of the farmers who cannot afford to invest adequately. This tends to diminishing livelihood support system. Land use diversification involves multidisciplinary approach including interaction among climate, soil, water, vegetation, livestock and socio-economic dimension in devising most remunerative, eco-friendly and environmentally sustainable land use. Since drought and floods are common evil in rainfed areas, appropriate techniques and technologies are to be adopted on watershed basis for effective soil and water conservation to have sustainable land diversification systems and improve the socio-economic condition of the poor farmers.

Recent flood disaster of Uttarakhand has re-iterated nature's warning of severe ecological backlash if our developmental planning fails to address environmental issues of the impact areas. Chapter 8 discusses the remote sensing and Geographical Information System application in environmental management planning of Vyasi Hydroelectric Project in Uttarakhand state of India. Environmental Impact Assessment (EIA) is a decision making tool to ensure consideration of environmental impacts of a developmental activity through incorporation of appropriate At present, various remote-sensing satellites are capable of providing extraordinary data on all aspects of the environment with microscopic resolution. These inestimable spatial data sets can be utilized in environmental decision making processes. Utilizing these abilities coupled with GIS, the tedious process of baseline data storage and subsequent analysis can be made efficient and less time consuming.

Development of Groundwater Prospects Zone Using Remote Sensing and Geographical Information System is the focus of chapter 9. The groundwater levels are decreasing over the years due to decline in annual rainfall, climatic changes, rapid urbanization, industrialisation, increasing runoff, agricultural activities and deforestation. The groundwater prospects evaluation for the parts of Hyderabad and Mahabubnagar districts of Andhra Pradesh has been attempted based on hydro-geomorphological mapping by using high resolution geo-coded merged satellite data (IRS-ID, PAN and LISS-III) in a GIS environment. In order to meet the future demands, less groundwater potential zones are identified and artificial recharge structures are recommended to improve the groundwater prospects.

Chapter 10 enumerates on groundwater resource management by hydraulic simulation of groundwater flow using Visual Modflow model. Ground water flow models for assessing groundwater potential have been a long-standing interest for water engineers. Numerical simulations based on a natural river channel indicate that explicitly modeling local obstructions/boundaries can significantly impact predicted flow parameters. A study on historical groundwater levels at confined and semi-confined aquifers in Vaigai river basin situated in Tamil Nadu showing a long-term fluctuation was undertaken. With the application of software like Visual MODFLOW, it has proved to be the convenient way to study such problems. In addition, it can generate large amount of data quickly and experimental modifications can be made with minimal efforts. These models are useful for better water resource management and understand the coastal hazards of the basin.

Water forms an essential commodity of life at domestic and ecosystem levels. It plays a complex and multifaceted role in both human activities and natural systems. Water Scenario in India in the context of the river-linking proposal of Indian Government during past decade is the focus of chapter 11. The river-linking has been put into water management discussion tables as a panacea of all hydro-meteorological troubles by some professional and political fractions without subjecting the matter to proper scientific and ecological scrutiny. The recent directive of the apex court in India also caused a situation of conflicts and dilemma regarding ecological perceptions of sustainable development and also the philosophy of 'win the nature'. Chapters 11 discusses the pros and cons of the water governance and context of riverlinking proposal from the angle of an environmental impact assessment.

Availability of water is highly uneven in both space and times but have competing uses. Land and land-use is crucial in water resource systems and its management. Chapter 12 discusses urban water supply system in context of water body management in an urban area. Reference has been taken to discuss the water use for drinking purpose. Planning and implementation of water resource projects involve a number of socio-economic aspects and issues such as environmental sustainability, appropriate resettlement and rehabilitation of project-affected people and livestock, public health concerns of water impoundment. Costs and benefit aspects of municipal water supply system has also been discussed with a perspective of a water balance.

Chapter 13 on 'agroforestry vis-a-vis environment' deals with alternative land-use promotion in ago-ecosystems particularly in rainfed and other drought prone areas of the country. Basically agro forestry is a land use system and the term was coined in 1970s. An ideal agro forestry system should possess the three attributes: productivity, sustainability and adaptability. Considerable work has been done in identifying the most suited system for the semi arid sub tropics where moisture evaporation is the double the average rainfall. Trees are a vital component of the survival economy of the rural poor, and this social reality has been utilized in promoting the agro-forestry models which are socially acceptable and ecologically suitable for the land.

*– Editors*



# Contents

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<b><i>Acknowledgements</i></b>	<b>v</b>
<b><i>Foreword</i></b>	<b>vii</b>
<b><i>Introduction</i></b>	<b>ix</b>

## Introduction and Overview

<b>1. Land-Use for Climatic and Human Security: Policy Concerns</b>	<b>3</b>
<i>Anil K Gupta, Sreeja S. Nair and Mohammad Yunus</i>	
<b>2. Land-capability and Land-Use Optimization</b>	<b>11</b>
<i>Hrittick Biswas, Brij Lal Lakaria and V.S. Katiyar</i>	
<b>3. Land Reforms and Environmental Sustainability: Reference to Real Estate Boom</b>	<b>25</b>
<i>Nisha Pandey and V. Vedak</i>	
<b>4. Land-Use Planning in the Coastal Region through Remote Sensing Based Technique: A Case Study from Gujarat</b>	<b>37</b>
<i>Shital Lodhia</i>	

## Methods and Case Studies

- |                                                                                                                                          |            |
|------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>5. Spatial Decision Support Systems for Sustainable Land-Use Suitability Analysis: An Example from Ebro Basin in Zaragoza (Spain)</b> | <b>53</b>  |
| <i>M.T. Lamelas, O. Marinoni, A. Hoppe and J. de la Riva</i>                                                                             |            |
| <b>6. Land-Use and Land-Cover Change: Case of Jhansi in Bundelkhand</b>                                                                  | <b>69</b>  |
| <i>R.S. Khoiyangbam and Santaram S. Oinam</i>                                                                                            |            |
| <b>7. Diversifying Land-Use: Case of Shivaliks in Indian Himalayas</b>                                                                   | <b>81</b>  |
| <i>Sanjay Arora and M.S. Hadda</i>                                                                                                       |            |
| <b>8. Environmental Management Planning: Remote Sensing and GIS Application</b>                                                          | <b>93</b>  |
| <i>D.K. Agrawal and M.S. Lodhi</i>                                                                                                       |            |
| <b>9. Groundwater Development Using Remote Sensing and GIS</b>                                                                           | <b>113</b> |
| <i>Y. Rama Mohan, Avinash Kumar and Anil K. Gupta</i>                                                                                    |            |
| <b>10. Hydraulic Simulation of Groundwater Flow</b>                                                                                      | <b>127</b> |
| <i>V. Ramani Bai, Sumiani Yusoff and S. Mohan</i>                                                                                        |            |
| <b>11. Water Scenario and the River Linking Proposal: An Impact Analysis</b>                                                             | <b>141</b> |
| <i>Pallavee Tyagi and Anil K. Gupta</i>                                                                                                  |            |
| <b>12. Water Use in Drinking: Analysis at Urban Local Body Level</b>                                                                     | <b>149</b> |
| <i>Jharna Pathak</i>                                                                                                                     |            |

## Management Strategies

- |                                                                      |            |
|----------------------------------------------------------------------|------------|
| <b>13. Agroforestry vis-à-vis Environment and Disaster Reduction</b> | <b>167</b> |
| <i>A.S. Gill</i>                                                     |            |
| <b>14. Ecosystem Approach to Resurrection of Gulf Coast</b>          | <b>175</b> |
| <i>Ashwani Vasishth</i>                                              |            |
| <b>15. Non-timber Forest Produce for Livelihood Security</b>         | <b>185</b> |
| <i>R.K. Pandey and Satvant Kaur Saini</i>                            |            |
| <b>16. Conservation and Management of Bhopal Lakes</b>               | <b>199</b> |
| <i>Sanjeev Sachdev</i>                                               |            |

<b>17. Fuel Oil from Wastelands: Jatropha Project</b>	<b>215</b>
<i>Kumud Dubey, Md Rizwan Khan, Anubha Srivastava and V.K. Singh</i>	
<b>18. Solid Waste Treatment and Disposal Options</b>	<b>221</b>
<i>Sutapa Bose, Gurmeet Singh and Anil K. Gupta</i>	
<b>List of Contributors</b>	<b>235</b>
<b>Index</b>	<b>241</b>