

R. M. Yuvaraj
M. V. Karunambigai
V. Gopal *Editors*

Advanced Landslide Susceptibility Modeling

Effects on Sustainability and Human and
Economic Welfare

 Springer

Advanced Landslide Susceptibility Modeling

R. M. Yuvaraj · M. V. Karunambigai · V. Gopal
Editors

Advanced Landslide Susceptibility Modeling

Effects on Sustainability and Human
and Economic Welfare

 Springer

Editors

R. M. Yuvaraj
Department of Geography
Institute of Distance Education
University of Madras
Chennai, Tamil Nadu, India

M. V. Karunambigai
Department of Tourism and Travel
Management
J. B. A. S. College for Women
Chennai, Tamil Nadu, India

V. Gopal
Centre for Earth and Atmospheric Sciences
(CEAS)
Sathyabama Institute of Science
and Technology
Chennai, Tamil Nadu, India

ISBN 978-3-032-14484-3 ISBN 978-3-032-14485-0 (eBook)
<https://doi.org/10.1007/978-3-032-14485-0>

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer
Nature Switzerland AG 2026

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Disclaimer: The authors of individual chapters are solely responsible for the ideas, views, data, figures, and geographical boundaries presented in the respective chapters of this book, and these have not been endorsed, in any form, by the publisher, the editor, and the authors of forewords, preambles, or other chapters.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

If disposing of this product, please recycle the paper.

Foreword

Landslides are among the most destructive and unpredictable natural hazards, posing severe threats to human life, infrastructure, and ecosystems worldwide. Their occurrence is intricately linked to complex interactions between geology, geomorphology, climate dynamics, and human activities. In recent years, accelerated urbanization, deforestation, and the intensifying effects of climate change have significantly increased the vulnerability of fragile hill and mountain ecosystems to landslide disasters. These events not only cause physical damage but also have far-reaching implications for economic stability, community livelihoods, and sustainable development.

In this context, adopting advanced scientific tools and holistic approaches for landslide prediction and management is no longer an option but a necessity. The integration of **geospatial technologies, machine learning models, and sustainability-driven frameworks** has opened new horizons for understanding the spatial-temporal dynamics of landslide susceptibility. This book, *Advanced Landslide Susceptibility Modeling: Effects on Sustainability and Human and Economic Welfare*, arrives at a critical juncture, offering a comprehensive and multidisciplinary exploration of this pressing issue.

The volume brings together contributions from leading experts who examine landslide risk through multiple lenses—ranging from terrain-based and geostatistical modeling to the socio-economic dimensions of hazard impacts and the role of indigenous knowledge in building resilience. Each chapter not only presents scientific rigor but also emphasizes practical strategies for policy-making, risk reduction, and sustainable land-use planning.

Acknowledgments

The successful completion of this edited volume, *Advanced Landslide Susceptibility Modeling: Effects on Sustainability and Human and Economic Welfare*, would not have been possible without the valuable contributions, guidance, and support of many individuals and institutions.

First and foremost, we express our profound gratitude to **Springer Nature** for providing this distinguished platform to publish and disseminate cutting-edge research on landslide susceptibility, environmental sustainability, and geospatial innovation. Their continued commitment to academic excellence and scientific advancement has been a great source of encouragement.

We sincerely thank all the **chapter contributors** for their scholarly inputs, rigorous research efforts, and timely cooperation, which have enriched this book with diverse perspectives and scientific depth. Each chapter reflects the dedication and collaborative spirit of researchers who share a common goal of mitigating landslide risks through scientific innovation and sustainable approaches.

We extend our heartfelt appreciation to the **reviewers** for their insightful comments, constructive suggestions, and meticulous efforts that ensured the high academic quality of this publication.

This book is dedicated to all researchers, scholars, and practitioners striving toward a safer, sustainable, and resilient world through scientific knowledge, innovation, and the continued advancement of the discipline of geography at the international level.

Contents

Part I Introduction

- 1 **Environment, Geography, Landslide, and Sustainability:
An Overview of Geography–Landslide Interface** 3
Rushda Sharf, Yusra Sharf, Kashif Abbas, and Mudassir Alam
- 2 **Landslide Sustainability: Effects on Human and Economic** 25
S. Aravind Raj and G. Bhaskaran
- 3 **Overview of Landslides in Tamil Nadu and Its Effects** 49
K. S. Banu and B. Vijayakumari

Part II Contemporary Issues of Geographical and Geological Aspects of Landslide, Various Susceptibility Modeling Techniques and Accuracy Assessment

- 4 **Terrain-Based Modeling of Landslide Susceptibility** 65
R. M. Yuvaraj
- 5 **Landslide Susceptibility Modeling Using Integrated Geospatial
and AHP Approaches: A Case Study in Idukki District, India** 79
Kongeswaran Thangaraj, Prabakaran Kulandaisamy,
Sivakumar Karthikeyan, Muthuramalingam Rajendran,
Muruganatham Arumugam, Perumal Velmayil,
Venkatramanan Senapathi, and Bangaru Priyanga Sundaram
- 6 **Geospatial Analysis and Prediction of Landslide Susceptibility
in Uttara Kannada District, Karnataka (2025–2050):
A Multi-Model Approach Using Maxent, MGWR, and ANN** 105
M. Sasi and Sawant Sushant Anil

Part III Roots of Various Climate and Environment Related Causes of Landslides



Environment, Geography, Landslide, and Sustainability: An Overview of Geography–Landslide Interface

1

Rushda Sharf , Yusra Sharf , Kashif Abbas ,
and Mudassir Alam 

Abstract

This chapter provides a comprehensive overview of the intricate relationships between environment, geography, landslides, and sustainability. Landslides, as complex geomorphological phenomena, play a crucial role in shaping landscapes and pose significant risks to human societies worldwide. We explore the geographical aspects of landslides, examining their spatial distribution using high-resolution DEMs and the geomorphological factors influencing their occurrence. The chapter probes into the environmental determinants of landslide susceptibility, including lithology, and hydrological processes. The impacts of climate change on landslide dynamics are critically assessed using the latest IPCC AR6 projections. The chapter examines cutting-edge approaches in landslide hazard assessment, including the integration of InSAR for ground deformation monitoring, LiDAR for high-resolution topographic mapping, and deep learning models such as convolutional neural networks for automated landslide detection. The chapter concludes by identifying emerging research directions, such as the application of UAV-based photogrammetry for rapid landslide inventory mapping and the integration of landslide risk assessment into sustainable development planning using multi-criteria decision analysis techniques. This holistic approach aims to bridge the gap between scientific understanding and practical implementation, fostering resilience and sustainability in landslide-prone regions.

R. Sharf (✉)

Department of Environmental Science, Integral University, Lucknow, India
e-mail: rush.khan09@gmail.com; rsharf@iul.ac.in

Y. Sharf · K. Abbas · M. Alam

Department of Zoology, Aligarh Muslim University, Aligarh, India

© The Author(s), under exclusive license to Springer Nature Switzerland AG 2026

R. M. Yuvaraj et al. (eds.), *Advanced Landslide Susceptibility Modeling*,

https://doi.org/10.1007/978-3-032-14485-0_1

3