Jayanta Das
Somenath Halder *Editors*

New Advancements in Geomorphological Research

Issues and Challenges in Quantitative
Spatial Science

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Editors

New Advancements in Geomorphological Research

Issues and Challenges in Quantitative Spatial Science

Editors
Jayanta Das ⓘD
Department of Geography
Rampurhat College
Rampurhat, West Bengal, India

Somenath Halder ⓘD
Department of Geography
Kaliachak College
Malda, West Bengal, India

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Dedicated to scholars and young geographers

Foreword

It's a delightful feeling to write the Foreword for the edited volume on *New Advancements in Geomorphological Research*, which includes diversified themes of contemporary significance. The book is edited by two young scholars, Jayanta Das and Somenath Halder, from the broad group of physical geography, applied geomorphology, geohydrology, coastal geomorphology, regional geomorphology, and natural hazard and disaster management.

Very recently, the claims and reworking of advanced methodological knowledge of Geographic Information Science have been perceived across the disciplines. Thus, the approach of the said branch has been transformed into a multi-disciplinary milieu. The core discipline of *geomorphology* is promisingly moving toward hybrid statistical models, like artificial intelligence and machine learning. Along with the traditional branches of geomorphology, many sub-branches of geomorphology have been introduced since the 1990s, like environmental geomorphology, climatic geomorphology, tectonic geomorphology, geomorphological sites, and many others.

The dynamic global environmental challenges, such as sea-level rise, disappearance of mountain glaciers, molten polar ice caps, catastrophic climate events, massive mass wasting, deteriorating river health, and declining groundwater levels, are captivating earth scientists, geomorphologists, geologists, geoengineers, and policymakers to boost the periphery of the discipline. Meanwhile, the ever-increasing magnitude of human activities in a specific geoentity has also generated immense pressure on natural landscape sustainability, geoheritage management, and terrain ecology throughout the globe. After the industrial revolution, human activities like

infrastructural development in the form of geared-up urbanization, big dams and hydel power projects, construction and expansion of expressways and giant bridges, excessive usage of groundwater, and similar other activities also upsurge new challenges to human society. Nature always tries to stabilize itself. Geomorphological hazards have been more frequent in making such natural stability from human interventions.

The present book is an assortment of 25 research studies from across the trans-disciplinary communities of the globe covering topics ranging from the changing nature of geomorphological research, adaptation of newly advanced technology for analyzing geomorphological features in the shape of sub-groups like mountain geomorphology, hydro geomorphology, and coastal geomorphology. The themes recognized and integrated in this edited piece are vital components of the current developments in geostatistical model usage, adopting machine learning and artificial intelligence, and the issues addressed are of utmost significance because of the present-day geoenvironmental crisis management for sustainable conservation. I want to convey my appreciation to the editors and congratulate them on endeavoring to pursue this volume for readers of diverse bands of disciplines in geomorphology and applied geomorphology.

The case study approach persuaded in the chapters, with examples across the various parts of the globe covering varied geoenvironments, brings the insights of the authors and editors to bear upon the micro-regional pattern of interconnection between new advancement in ML and AI and applied geomorphology. This edited book will be widely acclaimed by geologists, geomorphologists, earth scientists, geoengineers, policymakers, and scholars of allied disciplines on the emerging topics of quantitative spatial science connected with geomorphology.

Sunil Kumar De
President
International Association of Geomorphologists (IAG)

Professor
Department of Geography
North Eastern Hill University
Shillong, Meghalaya, India

Preface

At the beginning stage, the eminent branch of physical geography, *geomorphology*, began its journey of qualitatively analyzing and describing the earth's landforms and processes. After the quantitative revolution, there was a remarkable shift in methodological breakthroughs and the design of research in studying geomorphology. In the present century, with the advancement of computer and information technology and innovation in hybrid statistical models (in the form of machine learning and artificial intelligence), a new kind of wave has emerged in geomorphological research. Thus, to resuscitate the statement above, partially, the current title *New Advancements in Geomorphological Research* would be an attempt. Recently, while comprehending the scientific milieu in geomorphological revision, several new-age global problems like sea-level change, coastline shrinkage, mountain glacier disappearance, shortening of area coverage of polar ice, catastrophic climate events, unexpected mass wasting events, worsening river health, deteriorating ground water level, etc., have been encountered by numerous scientists. Consentingly, advanced research, applying cutting-edge technology, would provide a fruitful result to encounter the current problems related to the geoenvironment. The recent research with precise and subjective findings also helps minimize the impacts of inherent and outside factors that are responsible for triggering geomorphological processes.

Undoubtedly, our present world has encountered several changing natural phenomena and problems generated by greater human activities in the earth's environment. Some of the issues are discussed earlier. Eventually, the well-advanced modern information technology and means, with innovative and precise investigation and calibration methodology and policy guidance, can help. In that case, it will reduce half of the problem and ensure geoenvironment conservation and management for the holistic benefit of human society. The present 'issues and challenges in quantitative spatial science' also can curtail the other partially linked complications in micro-regional scale, like preparedness for natural hazards, mode of operation agricultural livelihoods, river-course shift and adopted agricultural sustainability, shrinkage of coastline and risk reduction, win-win condition for geoheritage conservation and ecotourism, and so on. Simultaneously, cultivating knowledge in the desired way of applying information technology for the modern (sustainable) society and their intensive (self) care and management can curb the gap between science, policy, and the ground-level situation concerned.

The book encompasses five major parts: (1) Introduction and Conceptual Framework, (2) Mountain Geomorphology, (3) Hydro Geomorphology, (4) Coastal Geomorphology, and (5) Conclusive Remarks. The amalgamated 25 chapters attempt to apprehend the different and complex trends of usage of GIScience in geomorphological research and/or applied geomorphological persuasion. The above-said situations are induced to venture through case studies and discussions from different corners of the developing world.

Under the first part (Part I), there are two chapters. Chapter 1 tries to explore the reality of whether there is any paradigm shift in applied geomorphological research and the final output of this debatable theme through a systematic literature review. In the subsequent chapter, Chap. 2, through a case study method, an attempt has been made to establish changing paradigms in applied geomorphology for hydroclimatic research studies and establish that there is certainly a recognizable paradigm shift.

The next part (Part II) has three chapters. Chapter 3 assesses the GLOF susceptibility in a river basin situated in the Himalayan region. This chapter is trying to pursue risk mapping with the help of optical remote sensing data. In Chap. 4, with the help of an advanced database and ground investigation, a terrain sensitivity assessment of eastern Himalayan has been made. Subjectively, after adopting MCDA, GIS, and field investigation followed by a method of deduction in Darjeeling hills, it would be new assistance for environmental planning and management. Chapter 5 encompasses the most crucial issue of landslide hazard and its appropriate zonation, adding the potential layout for land use planning, infrastructure development, and disaster mitigation.

The subsequent part (Part III) has 14 chapters. Chapter 6 concentrated on the enlightened agenda of searching the trend of research and pointing the research gap(s) on the specific corner of river basin morphometry through meta-analysis on a global scale. Chapter 7 endorses a comparison between Al and ML for gully erosion susceptibility. This chapter may contribute a highly potential approach to applied geomorphology. Chapter 8 examines the changing scenarios of landforms and LULC and the environment-friendly role and resilient qualities of South Indian peasants under the current situation of climate change. Subsequently, in Chap. 9, an attempt has been made to incorporate a progressive database for profiling geomorphological characteristics of sub-tributary. This chapter successfully enabled to highlight how a hybrid real-time database, on a temporal scale, may contribute toward the fluvio-geomorphological research on a lesser-known sub-tributary. Chapter 10 explores the novelty of integrating geospatial modeling and GWP analysis via GIS-Based TOPSIS, VIKOR, and EDAS techniques. This chapter would be capable of providing more sustainable ground water management. Chapter 11 reexamines one of the most important fluvio-geomorphic phenomena, like riverbank instability and bank-line migration of a foothill-fed transboundary river located in the Eastern Himalayan Region. With the advent of satellite imagery, Chap. 12, on real-time background, attempts to explore the upper part of one of the major rivers of Bangladesh on the vital geomorphic agenda of spatiotemporal channel dynamics. This chapter pleasantly throws light on data-analytical design for future geomorphological analysis. Chapter 13 tries to foresee the water conservation and run-off estimation by applying the MCDM model for handling water

crises in semi-dry areas. Broadly, this chapter engrossed flood susceptibility assessment and hydrological modeling for the micro-scale analysis. Chapter 14 attempted to evaluate the Beas River in Punjab (India) and its crucial riverbank erosion using geomatics on a spatiotemporal scale. Subsequently, in Chap. 15, under the canopy of fluvial geomorphology, a persuasion of re-exploration has been made for flood frequency assessment of the micro-scaled river basin of eastern India. Chapter 16 examines the river-path change detection and monitoring of one of the vital Indian Rivers (Yamuna) on the micro-regional scale. This chapter proved to be a torchbearer for future research in the line of stream-line change detection parameters. While in Chap. 17, the limelight is enforced upon watershed prioritization, in the case of micro-scaled geomorphic units, side-by-side, this chapter also adopted neoclassical and hybrid methodology for the targeted output. Chapter 18 encompasses the geospatial analysis of groundwater recharge potential, visualizing the ground reality in the complex rock terrain of eastern India. With a well-advanced method of geospatial modeling, Chap. 19 tries to focus on flood hazards and their influence on the river-side dwellers, especially in a low-ranged Himalayan stream.

Four chapters have been included in the succeeding part (Part IV). In the first chapter of this part, Chapter 20, under the larger geomorphological profile of coastal geomorphology, purposively tries to focus on the recently detected climate change phenomenon in the micro-region of Gujarat (India). Chapter 21 contextualizes the integrated coastal zone management scenario; after corresponding the RS and GIS techniques, a critical analytical approach is made in force to solve contemporary problems in a coastal environment. Whereas, in Chap. 22, an exploration has been made of how, during the post-polderization period, LULC change influenced the inhabitants and their livelihoods under the coastal regime of Southeast Asia. Chapter 23 makes an assessment of aquaculture practices exclusively in the saline-prone coastal region of Bangladesh. This chapter also tries to underline some reframed policy issues interrelated with the changing coastal environment, stakeholders' perceptions, and suitable government policies.

The end part (Part V) has two more chapters. In Chap. 24, under the envelope of regional geomorphology with GIScience breakthrough, the said chapter finds out the lesser-enlightened geomorphological features in a plateau region. Chapter 25 makes a conclusive contribution to the debate on using and misusing cutting-edge technology and methods for applied geomorphological research. This chapter very enthusiastically solves the above-mentioned debatable agenda.

Finally, this volume should be measured as an academically and advanced knowledge-oriented persuasion in terms of its 'ground to laboratory and laboratory to ground' journey, procedural, and axiological rigor in accelerating integrative sciences toward inculcating developed knowledge-based societal and environmental welfare in the practical sense.

Birbhum, West Bengal, India   Jayanta Das
Malda, West Bengal, India   Somenath Halder

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and infrastructure. Finally, we also thank the Springer Management team for accommodating us and providing us such a prestigious platform for this book for its successful completion. It was a pleasure to work with them throughout the process.

About This Book

This book on *New Advancements in Geomorphological Research: Issues and Challenges in Quantitative Spatial Science* asserts the contributing aspects of neo-modern developments related to applied geomorphology. This includes hydrological research, fluvial geomorphology, mountain geomorphology, changes in coastal geomorphology, regional to global level disaster and/or hazard monitoring with advanced models, landslide monitoring, bank and gully erosion detection, and complexities and suitability of hybrid geostatistical model usage. Contemporary developments in linking with the advanced progression in remote sensing and GIS, and with spatial science, conquer its position in applied geomorphology and allied sub-branches of earth science. Recently, global climate change phenomena (GCCP) impacted local to regional climatic events, resulting in sea-level rise, melting of glaciers, drastic river-course changes, the disappearance of the coastal area, and shrinkage of natural resources toss significant tests to sustaining human civilization. Meanwhile, this present volume of the book caters a rational time-scale of the analyzed processes from mountain to coastal regions. And for better academic persuasion, this will also incorporate the level of analysis, in the shape of 'susceptibility' to 'risk', with newly advanced methods. Therefore, appropriate cultivation of the knowledge with the proper application of GIScience for applied geomorphology and on the bigger aspect of the welfare of society and environment made possible. In addition with the above stated arguments subjective nursing and administration also can curtail the gap between science, policy, and the bottom-level scenario concerned.

This current endeavor is also underlining the adaptation of hybrid techniques, remote sensing, statistical tools, and GIS technologies for the quantification of various issues related to several branches of applied geomorphology. This contributed piece includes focused and problem-oriented case studies to underline the versatility of changing geomorphological research, environmental resources, natural landscape, geo eco-system management, interconnected problems, and concerned applied vista at various spatiotemporal scales. The endorsed chapters, encircling both theoretical and applied aspects, help as guideline information for future research. Concisely, this book will offer traditional and advanced geospatial technologies used in earth science, atmospheric, lithospheric, hydrosphere, and biospheric contexts connected to applied geomorphology and for

better management. This will be a commendable product from the belvedere of researchers, scientists, academic personnel, policymakers, advanced learners.

Key Features

- Offers modernized knowledge of applied geomorphology with the advanced GIScience application in India and other regions.
- Covers diverse topics, including natural, environmental, geostatistical, and anthropogenic.
- Presents the role of hybrid technology, boosted methods, and modeling used to monitor and manage measures for problematic geomorphological and geohazard agendas.
- Provides methodologies for mitigating environmental degradation, geohazard management, geoconservation, deterioration of physical resources, anthropological practices on terrain and landscape, as well as relevant issues to ensure a win-win situation and resilient society.
- International and cross-disciplinary contributions by scholars recognized globally.

Contents

Editors and Contributors

About the Editors

Dr. Jayanta Das is an assistant professor at the Department of Geography, Rampurhat College, affiliated to University of Burdwan, West Bengal, India. He has completed his Post Graduate and Ph.D. degrees from the Department of Geography and Applied Geography, University of North Bengal, India. His research interest includes agricultural modeling and sustainable management studies, groundwater, flood, drought analysis, climate change, watershed management, hydrological modeling, water quality, geospatial data analysis, data mining, and GIS applications with more than 15 academic years of experience. Dr. Jayanta Das has published more than 50 scholarly articles in peer-reviewed journals, focusing mainly on: climate change, agricultural suitability analysis, natural and man-made hazards analysis, risk management, and spatial data analysis. He has been reviewing many journals such as *Advances in Space Research*, *Natural Hazard*, *Arabian journal of Geosciences*, *Archives of Agronomy and Soil Science*, *Climatic Change*, *Environment*, *Development and Sustainability*, *Geo Journal*, *Sustainability*, *SN Applied Sciences*, *Geocarto International*, *Environmental Science and Pollution Research*, etc. Dr. Das has also published three edited books with Springer Nature. He has served as an editor for the *Journal of Water* and as a guest editor for *Environmental Science and Pollution Research* (ESPR), published by Springer.

Dr. Somenath Halder is an assistant professor at the Department of Geography in Kaliachak College, University of Gour Banga, West Bengal, India. He has completed his PG from the Department of Geography and Applied Geography, University of North Bengal, India, and Ph.D. from the Department of Geography, Visva-Bharati, India. Dr. Halder's field of interest includes multi-dimensional data modeling connecting to socio-political agenda, conflicting issues with laws and ecology, community practices, crisis management, spatiotemporal analysis, environmental management, policy science, climate change, watershed management, hydrological modeling, geospatial data analysis, and GIS applications with more than 14 academic years of experience. Dr. Halder has published more than 46 research articles in peer-reviewed reputed journals. Meanwhile, he performs his academic endeavor as peer-reviewer in number of Scopus and Web of Science indexed prestigious journals like *Modeling Earth System and Environment*, *Journal of Environment*, *Development and Sustainability*, *Internal Journal of Geoheritage and Parks*, *GeoJournal*, *South Asian Survey*, *Research in Globalization*, *Current Psychology*, *Sage Open*, and many more. Recently, Dr. Halder published an edited book entitled *Advancement of GI-Science and Sustainable Agriculture: A Multi-Dimensional Approach* jointly with Dr. Jayanta Das from Springer Nature.

Contributors

Aminu Abdulwahab Department of Natural Resources, TERI School of Advanced Studies, New Delhi, India; Department of Surveying and Geoinformatics, Federal Polytechnic Mubi, Mubi, Adamawa State, Nigeria

Vikram Agone Department of Geography, Nanasaheb Yashvantrao Narayanrao Chavan Arts, Science & Commerce College, Chalisgaon, Maharashtra, India

Rithwik Vardhan Akkinepally Department of Civil Engineering, Sreenidhi Institute of Science and Technology, Hyderabad, India

Liya Akter Environmental Science Discipline, Khulna University, Khulna, Bangladesh

Jiarul Alam Research Scholar, University of North Bengal, Darjeeling, West Bengal, India

Ruhul Amin Environmental Science Discipline, Khulna University, Khulna, Bangladesh

Sudha Arlikatti Amrita School for Sustainable Futures, Amrita Vishwa Vidyapeetham, Kollam, Kerala, India

Sudip Kumar Bhattacharya Department of Geography and Applied Geography, University of North Bengal, Darjeeling, West Bengal, India

Sarmin Akter Bristy Environmental Science Discipline, Khulna University, Khulna, Bangladesh

Kamal Darwish Department of Geography, Faculty of Arts, Minia University, El Minya, Egypt

Jayanta Das Department of Geography, Rampurhat College, Birbhum, West Bengal, India

Shiv Dutt Department of Geography, Panjab University, Chandigarh, India

Nithin Elpula Department of Civil Engineering, Sreenidhi Institute of Science and Technology, Hyderabad, India

Beauty Ghosh Department of Earth Sciences and Remote Sensing, JIS University, Agarpara, West Bengal, India

Asutosh Goswami Department of Earth Sciences and Remote Sensing, JIS University, Agarpara, West Bengal, India

Srimanta Gupta Department of Environmental Science, University of Burdwan, Golapbag, Bardhaman, West Bengal, India

Subhadip Gupta Department of Geography, Asutosh College, Kolkata, West Bengal, India

Somenath Halder Department of Geography, Kaliachak College, Malda, West Bengal, India

Enamul Haque Department of Geography, Netaji Subhas Ashram Mahavidyalaya, Bagmundi, Purulia, India

Khandoker Faiaz Ishtiak Environmental Science Discipline, Khulna University, Khulna, Bangladesh

K. Jayarajan Department of Geography, Government College Chittur, Palakkad, Kerala, India

C. Muralee Krishnan Amrita School of Business, Amrita Vishwa Vidyapeetham, Coimbatore, Tamil Nadu, India

Kamlesh Kumar Ecophysiology and RS-GIS Laboratory, Department of Botany, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India

S. M. Shravan Kumar Department of Civil Engineering, Sreenidhi Institute of Science and Technology, Hyderabad, India

Uthpal Kumar Solidaridad Network Asia, Khulna, Bangladesh

Ram Lal Department of Geography, Himachal Pradesh University, Shimla, Himachal Pradesh, India

Yila Caiaphas Makadi Amrita School for Sustainable Futures, Amrita Vishwa Vidyapeetham, Kollam, Kerala, India

Ramandeep Kaur M. Malhi Ecophysiology and RS-GIS Laboratory, Department of Botany, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India

Deepak Kumar Mandal Department of Geography and Applied Geography, University of North Bengal, Darjeeling, West Bengal, India

Rajib Mitra Department of Geography and Applied Geography, University of North Bengal, PO-North Bengal University, Darjeeling, India

Agradeep Mohanta Ecophysiology and RS-GIS Laboratory, Department of Botany, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India

Ajmal Munir Mondal Department of Geography, Asutosh College, Kolkata, West Bengal, India

Sadia Islam Mou Environmental Science Discipline, Khulna University, Khulna, Bangladesh

Smriti Murmu Department of Earth Sciences and Remote Sensing, JIS University, Agarpara, West Bengal, India

Mahabir Singh Negi Department of Geography, Hemwati Nandan Bahuguna Garhwal University, Srinagar, Uttarakhand, India

Kavi K. Oza Ecophysiology and RS-GIS Laboratory, Department of Botany, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India

Pramod Pagare Department of Geography, PM College of Excellence, Niwari, Niwari, Madhya Pradesh, India

Priyank Pravin Patel Department of Geography, Presidency University, Kolkata, India

Swarnali Paul Department of Earth Sciences and Remote Sensing, JIS University, Agarpara, West Bengal, India

Pankajkumar C. Prajapati Ecophysiology and RS-GIS Laboratory, Department of Botany, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India

Dhanya Punnoli Department of Geography, Government College Chittur, Palakkad, Kerala, India

Fahim Rahman Rafi Environmental Science Discipline, Khulna University, Khulna, Bangladesh

Md. Mujibor Rahman Environmental Science Discipline, Khulna University, Khulna, Bangladesh

Vinay Raikwar Department of Geography, PM College of Excellence, Niwari, Niwari, Madhya Pradesh, India

P. P. Nikhil Raj Department of Chemical Engineering and Materials Sciences, Amrita Vishwa Vidyapeetham, Coimbatore, Tamil Nadu, India

Shrishti Rajput Ecophysiology and RS-GIS Laboratory, Department of Botany, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India

Vikas Rawat Department of Geography, Hemwati Nandan Bahuguna Garhwal University, Srinagar, Uttarakhand, India

Sanjoy Saha Department of Geography, Kaliachak College, Malda, West Bengal, India

Sucharita Saha Department of Environmental Science, University of Burdwan, Golapbag, Bardhaman, West Bengal, India

G. Sandhya Kiran Ecophysiology and RS-GIS Laboratory, Department of Botany, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India

Shyampada Sarkar Department of Geography and Applied Geography, University of North Bengal, Darjeeling, India

Souvik Sarker Environmental Science Discipline, Khulna University, Khulna, Bangladesh

Suresh Selvaraj Sree Sankaracharya University of Sanskrit, Kalady, India

Suhel Sen Department of Geography, Bhairab Ganguly College, Belgharia, West Bengal, India

Mangala Shah Department of Statistics, Faculty of Science, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India

Shekhar Singh Department of Soil and Water Conservation Engineering, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, Uttarakhand, India

Divya Sood Department of Geography, Panjab University, Chandigarh, India

Sadhon Chandra Swarnokar Environmental Science Discipline, Khulna University, Khulna, Bangladesh

Gulshan Verma Wazir Ram Singh Government College Dehri, Kangra, Himachal Pradesh, India

Degu Zewdu Amrita School for Sustainable Futures, Amrita Vishwa Vidyapeetham, Kollam, Kerala, India

Abbreviations

ACI	Average Citation per Year
AGR	Absolute Growth Rate
AHP	Analytical Hierarchy Process
AI	Artificial Intelligence
ANN	Artificial Neural Networks
ANR	Applicability in Real World
AR	Annual Rainfall
AUC	Area Under the Curve
AVRR	Advanced Very High Resolution Radiometer
BI	Braiding Index
CART	Classification and Regression Trees
CEGIS	Center for Environmental and Geographic Information Services
CGC	Chotanagpur Gneissic Complex
CGWB	Central Ground Water Board
CI	Consistency Index
CN	Curve Number
CNN	Convolutional Neural Network
CNNs	Convolutional Neural Networks
CR	Consistency Ratio
CRU	Climatic Research Unit
CSA	Cross Sections of the River in Segment A
CSB	Cross Sections of the River in Segment B
CSLB	Left Bank Cross Section Site of the Active Channel
CTI	Compound Topographic Index
CV	Coefficient of Variation
CZ	Coastal Zone
Dd	Drainage Density
DDMPJD	District Disaster Management Plan of Jalpaiguri District
DDMPKD	District Disaster Management Plan of Koch Bihar District
DEM	Digital Elevation Model
DGR	Decadal Growth Rate
DHI	Danish Hydraulic Institute
DI	Dissection Index
DM	Distance of Migration
DNo	Data Novelty
DR	Descriptive Research

DT	Daling Thrust
E	Elevation
E4LIFE	Education for Life
EDAS	Evaluation Based on Distance from Average Solution
EGIS	Environmental and GIS Support Project for Water Sector Planning
ERDAS	Earth Resources Data Analysis System
ETM	Enhanced Thematic Mapping
ETM+	Enhanced Thematic Mapper Plus
FAHP	Fuzzy Analytical Hierarchy Process
FAO	Food and Agricultural Organization
FCC	False Color Composite
FDP	Flood Defenselessness Planning
FGD	Focus Group Discussion
FIGDM	Framework for Integrated Geomorphological Decision-Making
FR	Frequency Ratio
FSZ	Flood Susceptibility Zonation
GAI	Geospatial Artificial Intelligence
GCFs	Gully Conditioning Factors
GCP	Ground Control Point
GDB	Geodatabase
GDP	Gross Domestic Product
GE	Gully Erosion
GEE	Google Earth Engine
GES	Gully Erosion Susceptibility
GI	Greenness Index
GIM	Gully Inventory Map
GIS	Geographic Information System
GL	Glacial Lake
GLOF	Glacial Lake Outburst Flood
GNSS	Global Navigation Satellite System
GoK	Government of Karnataka
GPS	Global Positioning System
GRP	Groundwater Recharge Potential
GSI	Geological Survey of India
GWM	Ground Water Monsoon
GWPM	Ground Water Pre-Monsoon
GWPZ	Ground Water Potential Zonation
GWT	Ground Water Table
GWW	Ground Water Winter
HMA	Historical Migration Area
HP	Himachal Pradesh
ICZM	Integrated Coastal Zone Management
ICZMP	Integrated Coastal Zone Management Plan
IDW	Inverse Distance Weight
IF	Impact Factor
IMD	Indian Meteorological Department
ISRO	Indian Space Research Organization

IWRIS	Indian Water Resources Information System
KII	Key Informant Interviews
KML	Keyhole Markup Language
LaRC	Langley Research Center
LCSA	Life Cycle Sustainability Assessment
LD	Lineament Density
LHS	Lesser Himalayan Sequence
LHZ	Landslide Hazard Zonation
LiDAR	Light Detection and Ranging
LSI	Landslide Susceptibility Index
LULC	Land Use Land Cover
MBT	Main Boundary Thrust
MC	Municipal Corporation
MCDA	Multi-Criteria Decision Analysis
MCDE	Multi-Criteria Decision Evaluation
MCDM	Multi-Criteria Decision-Making
MCT	Main Central Thrust
MIF	Multi Influencing Factors
MiSA	Model Interpretability
ML	Machine Learning
MODIS	Moderate Resolution Imaging Spectroradiometer
MOTA	Motivation and Ability Framework
MSS	Multi-Spectral Scanner
NASA	National Aeronautics and Space Administration
NB	Non-Beneficial
NDA	Negative Distance from Average
NDMP	National Disaster Management Plan
NDSI	Normalized Difference Snow Index
NDVI	Normalized Difference Vegetation Index
NDWI	Normalized Difference Water Index
NIR	Near-Infrared
NRCS	Natural Resources Conservation Service
NVW	Novelty of Work
OLI	Operational Land Imager
OM	Organic Matter
PC	Plan Curvature
PD	Population Density
PDA	Positive Distance from Average
PFI	Plan Form Index
PrC	Profile Curvature
PSWD	Proximity to Surface water Distance
PVR	Proportional Value-Added Rating
QMo	Methodology Novelty
QR	Quantitative Research
RCI	Random Consistency Index
RF	Random Forest
RI	Random Index
RL	Reference Line
RMSE	Root Mean Square Error

Rn	Ruggedness Number
ROC	Receiver Operating Characteristic
RS	Remote Sensing
SAR	Synthetic Aperture Radar
SAW	Simple Additive Weighting
SCS	Soil Conservation Service
SD	Standard Deviation
SE	Shannon Entropy
SLR	Systematic Literature Review
SRTM	Shuttle Radar Topographic Mission
SSI	Standard Sinuosity Index
SVM	Support Vector Machine
SWAT	Soil and Water Assessment Tool
SWIR	Short-Wave Infrared
SWL	Strengths, Weaknesses, and Limitations
TG	Tea Garden
TIF	Tag Image File
TIRS	Thermal Infrared Sensor
TM	Thematic Mapper
TOPSIS	Technique for Order Preference by Similarity to Ideal Solution
TRI	Terrain Ruggedness Index
TS	Terrain Sensitivity
TSA	Terrain Sensitivity Assessment
TSC	Terrain Sensitivity Classification
TT	Terrain Tolerance
TWI	Topographic Wetness Index
UAV	Unmanned Aerial Vehicles
UGI	Usefulness of Geographic Information
UHD	Use of Hybrid Data
ULMo	Usefulness of Hybrid Models
UNB	Upper Narmada Basin
USD	Use of Secondary Data
USDA	United States Department of Agriculture
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
VIF	Variance Inflation Factor
VIKOR	Vise Kriterijumska Optimizacija Kompromisno Resenja
VLW	Validation in Real World
WGS	World Geodetic System
WRI	Water Ratio Index
WRS	Worldwide Reference System

Part I
Introduction and Conceptual Framework

Raising the Agenda of 'Paradigm Shift' in Applied Geomorphology: Question(s) or Acceptability

1

Somenath Halder and Jayanta Das

Abstract

The concept of a paradigm shift in applied geomorphology has gained considerable attention in recent years, as researchers and practitioners recognize the need to reassess traditional approaches and embrace new perspectives. The introductory chapter aims to explore the question of whether a paradigm shift is necessary in applied geomorphology and, if so, to what extent it is accepted within the scientific community. Through a comprehensive review of relevant literature and case studies, this chapter examines the challenges and opportunities associated with a paradigm shift in applied geomorphology. It highlights the limitations of conventional methodologies and theories, emphasizing the need for innovative approaches that integrate interdisciplinary knowledge and emerging technologies. Furthermore, the chapter analyzes the factors that contribute to the acceptability of a paradigm shift in the said field. It discusses the role of scientific consensus, stakeholder engagement, and the ability to address pressing societal and environmental challenges. The current endeavor also explores the resistance and barriers encountered in implementing a paradigm shifts, including institutional inertia and disciplinary boundaries. Ultimately, this chapter advocates for raising the agenda of a paradigm shift in applied geomorphology. It argues that embracing new conceptual frameworks and methodologies can enhance individuals' understanding of landscape dynamics, improve hazard assessment and mitigation strategies, and promote sustainable land management practices. By addressing the question of acceptability, this chapter aims to stimulate further discussion and encourage the adoption of transformative approaches in the field of geomorphology.

S. Halder (✉)
Department of Geography, Kaliachak College, Malda, West Bengal, India
e-mail: somnatgeo@gmail.com

J. Das
Department of Geography, Rampurhat College, Birbhum, West Bengal, India

1.1 Introduction

Passing through a several decades, the branch of 'geomorphology' does not need any further prologue; rather the appraisal of contemporary

shift or development of the said branch is more rational in the world of academia (Burton 1963; Sharma 1981; Nanson and Huang 2018; Tinkler 2020). The science of 'geomorphology' is widely acknowledged for its scope for studying of our planetary (earth) landforms and the processes that sculptured them. Due to the inherent aesthetic quality, geomorphology has long been a deep-seated discipline under the broad field of earth sciences (Sharma 1981; Umeuduji 2001; Bharatdwaj 2009; Page 2020). Over the decades, numerous theories, methodological developments, and trans-shifting conceptual frameworks have helped to envisage new research and practice in applied geomorphology. The foresaid developments are contributing to our better understanding of earth's landscape dynamics and the assessment of hazards (Chorley 1962; Sack 1992; Oguchi and Butler 2017; Hook 2020; Lewin 2022). Recently, there has been a rising appreciation, among the earth scientists, of the need for a paradigm shift in *this* field (i.e., geomorphology)—a fundamental transform in the underlying assumptions, approaches, and perspectives that drive geomorphological research and its practical applications.

This chapter targets to survey the theme of raising the agenda of a *paradigm shift* in applied geomorphology, lime-lighting on two key aspects: questioning the need for a paradigm shift and judging its acceptability within the scientific community. The term 'paradigm shift' refers to a transformative change, within the arena of specific discipline or sub-discipline, that challenges established theories and methodologies, replacing them with new, more comprehensive frameworks, may be with the help of advanced tools. Although it is also worthy to note that since *its* birth there are so many new sub-disciplinary branches (*like* remote sensing, GIS, machine learning, AI, and so on) emerges into 'geomorphology' and surely all these emergence accelerate the all-round development (Eisman et al. 2021). Side-by-side, there is a deep possibility of *paradigm shift*.

The necessity of paradigm shift in the sphere of applied geomorphology always had been a debatable issue (Sherman 1996; Neppe and Close 2014). Several factors have encouraged raising the question of whether a paradigm shift is essential in applied geomorphology or not. Firstly, conventional and established methodologies and theories may have limitations in addressing complex geomorphological phenomena. Especially, in the face of present days, rapid environmental changes and anthropogenic influences make this matter more relevant to examine (Church et al. 1999; Bishop et al. 2012; Sofia 2020). Secondly, the materialization of interdisciplinary and multi-disciplinary approaches and advancements in technology bid new opportunities for ensembling diverse knowledge and tools, potentially enhancing our understanding of landscape processes and dynamics (Korup 2005; Rhoads 2006; Phillips and Ritala 2019; Sofia 2020). Consecutively, the urge to address pressing societal and environmental challenges, such as climate change impacts and sustainable land management, needs innovative or new kind of approaches that go beyond traditional boundaries.

Still, the concept of paradigm shift within the scientific community and the acceptability, in the segment of geomorphology, is a critical facet to judge. Scientific accord, stakeholder engagement, and realistic applicability are factors that influence the adoption of advanced frameworks and methodologies (Schickhoff et al. 2014; Gleason 2015; Schliep et al. 2017; Eisman et al. 2021; Raška 2022). Separately, confrontations for the acceptance and execution of a paradigm shift in applied geomorphology come from established institutions, disciplinary boundaries, and the anxiety of destabilizing existing knowledge structures. By exploring these dimensions, this chapter aims to throw light on the need for and acceptability of a paradigm shift in applied geomorphology. It synthesizes existing literature, presents case studies, and analyzes the opportunities and barriers associated with transformative change in the abovementioned field. Ultimately, the goal is to stimulate further discussion, encourage critical thinking, and inspire researchers and practitioners to embrace new approaches that can enhance individuals' understanding of