



**DISASTER RESEARCH AND MANAGEMENT SERIES
ON THE GLOBAL SOUTH**
SERIES EDITOR: AMITA SINGH

Development in Coastal Zones and Disaster Management

Edited by
Amita Singh
R. Lalitha S. Fernando
Nivedita P. Haran

palgrave
macmillan

Disaster Research and Management Series
on the Global South

Series Editor
Amita Singh
Centre for the Study of Law and Governance
Jawaharlal Nehru University
New Delhi, India

Disaster Research and Management Series on the Global South is a series coming out of Special Centre for Disaster Research (SCDR) at Jawaharlal Nehru University (JNU), New Delhi, India. SCDR is the first in Asia Pacific to start a course on disaster research within a social science perspective. The series follows and publishes pedagogical and methodological change within the subject. The new direction of teaching, research and training turns from 'hazard based' to 'resilience building'. The series taps such research for the benefit of institutes and higher education bodies of the global south. It also suggests that much of the western literature based upon rescue, relief and rehabilitation which is also being taught in the Asian institutes is not directly relevant to managing disasters in the region. It provides reading and study material for the developing field of disaster research and management.

1. Generates a non-west transdisciplinary literature on disaster research and studies
2. Strengthens disaster governance and improves its legal framework
3. Sensitizes disaster management authorities towards key priorities and attention areas
4. Focus on preparedness is strongly proposed and revisited
5. Highlights changes in pedagogy and methodology of disaster research and teaching
6. Mainstream vulnerable communities of differently abled, elderly, women, children
7. Indicate strategies needed to protect city animals, birds and wildlife during disasters

More information about this series at
<http://www.palgrave.com/gp/series/16402>

Amita Singh
R. Lalitha. S. Fernando • Nivedita P. Haran
Editors

Development in Coastal Zones and Disaster Management

palgrave
macmillan

Editors

Amita Singh
Center for the Study of Law &
Governance
Jawaharlal Nehru University
New Delhi, India

R. Lalitha. S. Fernando
Department of Public Administration
University of Sri Jayewardenepura
Nugegoda, Sri Lanka

Nivedita P. Haran
Additional Chief Secretary, 3rd Floor
Government of Kerala, South Block
Trivandrum, Kerala, India

ISSN 2662-4176

ISSN 2662-4184 (electronic)

Disaster Research and Management Series on the Global South

ISBN 978-981-15-4293-0

ISBN 978-981-15-4294-7 (eBook)

<https://doi.org/10.1007/978-981-15-4294-7>

© The Editor(s) (if applicable) and The Author(s), under exclusive licence to Springer Nature Singapore Pte Ltd. 2020

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.

This Palgrave Macmillan imprint is published by the registered company Springer Nature Singapore Pte Ltd.

The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

FOREWORD: A MESSAGE FROM THE COAST

Was it time for Mother Earth to take a break? Is this one of the many ways? Has she sent a message to all of 8 billion+? Did she not send messages earlier which we did not heed? Or resisted? Will we learn the lessons? For those fortunate?
(Hon'ble Lt. Governor Puducherry, Dr Kiran Bedi on the recent outbreak of COVID-19, March 2020)

Coasts have always been fascinating for me both for their pristine purity of an infinite spiritual universe which they offer and for the challenge which grips me as I stand over a fragile, floating landmass against a mighty, tempestuous and endless spread of turquoise ocean. There is so much to write and feel about the coast which valiantly stands between the two un-equals to protect the enormous biodiversity that adorns her throughout the year. Its ironical that mankind in its miniscule size inhabits the tenuous coast to only weaken it further and make it more vulnerable against the turbulence and fury of the ocean. Coasts need special protection, care and consideration from citizens as much as from governments which control activities over it.

India has a long coastline of 7516.6 km, out of which mainland coastline consists of 6100 km and islands' coastline consists of 1197 km. Around nine states and four union territories fall in the coastal area which establishes that Indian economy has a huge share of these coastal goods, manpower and natural resources. No government can afford to ignore coastal health in terms of natural resources, its culture and its people. My experience of managing disasters at Andaman and Nicobar islands and then as the Lt. Governor at Puducherry has opened me to a deepening

understanding about the nature of an ocean and about responsibilities of citizens and administration who inhabit the coast. The manner in which consumerism, ostentatiousness and greed have overtaken mankind has caused the erstwhile serenity of coasts to be somewhat disturbed and disasters to become more frequent, more impactful and more unpredictable. This has only increased as one looks into the scattering of coastal communities and nonhuman wildlife which provided the best early warning system against disasters.

I would prefer to highlight the three most important areas where habitual governmental lethargy and apathy have weakened the coasts; and by mentioning them here, I would like the readers of this work to give a thought to it as they participate in policy planning processes.

First is reinstating participatory governance in coastal cities and villages so that they can protect and conserve their own local resources. I tried to arrange a community meeting at Allankuppam village and the experience was so rewarding for environmental awakening that with the help of these communities I could set up a forum which also included some officials including the area's Junior Engineer. This monthly meeting is now instituted as a regular governance practice. Sometimes, apathetic public servants perceive participatory governance as interference in their day to day affairs because it creates public vigilance and watchfulness. In a recent 11 March judgement in which the Madras High Court dismissed this perception of 'interference' presented as a problem by the Chief Minister against my involvement with communities and local administration revives hope that people are powerful and their rise to vigilance does create ripples across bureaucracy. The judgement has established the need for collaborative, participatory and pro-people governance in the coastal Union Territory of Puducherry. I would like to suggest that this should be the guiding principle of participatory governance on the coasts so that these areas become clean, green and water rich. Notwithstanding the acts and laws through which states and union territories are governed (e.g., Puducherry Village and Commune Panchayats Act of 1973), there is a pressing need for some serious incorporations and changes in the Disaster Management Act 2005, which has so far not attempted to elaborate the responsibilities of decision makers too intricately with a vision for sustainable participation and administrative accountability in managing a disaster.

Second is the building of true leadership which can keep the coasts prepared to prevent a hazard from escalating into a disaster. This may entail a responsibility of keeping all ministries coordinated and not just the State Disaster Management Authority. That would be over-expectation from a single department for action which takes place in other departments. I have been a great advocate of building a grassroots women leadership which brings immense resilience to local community action. I even instituted a Pudukkottai Pengal Award to encourage women leaders of local communities. The first awardee of this honour is Mrs Allimuthu of Villianur who maintains 51 women Self-Help Groups, and has spearheaded the construction of 100 toilets. I also suggest that police force at the rank of Sub-Inspectors should be trained to be more community oriented to prevent land grabbing in coastal areas by powerful interests.

Third, that governance should be ‘conservation oriented’ – conservation of everything which is local such as culture, people, livelihood choices, plants, trees, animals, birds, mountains, hills and agricultural practices. A combination of conservation knowledge which is indigenous wisdom and modern technology would definitely help in sustaining coastal wetlands for all forms of life that inhabits it. Conservation also has a spiritual element which I experienced while walking by an ‘old reborn tree’ collectively conserved near the police station at Puducherry (see the photograph). Such old trees have been preserved through titles of ‘sacred groves’ or the ‘abode of deities’. In reality, they are the greatest insurance for the local communities against scarcity of water, livelihood, food and ecosystem. The Forest Rights Act of 2006 has given community rights to manage these pristine environmental conservation spaces. Those belonging to the coasts are the biggest stakeholders in conservation but plans undertaken by coastal governments have not trusted their participation and sharing of knowledge. The energy of college youth and children in schools ought to be tapped to achieve a two sided goal of sustainable development and sustainable economy at the coasts. It had been a worthwhile experience to organize college level Science Exhibitions and open to them a world of relevant and appropriate scientific solutions for their surroundings. Many bigger institutions of Science in the neighbourhood such as the National Centre for Sustainable Coastal Management at Chennai should play a more involved community role to tap young talent of local students. An

experience of conservation of water bodies and tanks has generated much responsibility. When Puducherry youth undertook desilting of Bahour Lake, much support arrived from Club Mahindra and Sri Aurobindo Society for undertaking the work. One sixth standard girl promised that she and her friends would take care of it. The Aurobindo Society has decided to adopt her to be an engineer. Another experience of recharging local people was the Clean Kanagan Lake. However, the most promising effort was the revival of a huge water body next to the Puducherry Medical College which was dead under the loads of garbage dumps and sewerage discharge of drains. Its revival into a tourist spot now is a result of a combined and collaborative effort of many government departments, local communities, Resident Welfare Associations, children and college students. This was part of a Green Puducherry Initiative.

In conclusion, I found that four steps definitely lead to achievement; Plan purposefully, Prepare prayerfully, Proceed positively and Pursue persistently. I applied these principles during my directives to disaster management departments at Puducherry. I also found that the Karaikal administration had undertaken a meticulous preparation and planning as a result of which no life was lost. In encountering disasters at the coasts, mankind is merely a dot before the might and prowess of the ocean. What it can do is to change ways to live and use coastal attributes and resources. An attitude of conservation and co-existence is indispensable. I wish to recall the passion of Dr Jane M. Goodall, an English primatologist and anthropologist. At the age of 26, carrying just her notebook and binoculars, she travelled from England to an unknown tropical forest of Tanzania to protect, save and conserve Chimpanzees and to give the world a remarkable window into humankind's closest relatives. What if she had not dared to do this? Chimpanzees would have gone extinct and with them a deep history of the evolution of human beings. It is passion which drives exceptional leaders and the coasts need these leaders to train mankind to face oceans, save planktons and enrich carbon sequestration to obviate climate change and disasters waiting to devour our sinking coasts.

What you do makes a difference and you have to decide what kind of difference you want to make, The greatest danger to our future is apathy (Dr Jane M. Goodall)

(This is an invited 'Foreword' from Dr Kiran Bedi, a legendary Indian Police Service (IPS) Officer, currently the Lt. Governor of the Union Territory of Puducherry. She is one of the most brilliant and dedicated citizen of mother earth, a Magsaysay Award winner, a governance reformer, the Asian Tennis Champion and a versatile grassroots social worker heading NGOs 'Navjyoti' and IV Foundation. She has courageously withstood anyone who misused power against a common citizen in every way. Her contributions to coastal Puducherry have brought a transformation in many ways. Coasts have always needed someone like her to decide on how to protect them)

Lieutenant Governor of Puducherry
Puducherry, India

Dr. Kiran Bedi, IPS (Rtd)

ACKNOWLEDGMENTS

Our deepest gratitude to the former Executive Director of the National Institute of Disaster Management (NIDM) Mr. Anil Kumar and to the current Executive Director Major General Manoj Kumar Bindal for enabling wholesome participation, providing an atmosphere of academic freedom and encouraging empirical research in the NIDM faculty. The faculty of the Special Centre for Disaster Research (SCDR) at JNU and the NIDM collectively encountered challenges in the field and contributed to a variety of curriculum building events at JNU.

SCDR is equally appreciative of Lt. Gen. N.C. Marwah, Member of the National Disaster Management Authority (NDMA), who consistently provided the required backup support during field surveys and data collection in disaster-affected areas. Sometimes the victims of disasters became his mission and brightened studies on administrative leadership in managing disasters.

The JNU Central Library deserves a special mention. The readiness to help in exploring and providing rare literature and data on disasters came in handy to many of the authors. The former librarian Dr Ramesh C. Gaur and after him Dr Manorama Tripathy understood and appreciated our search for literature on transdisciplinary disaster studies in law, governance, public policy and sciences. We will never forget the vibrancy and intellectual energy of a younger librarian, Azmi Khan, of a smaller library at the Centre for the Study of Law and Governance at JNU. She always waited to hear from the research team about their next search and joined them in loud youthful discourses.

Our office staff of the Special Centre for Disaster Research, Deepak Kumar, Hemchand Pandey, Darakshan, Jhuman and Narinder, brightened the work with their secretarial assistance and coordination support, which helped us immensely in meeting the deadline.

This section also acknowledges the unforgettably versatile contribution of the research team of Gaurika Chugh, Vualzhong Mung, Chetana Attri and Natasha Goyal. The long-distance support of Dr Manika Kamthan and Dr Binod Kumar was always available like disciplined soldiers of the team.

The most enlightened support arrived from the Springer-Palgrave publishing team guided by the visionary Editorial Director for Springer Singapore William Achauer, Associate Editor for Palgrave Macmillan Sandeep Kaur and Editor for Springer-Nature Nupoor Singh, who managed discussions and coordination in an unfailing manner. Their collaboration goes beyond mere publication, as they absorbed themselves in the research teams including many workshops, symposiums and debates.

Publishing these volumes of non-western literature has led the SCDR research team to look for many new authors from local administrations, affected communities and implementers. The editors acknowledge the shared contribution of many who, despite the motivation, could not write due to their intensive work responsibilities in the Chennai floods, Cyclone Gaja and the Kolkata Bridge collapse. The Indian Council of Social Science Research (ICSSR) has empowered many of these implementers who remain knowledge repositories for original literature in disaster studies. The editors appreciate the supportive role of ICSSR in bringing about this volume.

Last but not the least, NAPSIPAG (Network of Asia Pacific Schools and Institutes of Public Administration and Governance) stands with this initiative, as strong and determined as ever before. This is one big Asia-Pacific family of policy experts which is always passionate to celebrate collaborations in generating knowledge from their homelands.

CONTENTS

Disaster Management in Coastal Areas: An Introduction	1
Nivedita P. Haran	
Part I Policies, Law and Regulations for the Mitigation of Coastal Disasters	7
Coastal Conservation in Sri Lanka: Problems and Prospects	9
R. Lalitha S. Fernando, H. M. I. U. P. Herath, and R. B. P. M. Rathnayake	
The Coastal Zone Policy in Bangladesh: An Appraisal	39
N. Nabila Hoque	
Disaster Mitigation & Planning for Tsunami in Coastal Areas	49
Mehul Padharia	
Part II Land, Agriculture and Food at the Coastal Rim	59
Coastal Agriculture and Future Challenges	61
Anurudh K. Singh	

Land Mismanagement and Coastal Disasters Gaurika Chugh	87
Farmers, Climate and Disaster Management in a Coastal Region Swarnamayee Tripathy	101
Part III Conserving Marine Flora and Fauna	119
Marine Animals and Coastal Disasters Amita Singh	121
Protecting the Non-Human Animals of Coastal Ecosystems from Disasters Surinder Verma and Shalini	139
Part IV Tackling Vulnerability and Resilience in Coastal Ecosystems	157
Building Resilience in Coastal Ecosystems: Problems and Prospects Akanchha Singh	159
Sustainable Development Goals (SDGs) and Risks to Coastal Communities Sushma Guleria	171
Disasters and Climate Change Adaptability at Odisha Coast Niranjan Sahoo and Maheswar Satpathy	185
Women in 2018 Kerala Floods: A Sociological Narrative Nisha Jose and Sony Kunjappan	201

Climate Change and Coastal Disasters of Bangladesh	215
Nasim Banu	
Role of Insurance in Building Resilience for Coastal Zones: Market Versus the State	225
Shubhalaxmi Sircar	
Part V Case Studies	233
Coastal Flooding by Dam Mismanagement: Investigative Post-Disaster Study on <i>Criminal Negligence or An Act of God</i>	235
N. R. Joseph	
Coastal Ballads and Conservation Ironic: Understanding Implementation Slippages of the CRZ Law	255
Amita Singh	
Environmental Sociology of Floods in the Colombo District of Sri Lanka	271
Dinushika M. Yapa Abeywardhana	
Loss and Damages from Cyclone: A Case Study from Odisha, a Coastal State	281
Trupti Mishra and Krishna Malakar	
Downstream Impact of Melting Glaciers: Climate Change in Nepal and Beyond	293
Meen B. Poudyal Chhetri	
Part VI Preparedness and EWS Technology	303
Artificial Intelligence Based Early Warning System for Coastal Disasters	305
Rabindra Lamsal and T. V. Vijay Kumar	

Part VII Path Ahead 321

Critical Coastal Planning to Prevent Coastal Elogy 323

Amita Singh

LIST OF FIGURES

Disaster Mitigation & Planning for Tsunami in Coastal Areas

- Fig. 1 Five steps towards Tsunami preparedness. (Source: Tsunami preparedness: information guide for disaster planners, 2008) 51
- Fig. 2 Inundation area of Mandvi Taluka from Kutch district due to 1945 Makran trench earthquake and tsunami. (Source: Ministry of Earth Sciences, March 2009) 54

Coastal Agriculture and Future Challenges

- Fig. 1 Coastal agriculture and future challenges. (Source: A restructured version of “Map of India displaying geographic regions as effecting its bio-diversity” available on public domain under slideshare.net) 63

Marine Animals and Coastal Disasters

- Fig. 1 Five transformations to relate to nature (bracketed content is interpretative of the UNEP’s suggested transformation). (Source: UNEP <https://wedocs.unep.org/bitstream/handle/>) 122

Protecting the Non-Human Animals of Coastal Ecosystems from Disasters

- Fig.1 A Tweet from a public twitter account on rescue operations for companion animals from homes and streets 149
- Fig. 2 Some of the rescued animals by a good community Samaritan Johnson V. Edicula in Upper Kuttunad village of Kerala’s Alappuzha district 150

Sustainable Development Goals (SDGs) and Risks to Coastal Communities

Fig. 1 Parameters of coastal community resilience (ADPC 2007) 173

Disasters and Climate Change Adaptability at Odisha Coast

Fig. 1 Preparing communities for cyclonic disasters. (Odisha Government) 189

Fig. 2 Messages displayed on All India Radio and tweeted @ AkashwaniAIR for preparing communities for cyclonic disasters. (Odisha Government) (30 May 2017) when 4 districts were put on alert 190

Fig. 3 Wind and cyclone hazard map of Orissa. (Source: Vulnerability Atlas, Published by BMTPC, Government of India) 191

Women in 2018 Kerala Floods: A Sociological Narrative

Fig. 1 205

Coastal Flooding by Dam Mismanagement: Investigative Post-Disaster Study on Criminal Negligence or An Act of God

Fig. 1 Illustration in BIS guideline shows Flood Control Zone below FRL and not above it as mentioned in KSEBL affidavit 240

Fig. 2 The image shows the eye of storm of August 15–17 over Idukki (dark kidney-shaped area) where the storm was the strongest. ((Image Source: Study Report Kerala Floods of August 2018. Central Water Commission/Hydrological Studies Organization Hydrology (S) Directorate, Government of India) And yet, Idukki was not flooded while many towns far from Idukki where the storm was not as heavy were flooded: Chalakudy—under 10ft. water Kuttanand—under 8 ft. water Aluva—under 10 ft. water Chengannur—under 8 ft. water 243

Fig. 3 An analysis of the IMD Rain Chart 2018. (Source: IMD, <https://www.imdtvm.gov.in>) 244

Fig. 4 Discharge data on Periyar River at Neeleshwaram G&D site. (Source: Study Report Kerala Floods of August 2018. Central Water Commission/Hydrological Studies Organization Hydrology (S) Directorate, Government of India) 246

Fig. 5 CWC graph depicts struggle to keep water level that was just 1 m below FRL from overflow during storm in Idukki Dam. (Source: Study Report Kerala Floods of August 2018. Central Water

	Commission/Hydrological Studies Organization Hydrology (S) Directorate, Government of India)	247
Fig. 6	Study Report Kerala Floods of August 2018. Central Water Commission/Hydrological Studies Organization Hydrology (S) Directorate, Government of India)	249
Fig. 7	Chief Minister's Office Kerala appeal, Report: https://twitter.com/cmokerala/status/1028576388352110592?lang=en	249
Fig. 8	Flooded Aluwa/Kochi area due to Idukki Dam release on August 10 when the rain was just 20 mm (low) (aerial view) The water level at Idukki Dam was 2398 at 8 am, against the FRL of 2403 feet. Idukki Dam gates in Kerala were opened after 26 years. (Source: DD News, YouTube retrieved from site https://youtu.be/-YBbAfwlKa4)	251
Loss and Damages from Cyclone: A Case Study from Odisha, a Coastal State		
Fig. 1	Track of Cyclone Phailin (IMD 2014)	285
Artificial Intelligence Based Early Warning System for Coastal Disasters		
Fig. 1	Illustration of the proposed EWS	310

LIST OF TABLES

Coastal Agriculture and Future Challenges

Table 1	List of vegetable crops grown in coastal regions of Oregon, USA, for direct sale ^a	73
Table 2	Summary of challenges/constraints to coastal agriculture: causes and solutions	80

Farmers, Climate and Disaster Management in a Coastal Region

Table 1	Farmers in India, 2016	107
---------	------------------------	-----

Marine Animals and Coastal Disasters

Table 1	Total mangrove cover since 1987	126
Table 2	Total mangrove cover 2017	127

Protecting the Non-Human Animals of Coastal Ecosystems from Disasters

Table 1	State-wise Details of Damage due to Cyclonic Storm/Flash Floods/Floods/Landslides/Cloudburst etc. during the years 2013–14 to 2017–18	145
---------	---	-----

Women in 2018 Kerala Floods: A Sociological Narrative

Table. 1		209
----------	--	-----

Role of Insurance in Building Resilience for Coastal Zones: Market Versus the State

Table 1	Cost effectiveness of DRR investments in selected cases	227
---------	---	-----

Environmental Sociology of Floods in the Colombo District of Sri Lanka

Table 1	Awareness about environmental issues in the country	275
Table 2	People's view on the impact of flooding to their life	277

Loss and Damages from Cyclone: A Case Study from Odisha, a Coastal State

Table 1	Percentage of households experiencing various damages	285
Table 2	Time taken and costs incurred by the households to recover after the cyclone	287

Artificial Intelligence Based Early Warning System for Coastal Disasters

Table 1	Most powerful tsunamis sorted based on event magnitude and casualty	307
Table 2	Features considered in the proposed EWS	311
Table 3	Categorization of in-city flooding	314
Table 4	Performance of various classifiers	317

Critical Coastal Planning to Prevent Coastal Elogy

Table 1	Outcome of study of 6632 kms shoreline distributed in nine states during 1990–2016	324
---------	--	-----



Disaster Management in Coastal Areas: An Introduction

Nivedita P. Haran

INTRODUCTION

The coastal regions are five times more vulnerable to disasters than the hinterlands. About 80% of disasters are linked to water and the coastal areas are most exposed to water. More than 80% of the earth's surface is water and now humans are in search of water on the moon. The majority of countries in Asia have are near the sea. India, a sub-continent in itself, has a 10,000 km coastline. Sri Lanka, an island country, is situated at the confluence of two seas and an ocean. Bangladesh is considered one of the most vulnerable countries in terms of the vagaries of disasters that are connected to the sea; its geo-morphological features are such that a large part of its coastline lies at a level lower than the Marine Spatial Planning (MSP).

The coastal areas are exposed to a number of disasters that emanate from water: cyclones, storms, floods, high tidal waves and tsunamis. Due to easy access to water coastal areas are more densely populated. River-mouths are also the location for some of the larger urban agglomerations:

N. P. Haran (✉)

Government of Kerala, South Block, Trivandrum, India

© The Author(s) 2020

A. Singh et al. (eds.), *Development in Coastal Zones and Disaster Management*, Disaster Research and Management Series on the Global South, https://doi.org/10.1007/978-981-15-4294-7_1

ports attract trade that leads to human settlement. Recent times have seen some of the most severe urban floods in these cities. Urban flood brings with it destruction of life and property, homelessness, damage to infrastructure and break-down of public civil service. Urban floods bring life to a standstill causing huge loss in commercial activities. It is estimated that each day Mumbai suffers floods causes a loss of over \$ 300 million to its economy. In the aftermath of floods, issues such as the lack of potable water, outbreak of water-borne diseases and work days lost are alarming. Surely no country can afford such loss.

The coastal zone also provides some of the most precious and priceless resources: marine and aquatic life, rare metals mined from the sand, vegetation and fruits, thorium from the sparkling sands in Kerala, and gourmet seafood.

Nature is a generous giver. But when it is mindlessly and selfishly exploited, nature's fury can also be so overpowering that the impact can be unendurable. Humans are the only species that seem to grab and destroy as if there will be no consequences. It is ironic that humans are identified as occupying the apex of the evolutionary pyramid in terms of rationality, as the damage done to coastal areas in most developing countries has reached a stage where it is now almost irreparable. True, poverty can be a reason behind the destruction of coastal areas: mangroves uprooted for firewood, unlimited harvesting of marine products, fish, seaweed and even coral, and encroachment into the sea. Hence 'Eradication of poverty', as SDG 1 reminds us, remains the primary responsibility and the goal of any government, and indeed any society. The issue that needs to be raised here is the systematic destruction of the coastal areas through governmental mismanagement and human greed. In order to protect the long coastline along the Indian subcontinent a number of legislations are in progress: regulating construction, harvesting of marine products and use of marine transport. Yet in blatant disregard for and violation of these statutes and their poor enforcement, commercial construction has been allowed. The Coastal Regulation Zone norms, for instance, lay down strict guidelines on the nature of permissible construction and at what distance from the coastline. But the norms have been amended and made more lax each time, allowing more and more construction. Waste from these construction projects is released into the sea. A visit to any beach exposes one to a pathetic sight: solid waste including non-biodegradable waste is seen lining the beach area or floating as flotsam.

Areas that are declared as protected as ecologically sensitive zones or biologically sensitive or as a protected site based on the Ramsar declaration are not left unexposed. Land has always been the most acutely impacted asset that has suffered at the hands of the unholy nexus between crooked realtors, unscrupulous politicians and mendacious public servants. It is this unholy trinity that forms the basis for crony capitalism. So, even though the blame is placed on the poor and vulnerable, it is the rich and privileged that form the bulk of the land-grabbers. The coastal areas fall within their radar for three reasons: the coastline anywhere is geographically one of the most scenic by far, with the presence of water, vegetation and salubrious climate. Second, due to the above reason these lands are also the most high-priced and their location is considered the most upmarket. Third, most of the coastal lands are of low gradient, and hence easier to construct. They are also easily reachable by good access routes. Taking advantage of these factors, construction in violation of norms is clearly visible: posh hotels, high-end residences, even highly-rated and coveted commercial premises.

The disregard shown towards the Western Ghats, for instance, that run parallel to the west coast of India is a case in point. The report of the expert committee that recommended caution was ignored. Whether there is a causal link between the systematic destruction of the ghats and the severe climatological changes that have occurred in this area in the last few years could be the subject of debate and further research. But the fact that such destruction is irreversible is undeniable. The frequency of high rainfall incidents in Mumbai has increased. The extraordinarily intense rainfall over the state of Kerala in August 2019 is another case in point. The coastal regions are extremely sensitive and tampering with their natural features is indeed very risky.

Yet, mankind does not seem to learn these lessons. Cases of building collapse consequent to heavy rainfall and floods are reported with alarming frequency. Some of these constructions are either buildings declared unsafe or are constructed in violation of coastal zone or building norms. There was the case in Kochi, Kerala where a realtor had constructed cottages and even high-rises destroying virgin forests off the coastline. Of course, such extensive construction could not happen without the connivance of the administration. Based on a public interest litigation, the court had registered a *prima facie* case, but such cases get dragged on for years, if not decades. Citizens need to take matters into their hands. If clients refuse to buy properties that are constructed in violation of the building

by-laws, that ignore environmental considerations, and that destroy the ecology and pollute the environment, such agencies, corporations, authorities and even officials will be socially ostracized. Punitive action should be prompt and effective to act as a glaring deterrent so that the economic loss is also clear and accountability fixed unequivocally.

It is high time that the policy-makers and law-makers are made conscious of the concept of 'public trust'. The coastal areas and water bodies are part of public assets that are to be protected for future generations. It is the duty of public servants to hold public assets in public trust and to protect, conserve and maintain them. Unfortunately, over the years 'public trust' has been diluted and public assets are either ignored or treated as bureaucrats' or the elected representatives' personal assets. As a result coastal land is allowed to be grabbed haphazardly and construction is carried out with no consideration for the environment or ecology, and all to bestow favors and illegal gratification.

The chapters selected for this anthology have been researched and written by erudite scholars. The scholar's or academic's duty does not end with the publication of a paper; it goes far beyond it. Scholars hold the intellectual authority that can argue and establish a hypothesis through cogent debate and logical deduction. It is their duty to present and disseminate their theses to the citizens who are also the stakeholders. If they are truly committed and passionate about their ideas they need to present them to those who can make a difference: the policy-makers. There is a need to bridge the gap between thought and action, cognition and operation. In a perfect world such a gap should not exist, but in most countries it does, to a lesser or greater extent. It is as much the duty of academics as of administrators to close this gap to ensure that there is a synergetic outcome to improve the world.

The coastal regions of South Asia have faced some devastating disasters: the tsunami of 2004 left the southern coast of India and many parts of Sri Lanka reeling. Cyclones of varying intensity hit coastal areas of India and Bangladesh with unerring regularity. Storms and high tidal waves can be frighteningly destructive; when occurring in unison heavy rainfall and high tides have brought Mumbai to a standstill. Water bodies can be unforgiving agents of destruction. The movement of the sea leads to coastal erosion. Interference with the water in one area through construction and landfills can have ramifications for another area quite unknown to technical experts.

In this age of information explosion it is important to collate relevant data for use in research and policy-making and to make it available to those concerned. With the help of AI, data analysis is child's play. Vulnerability maps of the coastline can help identify the areas prone to erosion and accretion, which would provide basic data for development activities: road alignment, bridge location, areas requiring vegetative protection, or engineering interventions through sea-walls, gabion boxes or groins. Engineering interventions can be used sparingly and only where unavoidable. With reliable and accurate maps that are geo-referenced, it is possible to manage coastal disasters more effectively. There are also systems in place to monitor tremors that occur due to shifts in tectonic plates under water, tremors that can result in tsunamis; such tremors are now being monitored round the clock. With the use of technology the occurrence and arrival of storm surges can be forecast with precision.

The impact of climate change can be significant in the coastal areas. In some countries there are special statutes to manage coastal-linked disasters. Perhaps it is time for a discussion in this direction to commence in the South Asian countries. After all, adaptation to climate change is also very important in the coastal areas. The impact could range from rise in sea-level, thus inundating coastal areas, to disappearance of marine species and alteration in mangroves and other vegetation. Similarly, specially trained forces are needed to face such disasters. The example set by the state of Odisha in facing cyclones and the systemic changes made has borne fruits: the loss in human life and property has decreased considerably. There is a lesson in this for other areas similarly placed. It is possible to be better prepared to face coastal disasters with dedication. There is no reason why with modern technology and communication systems human life and all life and property should be placed in danger.

Nivedita P. Haran Additional Chief Secretary (Rtd), Government of Kerala. Led the constitution of the first State Disaster Management Authority after the Disaster Management Act 2005. Currently based in Delhi

PART I

Policies, Law and Regulations for the
Mitigation of Coastal Disasters



Coastal Conservation in Sri Lanka: Problems and Prospects

*R. Lalitha S. Fernando, H. M. I. U. P. Herath,
and R. B. P. M. Rathnayake*

HUMAN ONSLAUGHT OVER THE COASTS

A coastal zone is considered as the seaside terrain and it is the interface between the mainland and the sea. Coasts are unique, valuable and often threatened areas where the sea meets the land (Goodwin 2015). Coastal zones are continually changing due to the dynamic interaction between the oceans and the land (Nelson 2018).

Sri Lanka is an island enriched with various kinds of coastal resources which consist of a 1620 km long coastline all around the country (Lakmali et al. 2016). Due to rapid increase of population and developmental projects near coasts, these areas have particularly become more vulnerable. Due to various development activities in relation to various sectors such as construction, engineering, tourism, fishery and cultivation, coasts are degraded; some are able to be mitigated while some are not.

R. L. S. Fernando (✉) • H. M. I. U. P. Herath • R. B. P. M. Rathnayake
Department of Public Administration, University of Sri Jayewardenepura,
Nugegoda, Sri Lanka
e-mail: rlsf@sjp.ac.lk; isharaherath@sjp.ac.lk

© The Author(s) 2020

A. Singh et al. (eds.), *Development in Coastal Zones and Disaster Management*, Disaster Research and Management Series on the Global South, https://doi.org/10.1007/978-981-15-4294-7_2

Coastal line in Sri Lanka is nowadays being threatened by different causes including increasing population pressure. The natural environment is being converted into artificial ports, tourist beaches and residential places. The result is severe erosion of beaches and excessive sedimentation (United Nations Environment Programme [n.d.](#)). Rising sea levels, topological disasters, soil erosion by water and degradation of the natural seascape are identified as broader problems which may influence coasts (Encyclopedia [2018](#)).

Sri Lanka has a nearly 1700 km long coastline and a 30,000 km² continental shelf area up to 120 m deep (Koralagama [2008](#)). As Prasada et al. ([2015](#)) cited from the Ministry of Fisheries and Aquatic Resources Development, the coastal zone contains 26 major fisheries harbors; 58 boat anchorages; 193 improved landing centres; 890 minor fish landing centres; a fishing fleet of 51,127 boats of different sizes; a marine fishing household population of 824,680; and five seaports. The above statistical data shows the nature of activities in the relevant area and the extent of responsibility coming under the scope of marine environment protection in the country. Thus, maintaining coastal environment protection becomes paramount.

Population growth threatens the coastal zone (Samaranayake [1997](#)). Once the population starts to increase, resources fall short with respect to population growth, therefore overutilization, overexploitation and overextraction is justified for survival. Coastal erosion has become a severe problem that results in damaging or destroying buildings, coastal structures and other infrastructure of the country. It also causes loss or degradation of valuable land and disrupts fishing, navigation, recreation and other activities (Coast Conservation Department [1997](#)). A coastal departure, due to erosion by the sea, caused the loss of several square miles of the coast, especially in the southwestern region in Sri Lanka (Amarasinghe and Gerritsen [1976](#)). Prasada et al. ([2015](#)) noted that threats are still prevalent in the sustainability of a healthy marine environment in Sri Lanka. The National Report of Sri Lanka has identified many threats to the coastal and marine environment and its living resources, coastal and marine habitats, shoreline stability, coastal and marine fisheries, brackish water fisheries and culture, coastal and marine biodiversity (Prasada et al. [2015](#)).

Tsunami was a huge threat that badly impacted the coasts. The shoreline in Sri Lanka was severely affected and eroded with debris and seawater which resulted in destroying cultivatable lands, paddy fields and natural vegetation in the area (Nayanananda 2007). The tsunami in 2004 effected Galle district severely by destroying 70% of buildings located on the coastline and nearly 30% of structures within 1 km inland (UN Office for the Coordination of Humanitarian Affairs 2004).

Releasing garbage into the sea and coasts is another dangerous problem which has massively threatened natural environment and living beings in the sea and related areas too. There are frequent reports on the occurrences of dumping of ship-generated waste in the ocean, causing serious environmental and economic damages (Marine Environment Protection Authority 2014). Sunday Times (2016) reported that Sri Lanka has become a reported country in garbage dumping into the sea. Sri Lanka 'Global Coastal Index' represented a very bad picture with the island being ranked fifth out of 20 countries identified for dumping polythene and plastic to the ocean (Daily News 2017). Tissera (2018) pointed once that the coastal waste becomes more disruptive after the rains, weekends and during festivals. Sri Lanka Coast Guard (SLCG) works closely with the Maritime Environment Protection Authority in marine cleaning operations and also in terms of solid coastal litter; the situation is worse in the Southern and the Western Provinces.

Storms can impact the coastline at a higher rate than others. As per Lakmali et al. (2016), in the North-east coastline severe long-term erosions can be observed in some places like Verugal, and after the starting of the Pulmudei plant, the sediment supply has been reduced to downstream and thus it has resulted in downstream erosion.

Coral and sand mining in the coasts is another problem that effects coastal erosion. Improper mining for coral, sands, seashells, and limestone may adversely affect the coastal zone and the sustainability of coastal habitat. Lakmali et al. (2016) noted that earlier, many locations in these coastlines were subjected to severe erosions, for example Lansigama, Uswetakeiyawa, and and so on, and this was mainly due to the use of sea sand as an alternative to river sand policy.

"Recreations" done around beaches are another well-known cause for coastal erosion. In Sri Lanka, this has become prevalent and can be seen as beach-oriented resort development that has taken place in Negombo and